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Proceedings of the thirteenth meeting of the  
Advisory Board of the Imperial Council of  
Agricultural Research

Held at Delhi on the 10th, 11th, 13th & 15th  
February 1936.

NEW DELHI : PRINTED BY THE MANAGER  
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*Schedule of papers circulated to the members of the Advisory Board of the Imperial Council of Agricultural Research for its thirteenth meeting held at Delhi, on 10th, 11th, 13th and 15th February 1936.*

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AGENDA FOR THE MEETING OF THE ADVISORY BOARD OF THE  
IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH HELD  
AT NEW DELHI FROM THE 10<sup>TH</sup> TO THE 15<sup>TH</sup> FEBRUARY  
1936.

1. Decisions of the Governing Body on the recommendations of the Advisory Board made at the latter's meetings in February and July 1935.

2. Appointment of Committees.

3. Recommendations of the Locust Committee at its seventh meeting held in January 1936. Proposals for continuance and future programme of work.

4. Application from Dr. Bosi Sen, Director, Vivekananda Laboratories, Calcutta, for a recurring grant of Rs. 2,500 per annum for 3 years or 5 years for research in plant physiology.

5. Scheme for research in Economic Ornithology at a cost of Rs. 41,075 spread over a period of five years submitted by Mr. Salim Ali through the Government of Bombay.

6. Application from the Government of Mysore for a grant of Rs. 1,39,145 spread over a period of 10 years for a scheme of research on Sheep Breeding.

7. Progress Reports on Veterinary Research Scheme sanctioned by the Imperial Council of Agricultural Research:—

(i) Annual Report on the work of the Veterinary Investigation Officer, Madras, for 1934-35.

(ii) Annual Report on the work of the Veterinary Investigation Officer, Bombay, for 1934-35.

(iii) Annual Report on the work of the Veterinary Investigation Officer, Bengal, for 1934-35.

(iv) Annual Report on the work of the Veterinary Investigation Officer, United Provinces, for 1934-35.

(v) Annual Report on the work of the Veterinary Investigation Officer, Punjab, for 1934-35.

(vi) Annual Report on the work of the Veterinary Investigation Officer, Bihar and Orissa, for 1934-35.

(vii) Annual Report on the work of the Veterinary Investigation Officer, Central Provinces, for 1934-35.

(viii) Annual Report on the work of the Veterinary Investigation Officer, Assam, for 1934-35.

(ix) Annual Report on the work of the Veterinary Investigation Officer, Hyderabad, for 1934-35.

[Reports of items (ii)—(ix) already circulated.]

8. (a) Annual Report on the Rice Research Scheme in the Madras Presidency for the year 1934-35 (report circulated *vide* Memorandum No. F. 193-(1)/35-Agri., dated the 2nd December 1935).

(b) Annual Report on the Rice Research Scheme in Bengal for the year 1934-35 (report circulated *vide* Memorandum No. F. 196-(1)/35-Agri., dated the 14th December 1935).

(c) Annual Report on the Rice Research Scheme in the United Provinces for the year 1934-35 (report circulated *vide* Memorandum No. F. 196-(1)/35-Agri., dated the 2nd December 1935).

(d) Annual Report on the Rice Research Scheme in Burma for the year 1934-35 (report circulated *vide* Memorandum No. F. 196-(1)/35-Agri., dated the 2nd December 1935).

(e) Annual Report on the Rice Research Scheme in Bihar and Orissa for the year 1934-35 (report circulated *vide* Memorandum No. F. 196-(1)/35-Agri., dated the 21st December 1935).

(f) Annual Report of the deep water paddy research farm, Habiganj, Assam, for the year 1934-35 (report circulated *vide* Memorandum No. F. 196-(1)/35-Agri., dated the 2nd January 1936).

(g) Progress report on the scheme of research on quality in crops for the year ending 30th November 1935.

9. Application from the Government of the Punjab for a grant of Rs. 88,380 spread over a period of five years for a scheme for investigation of fungal diseases of the rice crop.

10. Extension for a period of five years of the scheme for breeding experiments in connection with the improvement of goats in the United Provinces conducted by Mr. A. E. Slater.

11. Application from the Academy of Sciences of the United Provinces of Agra and Oudh for an annual recurring grant of Rs. 1,000 from the funds of the Imperial Council of Agricultural Research in aid of its work.

12. (a) A brief report of the Cold Storage trials on the Alphonso Mangoes for the 1935 season (report circulated *vide* Memorandum No. F. 52-II/35-Agri., dated the 6th December 1935).

(b) Annual Report of the Hill-Fruit Research Scheme in the United Provinces for the year 1934-35 (report circulated *vide* Memorandum No. F. 52-(10)/35-Agri., dated the 30th November 1935).

(c) Annual Report of the Horticultural Research Station, Krishnagar, Bengal, for the year 1934-35 (report circulated *vide* Memorandum No. F. 52-(6)/35-A., dated the 2nd January 1936).

(d) Annual Report of the Horticultural Research Station, United Provinces and Bihar and Orissa, Sabour, for the year 1934-35.

13. Application from the Government of Bombay for a grant of Rs. 78,650 spread over a period of five years for a scheme for improvement of papaya breeding and cultural practices.

14. Annual reports for the years 1931-1932, 1932-1933, 1933-1934 and 1934-1935 on the scheme for the appointment of a Physiological Chemist to study animal nutrition problems at Dacca.

15. Proposal for the extension of the Bengal Animal Nutrition Scheme, for a further period of 5 years from January 1937, (total cost of scheme Rs. 99,276).

16. (a) Report by Dr. B. P. Pal, Second Economic Botanist, Imperial Institute of Agricultural Research on the scheme for breeding rust-resistant



wheats (report circulated *vide* Memorandum No. F. 35-I/35-Agri., dated the 3rd October 1935).

(b) Progress report for the year 1934-35 on the investigations on "Cereals" by Dr. K. C. Mehta, Agra College, Agra.

17. Application from the Government of Assam for a grant of Rs. 30,688 spread over a period of four years for mycological research on potatoes.

18. Report on:—

(a) the preliminary potato breeding experiments on the hills; and

(b) the non-recurring grant for the hills portion of the Potato Breeding Scheme for Northern India.

19. Application from the Government of Bombay for a grant of Rs. 44,060 (Recurring Rs. 40,860 *plus* Non-recurring Rs. 3,200) to test the value of different methods of controlling or eradicating ticks in this country.

20. Application from the Government of Bombay for a grant of Rs. 49,960 spread over 5 years for a scheme of investigation into the attack on *Jowar* by the parasite *striga* by the Economic Botanist to the Government of Bombay.

21. Application from the Government of Bombay for a grant of Rs. 37,510 spread over five years for a scheme for the investigation of the attack on tobacco by the phanerogamic parasite *Orobanche*.

22. Reconstitution of the Animal Nutrition Committee, Cattle Breeding Committee, and Dairy Committee, appointed by the Governing Body of the Imperial Council of Agricultural Research under Rule 30 of the Rules and Regulations of the Council.

23. Application from the Government of Travancore for a grant for a scheme for improving the cattle in the West Coast of India at a cost of Rs. 2,89,136 spread over a period of 10 years.

24. Application from the Government of Cochin for a grant of Rs. 40,580 spread over a period of five years for a scheme of investigation of the coconut leaf disease, in the Cochin State.

25. Application from the Government of Madras for a grant of Rs. 74,705 spread over a period of five years for a scheme of research work on coconuts in the Madras Presidency.

26. (a) Report on the tests on Indian Barley by the Institute of Brewing, London, for the year 1933-34 (report circulated *vide* Memorandum No. F. 15-34/Agri., dated the 10th October 1935).

(b) Report on the Scheme of Agricultural Meteorology for the year ending 21st August 1935.

(c) Report on the working of the Oil Section of the Harcourt Butler Technological Institute, Cawnpore, for the year 1934-35.

(d) Use of technical terms in progress reports on agricultural schemes financed by the Imperial Council of Agricultural Research.

27. Application from the Government of Bombay for a grant of Rs. 30,030 spread over a period of two years for a scheme of research on agricultural economics by the Director, Gokhale Institute of Politics and Economics.

28. (a) Second progress report on the scheme for the study of soil problems by the Physical Assistant appointed on the staff of the Agricultural Chemist, Bengal, for the year 1933-34 (*vide* Memorandum No. F. 44-I/35-Agri., dated the 28th November 1935.)

(b) Report of the work done in the Agricultural Research section of the Department of Chemistry, Dacca University, during the year 1934-35 (report circulated *vide* Memorandum No. F. 37-(1)/35-A., dated the 30th November 1935).

(c) Annual report on the work done during 1934-35 on the scheme for research into the properties of colloid soil constituents by Professor J. N. Mukherjee of the Dacca University. (Report circulated *vide* Memorandum No. F. 39-I/35-Agri., dated the 10th October 1935).

29. Application from the Government of Bengal for a grant of Rs. 27,720 spread over a period of five years on account of the extension of the scheme sanctioned for studying Soil problems in Bengal.

30. *Cancelled.*

31. Application from the Government of the Punjab for a grant of Rs. 29,286 spread over a period of five years for a scheme for the study of the effects of phosphatic manuring on grass land in an area of low rainfall.

32. Application from the Government of Bombay for a grant of Rs. 21,672 spread over a period of four years for a scheme to investigate the changes in the microflora of *kalar* soils in Sind.

33. Application from the Government of Mysore for a grant of Rs. 10,000 spread over three years for a scheme of study of the Colloids in tropical soils at the Chemistry Department, Central College, Bangalore., by Dr. B. Sanjiva Rao.

34. Application from the Government of Bihar and Orissa for a grant of Rs. 13,798 spread over a period of three years for a scheme for the determination of nutrient content in Indian soils.

35. Sanction for the purchase of apparatus required for the scheme for investigation on the physico-chemical properties of the clay fraction of lateritic soils and of the Dacca mixed soils and the nutrition of the rice plant out of the grant already sanctioned by the Council.

36. Report of the Dry-farming Research Schemes Co-ordination Committee on:—

(a) Progress Report of the Madras Dry Farming Research Scheme for the year 1934-35.

(b) Progress Report on the Bombay Dry Farming Research Scheme for the period October 1933 to March 1935.

37. Report of the Committee of Entomologists on:—

(i) Sugarcane insect pests Scheme.

(ii) Occurrence of Codling Moth in the Quetta Valley.

38. Scheme for work on the biological standardisation of insecticides and fumigants in India received from the Director, Imperial Institute of Agricultural Research (Estimated cost Rs. 15,770 spread over three years).

39. Application from the University of Madras for a grant of Rs. 21,300 for a scheme of enquiry into helminthiasis of cattle in the Madras Presidency spread over a period of five years.

40. Application from the Government of Madras for a grant of Rs. 92,487 spread over a period of three years for a scheme for research for improving the fishing industry and developing the supply of fish manure.
41. Application from the Director, Imperial Institute of Veterinary Research, Muktesar for a grant of Rs. 16,342 (11,298 recurring and 5,044 non-recurring) spread over a period of 2 years and 8 months for a scheme for research on an anti-rabic vaccine for dogs.
42. Application from the Government of the Punjab for a lump sum grant of Rs. 29,000 for sending an officer of the Punjab Veterinary Service (Class I) on deputation to South Africa to study the "Angora" Goat breeding industry.
43. Application from the Government of the Punjab for investigation and research of indigenous goat breeding at Government Cattle Farm, Hissar, at a cost of Rs. 38,000.
44. Progress report of the scheme regarding the insecticidal investigation of plant fish poisons and other forest products in Mysore during January to December 1935.
45. Establishment of Pedigree Herd Books in India.
46. (a) Annual Report of the Agricultural Marketing Adviser to the Government of India for the calendar year 1935.
- (b) Note by Mr. R. G. Allan regarding rate of progress of market surveys and adequacy of funds and staff.
47. Financial Assistance to the Oil Section of the Harcourt Butler Technological Institute, Cawnpore, for the year 1936-37.
48. Encouragement to the cultivation of medicinal plants and herbs in India.
49. Review of the Research Programme of the Imperial Council of Agricultural Research.
50. Application from Khan Sahib S. Dost Mohd. Khan, Proprietor, Cattle Farm, Jehangirabad, for a grant of Rs. 720 spread over a period of 2 years for the appointment of a milk tester in his Zail.
51. A note on 'the planning of Complex Experiments with special reference to Confounding' by the Statistician, Imperial Council of Agricultural Research.
52. Application from the Government of Bombay for a grant of Rs. 56,795 spread over a period of five years for research on the study of the Deccan Wingless Grasshopper (= *Colemania Sphenarioidis*).
53. Report on the working of John's disease investigation among cattle in Mysore, under the Imperial Council funds for the period ending November 1935.

PROCEEDINGS OF THE MEETING OF THE ADVISORY BOARD OF  
THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH  
HELD AT NEW DELHI ON MONDAY, THE 10TH FEBRUARY  
1936.

The following were present:—

1. Sir BRYCE BURT, *Chairman*.
2. Mr. R. G. ALLAN.
3. Rao Bahadur D. ANANDA RAO.
4. Dr. B. K. BADAMI.
5. Rao Bahadur BHIMBHAI R. NAIK.
6. Mr. N. BRODIE.
7. Dr. W. BURNS.
8. Mr. M. CARRERY.
9. Mr. J. N. CHAKRAVARTY.
10. Mr. J. CHARLTON.
11. Dr. J. K. DUBEY.
12. Sardar DATAR SINGH.
13. Mr. T. J. EGAN.
14. Mr. E. S. FARBROTHER.
15. Mr. S. GHOSE.
16. Dr. L. K. HYDER.
17. Mr. W. J. JENKINS.
18. Mr. P. J. KERR.
19. Dr. V. N. LIKHITE.
20. Mr. A. M. LIVINGSTONE.
21. Mr. J. C. McDUGALL.
22. Sir CHUNILAL V. MEHTA.
23. Mr. MOHAMMED HASAN KHAN.
24. Mr. A. N. MONTIRO.
25. Mr. A. M. MUSTAFA.
26. Dr. NAZIR AHMAD.
27. Dr. S. S. NEHRU.
28. Mr. NIZAMUDDIN HYDER.
29. Colonel A. OLVER.
30. Mr. R. V. PILLAI.
31. Mr. T. F. QUIRKE.
32. Diwan Bahadur T. RAGHAVIAH.
33. Major P. B. RILEY.
34. Mr. J. H. RITCHIE.
35. Mr. P. T. SAUNDERS.
36. Mr. S. M. A. SHAH.
37. Dr. F. J. F. SHAW.

38. Mr. G. T. TAIT.  
 39. Rao Bahadur M. VAIDYANATHAN.  
 40. Professor C. N. VAKIL.  
 41. Rao Bahadur B. VISVANATH.  
 42. Mr. F. WARE.

Mr. N. C. MEHTA, I.C.S., *Secretary*.

Mr. WYNNE SAYER and Dr. B. P. PAL kindly acted as recorders.

2. The meeting commenced at 11 A.M., and adjourned at 1 P.M.

3. The proceedings of the Board were opened by the Hon'ble Kunwar Sir Jagdish Prasad, the Chairman of the Council, who spoke as follows:—

Gentlemen, I consider it a privilege to be able to welcome you all to-day. Since you last met there have been many changes in the membership of the Advisory Board. We miss to-day a very familiar and well-known figure—the late Mr. Devadhar. He was in a true sense a servant of India. His work in connection with co-operative organisation and social welfare was of such great importance and of such outstanding merit that I am sure that it will remain as an abiding example of what an individual can do to help the poor and the afflicted. We also miss Major Stirling, the late head of the Veterinary Services in the Central Provinces. I am sure the Council would like to convey in appropriate terms their sympathy with the families of the two deceased members. Sir T. Vijayaragavacharya, who was for six years Vice-Chairman of the Council retired last October. I am glad to say that we shall not be deprived of his experience and help, as His Excellency the Viceroy has nominated him as an additional member of the Council.

2. It is now my pleasant duty to welcome a number of new members. I wish first to extend a cordial welcome to Sir C. V. Mehta, the first Minister for Agriculture in the Bombay Presidency and subsequently Finance Member to the Bombay Government. His wide knowledge of agricultural problems and of co-operative banking, his keen interest in cattle-breeding and his administrative experience will be of considerable value to the Advisory Board in its deliberations. I should also like to welcome (I do not think that he is here) Sir Mohd. Yakub, a fellow townsman, whose interest in rural welfare is well-known. I should also like to welcome Colonel Dibben (though he is not here at the moment), Director of Veterinary Services, Army Headquarters, Rao Bahadur Pillay and last but not least I should like to welcome Sir Bryce Burt in his new capacity as Chairman of your Board. I need not say much more about Sir Bryce because you are familiar with him and his work.

3. On looking through the agenda, I find what I regard as a distinctly pleasing feature is that you now have before you a number of progress reports on schemes which the Council has financed. In its early stages the Board was mainly concerned with applications for grants and to make suggestions as to the lines to be followed. Now you have to examine the actual work from a scientific standpoint, to see that schemes are being worked on proper lines and that defects are being rectified and to suggest what the future line of development should be. This I regard as work of great importance.

4. I consider that one of the really valuable features of your meetings is that scientific workers no longer work in watertight compartments and that they are no longer isolated from practical problems. I regard this as of special value to the scientific worker, particularly in view of the changes that have taken place in the constitution and in the I. A. S. It is very important that scientific workers in various fields should be able to assist each other, exchange ideas and get stimulus from the contact which comes from meeting and discussing around the table the problems which engage us throughout the year. It is also a very pleasant feature that we have been able to obtain the assistance of the universities. I understand that the Calcutta University is carrying out a scheme of research in soil science and in biometrics and also training agricultural officers in the technique of modern statistics. In Dacca there is a research scheme in animal nutrition; in Lahore a scheme relating to citrus diseases; in Agra an important scheme dealing with wheat rusts and in Madras research on the anatomy of sugarcane. It is a very desirable development that the Universities also should devote attention to the scientific aspects of agriculture.

5. I am afraid I must now deal with a point which, however much one may wish to avoid, it must be mentioned *viz.*, finance. It is not possible for me to anticipate the budget speech of the Hon'ble the Finance Member, but I understand that the Government of India have agreed, subject to vote of the Assembly, to restore the Council's annual recurring grant of five lakhs for research. I also hope it may be possible for them to give us a certain amount for non-recurring expenditure. What that amount will be it is impossible for me to anticipate, but knowing that after all the resources of the Government of India are not unlimited the Board will have to consider how in the future it can best deal with proposals for new expenditure. If recommended schemes accumulate there is likely to be a good deal of disappointment. Unless there is some sort of ruthless process of weeding out it is obvious that with the accumulation of the schemes which are running and those coming in, we shall ultimately have a situation in which there will be a number of schemes, which, however desirable they may be, will not have the slightest chance of being financed in the near future. One of the points I should like the Board to examine is the extent to which the provinces are willing to contribute. I consider there are two advantages in taking this line. The first is that if the provinces agree to undertake a certain amount of financial burden when sponsoring a scheme there will be a certain feeling of responsibility. Otherwise, human nature being what it is, one is apt to send up grandiose schemes without sufficient scrutiny particularly when the financial burden is on another's shoulders. I therefore think that in examining these schemes you should consider the extent to which provinces are willing to share the burden. The other advantage is that a time may come when you may feel that some of the schemes have reached a point when they should be taken over in the provinces. If the provinces make contribution from the outset it should be easier for them to take over schemes later than if they were entirely financed by the Council. There may be other schemes which may be possible for you to hand over to the Central research institutions. I think it is necessary that the financial question should remain prominently before you when you are discussing schemes and you should be able to give a clear lead to the Governing Body as regards the urgency and importance of the schemes which come up before you.

Then looking through your agenda, one of the most important points that is coming up before you,—and I have no desire to anticipate your findings,—is what I may call a scientific stock—taking of what the Council has done in the past. It is very natural that in view of large sums of money having been spent on agricultural research schemes people should enquire as to the value of these schemes; whether the money has been properly spent and in right direction. That is a very natural feeling of the people outside who wish to learn the way in which the funds placed at our disposal have been utilised. The general proposal has been approved by the Governing Body and now I hope that you will give your considered opinion on it and how it should be carried out.

I do not wish to detain you any longer and I will now take leave of you and leave you to proceed with your important deliberations”.

4. Sir Bryce Burt then moved the following resolution of condolence:—

“The Advisory Board of the Imperial Council of Agricultural Research records its deep regret at the loss of its two members Mr. Devadhar and Major Stirling and desire to express its deep sympathy with their families and relatives”.

This was passed all members standing.

5. *Decisions of the Governing Body on the recommendations of the Advisory Board made at the latter's meetings in February and July 1935. (Subject No. 1 of the Agenda.) (Appendix I).* —

Sir Bryce Burt pointed out that all the recommendations had been adopted with the exception of two items, Nos. 12 and 13, in which case the recommendations had been accepted but smaller grants sanctioned.

6. *Appointment of Committees. (Subject No. 2 of the Agenda.) (Appendix II and II-A).*

*Rice Research Committee.*

Mr. J. Charlton was added to this Committee.

*Committee to examine schemes regarding attack on (a) Jowar by the parasite Striga and (b) tobacco by the phanerogamic parasite Orobanche.*

In the absence of Prof. T. Ekambaram, Mr. K. Ramiah's name was added.

*Coconut Committee.*

Prof. T. Ekambaram being absent, Mr. K. Ramiah was appointed in his place.

*Soil Science Committee.*

Messrs. J. Charlton, M. Carbery and J. H. Ritchie were added to the Committee.

*Entomologists' Committee.*

Mr. A. Mustafa was added to the Committee.

*Committee to consider Bombay scheme for control of ticks and progress reports of Veterinary Investigation Officers, etc.*

Mr. S. M. A. Shah was added to the Committee.

*Marketing Scheme Sub-Committee.*

Prof. C. N. Vakil and Mr. G. T. Tait were added to the Committee.

*Wool Committee.*

Messrs. S. M. A. Shah and C. H. Parr were added to the Committee. Mr. P. T. Saunders was asked to attend in place of the Livestock Expert to the Government of Madras.

7. *Reconstitution of the Animal Nutrition Committee, Cattle Breeding Committee, and Dairy Committee, appointed by the Governing Body of the Imperial Council of Agricultural Research under Rule 30 of the Rules and Regulations of the Council. (Subject No. 22 of the Agenda.) (Appendix III).*

Col. Oliver referred to the fact that Mr. Warth had now retired and suggested that the Animal Nutrition Committee be composed of the following:—

1. The Vice-Chairman, Imperial Council of Agricultural Research.
2. The Animal Husbandry Expert, Imperial Council of Agricultural Research.
3. Statistician, I. C. of A. R.
4. Mr. A. V. Iyer, Offg. Physiological Chemist, Bangalore.
5. Dr. P. E. Lander, Agricultural Chemist, Punjab.
6. Dr. K. C. Sen, Bio-Chemist, Imperial Institute of Veterinary Research, Muktesar.
7. Rao Bahadur B. Viswanath, Offg. Director, Imperial Institute of Agricultural Research.
8. Mr. J. R. Haddow, Veterinary Research Officer, Imperial Institute of Veterinary Research, Muktesar.
9. Mr. Zal R. Kothavala, Imperial Dairy Expert, Bangalore.
10. Mr. F. Ware, Director, Imperial Institute of Veterinary Research, Muktesar.
11. Col. H. C. Dibben, Offg. Director of Veterinary Services, Army Headquarters, Simla.
12. Dr. W. R. Aykroyd, Director, Nutrition Research, Indian Research Fund Association, Coonoor.
13. Mr. T. F. Quirke, Director of Veterinary Services, Punjab.
14. Mr. M. Carbery, Agricultural Chemist, Bengal Government, Dacca.
15. Dr. J. K. Dubey, Director of Agriculture, Bhopal.
16. Mr. P. J. Kerr, Director of Veterinary Services, Bengal.
17. Mr. E. S. Farbrother, Director of Veterinary Services, Bombay.
18. Dr. Burch H. Schneider.
19. Mr. T. J. Egan, Director, Civil Veterinary Department, United Provinces.

Secretary, Imperial Council of Agricultural Research.

Mr. J. H. Ritchie proposed Mr. C. H. Parr and Rao Bahadur Viswanath proposed the Agricultural Chemist, Coimbatore, to be added to the Committee. Mr. McDougall proposed that Mr. Bal be added to the Committee. The names were accepted. The Advisory Board approved the proposal that the above Committee be recommended to the Governing Body for approval.



(ii) *Cattle Breeding Committee.*

The Advisory Board approved of the reconstitution of the Standing Cattle Breeding Committee with the personnel as mentioned below :—

1. The Vice-Chairman, Imperial Council of Agricultural Research.
2. The Animal Husbandry Expert, Imperial Council of Agricultural Research.
3. Statistician, Imperial Council of Agricultural Research.
4. Mr. T. F. Quirke, Director of Veterinary Services, Punjab.
5. Captain C. E. McGuckin, Assistant Director, Military Dairies, Lahore Cantt.
6. Mr. E. J. Bruen, Livestock Expert, Bombay.
7. Khan Sahib Dost Mohd. Khan, Proprietor, Jahangirabad Cattle Farm, District Montgomery.
8. Mr. C. H. Parr, Deputy Director of Agriculture, Bundelkhand.
9. Mr. Zal R. Kothavala, Imperial Dairy Expert, Bangalore.
10. Major P. B. Riley, Director of Veterinary Services, Bihar and Orissa.
11. Mr. Wynne Sayer, Imperial Institute of Agricultural Research, Pusa.
12. Mr. T. J. Egan, Director, Civil Veterinary Department, United Provinces.
13. Senior Marketing Officer dealing with live-stock.
14. Sardar Datar Singh, Montgomery.
15. Mr. K. P. R. Kartha, Statistical Assistant, Animal Husbandry Bureau, Imperial Council of Agricultural Research.
16. Mr. F. J. Gossip.
17. Mr. S. M. A. Shah.
18. Mr. R. W. Littlewood.
19. Mr. J. V. Takale.
20. Mr. R. C. Woodford.
21. Sardar Santokh Singh.
22. Mr. F. Ware.
23. Sir N. M. Kothavala.
24. Sir Chunilal V. Mehta.
25. Director of Agriculture, Mysore.
26. Pattagar of Palayakotai.  
Secretary, Imperial Council of Agricultural Research.

(iii) *Standing Dairy Committee.*

The Advisory Board approved of the reconsideration of the standing Dairy Committee with the personnel as mentioned below :—

1. The Vice-Chairman, Imperial Council of Agricultural Research.
2. The Animal Husbandry Expert, Imperial Council of Agricultural Research.

3. Statistician, Imperial Council of Agricultural Research.
4. The Imperial Dairy Expert, Bangalore.
5. The Director of Military Farms (or Representative).
6. Mr. W. Keventer.
7. Mr. R. C. Woodford.
8. Mr. E. J. Bruen.
9. Mr. R. W. Littlewood.
10. Mr. F. Ware.
11. Mr. A. C. Aggarwala.
12. Mr. ~~C. G. Takle~~ *J. V. Takale*.
13. Mr. Wynne Sayer.
14. Sardar Datar Singh.
15. Mr. F. J. Gossip.

Secretary, Imperial Council of Agricultural Research.

Mr. Kerr suggested that all committees should be kept down as far as possible to a small number to facilitate the disposal of work. Col. Olver stated that the Committees in the past had been criticised as being too small, as a good many members were unable to attend.

8. *Report on the working of the Oil Section of the Harcourt Butler Technological Institute, Cawnpore, for the year 1934-35. (Subject No. 26 (c) of the Agenda). (Appendix IV).*

*Financial assistance to the Oil Section of the Harcourt Butler Technological Institute, Cawnpore, for the year 1936-37. (Subject No. 47 of the Agenda). (Appendix V).*

The Vice-Chairman briefly explained the present position. In 1933 the Board decided not to recommend a grant until the Oil Seeds Cess materialised. But temporary assistance at the rate of Rs. 30,000 a year was eventually given to tide over the interregnum. The report for 1934-35 on the working of the Oil Section of the Harcourt Butler Technological Institute (Appendix IV) was considered and recorded.

Mr. Brodie then explained that the newly started Industrial Research and Intelligence Bureau hoped to be able to make some provision for research in oil technology work from 1937-38 and asked if the Imperial Council of Agricultural Research would sanction the continuation of the present arrangement for a further year.

The Vice-Chairman said that the proposal would give the Industrial Research Bureau a year to work out its programme and to decide what lines of work should be developed and obtain finance. All that the Council was asked to do was to provide the funds to prevent the work done in the past from being wasted.

Mr. Kerr asked if this matter would be circulated to the Governing Body.

The Vice-Chairman said that this would be done.

The proposal was then carried unanimously.

9. *Application from Dr. Bosi Sen, Director, Vivekananda Laboratories, Calcutta, for a recurring grant of Rs. 2,500 per annum for three years or five years for research in plant physiology. (Subject No. 4). (Appendix VI)*

Dr. Shaw said he was in favour of the scheme as proposed. It assisted an independent research laboratory and we should support this class of work whereas in the present case, it satisfied our Committees. The proposal was approved.

10. *Application from the Academy of Sciences of the United Provinces of Agra and Oudh for an annual recurring grant of Rs. 1,000, from the funds of the Imperial Council of Agricultural Research in aid of its work. (Subject No. 11). (Appendix VII).*

The Vice-Chairman invited Dr. Nehru to explain the position. Dr. Nehru asked on what principle was the grant asked for to be given to such academies whose work was largely academic? The Vice-Chairman said that grants already made to the other two sister institutions, viz., the Indian Academy of Sciences and the National Institute of Sciences of India were intended for publication and for scientific abstracting.

Dr. Burns opposed the grant and said that it seemed undesirable to give money to a body which though regional claimed to be national and especially as there were already two other bodies which claimed to be national.

Mr. Kerr supported Dr. Burns and said that the request was too indefinite.

Mr. Mehta pointed out that Dr. M. N. Saha was one of the founders of the academy, that the United Provinces had the largest body of universities in the country and that the United Provinces Government also supported it and if the province could be found to give substantial support, the Imperial Council of Agricultural Research should also do so. The scientific work of this Academy is in no way inferior to that done anywhere and a sum of Rs. 500 is only a gesture of sympathetic recognition.

The Vice-Chairman remarked that the position was that this society was not a regional academy co-operating with the National Institute of Sciences of India.

Dr. Nazir Ahmed supported the proposal and said that Rs. 500 would be well spent. He testified to the high standard of the contributions.

Rao Bahadur Vishwanath also supported it and pointed out that the United Provinces Academy was probably two years older than the Bangalore Academy.

Mr. Kerr pointed out that the Governing Body anticipated that every province would soon have a body of this kind to be supported and that we must ask ourselves the question as to whether we have the money. Dr. Burns disapproved of the principle of giving merely because the amount was so small and suggested that the request be not granted. Mr. Nizamuddin Hyder said that the academy was unable to carry on for lack of funds and why should we allow research of such value to lie in the dark? The Vice-Chairman remarked that this was not a sound argument, as the Imperial Council of Agricultural Research was always willing to publish scientific work of value. There were two proposals before the Board. One was the grant of Rs. 1,000 which was ruled out.

The second was the grant of Rs. 500 for three years, a similar grant to that already made to the other two academies. On being put to vote this proposal was carried by 20 to 12.

11. *Scheme for research in Economic Ornithology at a cost of Rs. 41,075 spread over a period of five years, submitted by Mr. Salim Ali through the Government of Bombay (Subject No. 5). (Appendix VIII and VIII-A).*

The Vice-Chairman referred to the discussion at a previous meeting and to the papers before the Board. A Committee had not been appointed because three local Governments had definitely opposed the Council spending money on the scheme. There were also several criticisms as to the method of work proposed.

Dr. Burns pointed out that this scheme was put up by a private individual who had chosen Bombay as the venue for the work, because they were able to give him certain accommodation and facilitate his researches at Poona. The author of the scheme, Mr. Salim Ali, was an expert in a rather specialised subject and he asked for help having had considerable amount of training both in Europe and India. Dr. Burns said that this scheme had much greater reasons for support than many schemes which had already been supported. The criticism had been made that more important work was held in abeyance for lack of funds, but he pointed out that the importance of the work and not the financial question is what the Board was concerned with. There were no doubts about the ravages of birds on crops and their undoubted services in other directions. The subject of the scheme was of considerable direct importance to agriculture.

There were two ways in which this scheme could be worked, *viz.*, (1) as an All-India scheme and (2) as a small scheme worked by an individual.

Dr. Burns was in favour of the latter. The Vice-Chairman first asked the Board to consider the general question whether the Council should finance research on this subject.

Mr. Kerr asked whether a Committee could say if the proposed work was of sufficient importance.

Dr. Shaw enquired whether the Provincial Government was contributing towards the scheme. The Vice-Chairman explained that the scheme was receiving no financial support from the Provincial Government. It was proposed that as a highly trained worker was available to carry out the work, the Council should give assistance to this investigation on Economic Ornithology.

On being put to the vote this motion was carried by a large majority.

The Vice-Chairman pointed out that the scheme would be too expensive to carry out on an All-India scale, and suggested that the scheme be now referred to the Entomological Committee for discussion of details. This suggestion was approved by the Board.

12. *Recommendations of the Locust Committee at its seventh meeting held in January 1936. Proposals for continuance and future programme of work. (Subject No. 3). (Appendix IX).*

Dr. Shaw explained the recommendations of the Committee. An important point was that the observational desert work would have to be placed on a more or less permanent basis. The total expenditure for year would be about Rs. 74,000.

The Vice-Chairman said that about two years ago the Locust Entomologist reported that he had some evidence of locusts migrating in the solitary phase to more favourable regions. This had been substantiated

by later work. This year there had been a considerable multiplication of solitary locusts in the Sind-Rajputana area and a rather similar increase had been reported in Arabia. In view of its importance, it was desirable that a permanent or quasi-permanent staff should be maintained to take desert observations, and the Locust Committee proposed that the Government of India be approached to relieve the Council's funds of part of this cost.

The Committee's report was approved.

13. *Report on the tests on Indian Barley by the Institute of Brewing, London, for the year 1933-34.* [Subject No. 26(a)]. (Appendix X).

Mr. Livingstone pointed out that there was no prospect of creating a market for malting barley from India until the *khapra* beetle pest could be controlled.

Mr. Ritchie informed the Board that the United Provinces Department of Agriculture was concentrating upon C-251 barley which has been favourably reported upon as a malting barley. He promised to ask the Entomologist to the United Provinces Government to take up the question of the beetle.

The Advisory Board decided that all the three provincial Departments concerned would be requested to take up the work on the control of this beetle.

14. *Use of technical terms in progress reports on agricultural schemes financed by the Imperial Council of Agricultural Research.* [Subject No. 26 (d)]. (Appendix XI).

This was for information only and was recorded.

The Board then adjourned till 10-30 A.M., on the 11th February 1936.

N. C. MEHTA,  
*Secretary.*

NEW DELHI;

The 10th February 1936.

PROCEEDINGS OF THE MEETING OF THE ADVISORY BOARD OF  
THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH  
HELD AT NEW DELHI, ON TUESDAY THE 11TH FEBRUARY  
1936.

The following were present:—

1. Sir BRYCE BURT, *Chairman*.
2. Mr. R. G. ALLAN.
3. Rao Bahadur D. ANANDA RAO.
4. Dr. B. K. BADAMI.
5. Rao Bahadur BHIMBHAI R. NAIK.
6. Dr. W. BURNS.
7. Mr. M. CARBERY.
8. Mr. J. N. CHAKRAVARTY.
9. Mr. J. CHARLTON.
10. Dr. J. K. DUBEY.
11. Sardar DATAR SINGH.
12. Mr. T. J. EGAN.
13. Mr. E. S. FARROTHER.
14. Mr. S. GHOSE.
15. Dr. L. K. HYDER.
16. Mr. W. J. JENKINS.
17. Mr. F. J. KERR.
18. Dr. V. N. LIKHTE.
19. Mr. A. M. LIVINGSTONE.
20. Mr. J. C. McDUGALL.
21. Sir CHUNILAL V. MEHTA.
22. Mr. MAHMUD HASSAN KHAN.
23. Sir MOHAMMAD YAKUB.
24. Mr. A. N. MONTIRO.
25. Mr. A. M. MUSTAFA.
26. Dr. NAZIR AHMAD.
27. Dr. S. S. NEHRU.
28. Mr. NIZAMUDDIN HYDER.
29. Colonel A. OLVER.
30. Mr. R. V. PILLAI.
31. Mr. T. F. QUIRKE.
32. Diwan Bahadur T. RAGHAVIAH.
33. Major F. B. RILEY.
34. Mr. J. H. RITCHIE.
35. Mr. P. T. SAUNDERS.
36. Mr. S. M. A. SHAH.
37. Dr. F. J. E. SHAW.
38. Mr. G. T. TAIT.

39. Rao Bahadur M. VAIDYANATHAN.  
 40. Professor C. N. VAKIL.  
 41. Rao Bahadur B. VISVANATH.  
 42. Mr. F. WARE.

Mr. N. C. MEHTA, I.C.S., *Secretary*.

Mr. WYNNE SAYER and Dr. B. P. PAL kindly acted as recorders.

2. The meeting commenced at 10-30 A.M., and adjourned at 1 P.M.

3. *Review of the Research Programme of the Imperial Council of Agricultural Research. (Subject No. 49 on the Agenda.) (Not printed).*

In introducing the subject the Offg. Vice-Chairman said that the papers on the subject were strictly confidential. The memorandum had been circulated to the Governing Body and had been approved by it. This particular procedure had been adopted as an important question of policy was involved. The position now was that the Governing Body had approved the proposal on the understanding that the Government of India would provide the necessary funds and it was now for the Advisory Board to give its considered findings on the detailed proposals contained in the note before them.

As the Hon'ble Member had explained yesterday, there was a possibility of the Government of India giving the Council something by way of a non-recurring grant to enable it to clear off some of the arrears of approved schemes. The grant from the Government of India was however conditional on the Council pursuing a somewhat more conservative policy in future and keeping in mind the financial resources available to it in approving schemes of agricultural research. It has also been suggested that the time has come when the Council should take stock of the work already accomplished. It was also necessary to consider whether the Council's research programme was properly distributed over the various branches of agricultural and veterinary research and the method of carrying out such stock-taking is set out in the memorandum (not printed). It was proposed to bring out two scientists from England to carry out this survey, one of whom would deal with the programme on the agricultural side and the other with the development of the dairy industry. It was felt that the progress in animal husbandry research schemes for various reasons had been slower than on agricultural schemes. The Government of India has agreed to bear the cost of bringing out these two experts from England.

Mr. Ware suggested that as the programme of work of the Council in future is likely to be influenced by the report of these two experts, a Veterinary Expert should also be added to balance the Committee. Sir Bryce made it clear that there was no possibility of getting out three experts, but undertook to see that the report of the Dairy Expert should not prejudice the claims of Veterinary Science and general Animal Husbandry to a share of the Council's funds.

Dr. Nehru wanted to make a general observation. He said that after all the final arbiter was the farmer and the extent of gain to him from agricultural research. This aspect of the question should weigh with any committee which was going to do stock-taking.

Sir Chunilal Mehta agreed with the principle that there should be some kind of stock-taking, especially as the funds at the disposal of the Council

were to be limited. He felt, however, that after so many years of work in agriculture we should be in a position to find one or two men who would be able to give us the kind of advice that we wanted, especially as such advice must be the result of very detailed examination and of many years experience of agricultural work in this country. As regards the association of two Indian technical officers as Secretaries to the two British Experts, he thought that the stock-taking should be more or less a continuous process, that it would have to be done periodically hereafter and consequently it would be of the utmost advantage to have men to carry out the present review who would be available on later occasions as well. If it were decided to get the experts from England at all, he suggested that the Indian technical officers should be associated with them on a footing of equality. Sir Chunilal Mehta enquired whether dairying was so far advanced as to require examination at this stage. Colonel Olver replying to the point raised by Sir Chunilal explained that Dairying had during the last few years made enormous progress in England and it was necessary to have some expert advice on the subject, in view of the importance of organising the dairy work in this country. The Vice-Chairman explained that it was proposed to have two or three small committees to prepare draft "appreciations" for the use of the two experts which would then be considered by the Advisory Board.

Diwan Bahadur T. Raghaviah enquired whether the time for preparing the appreciation was not too short and whether it would not be more appropriate for the Advisory Board to give their opinion regarding the proposal to get the expert advisers from England after the draft reports had been submitted to it by the committees to be set up.

Dr. Hyder supported the proposal for the review of the research programmes of the Council. While it was true that what we wanted was a review, it should enable us to know the lines on which we are advancing and the work that we are to take up in the future. He disagreed with Sir Chunilal's suggestion to omit animal husbandry from the scope of stock-taking. In view of the fact that land in this country could not be increased and that scientific agriculture was not likely to increase the agricultural resources rapidly, the field of animal husbandry provided the greatest scope for improvement. If nothing had hitherto been done in the field of animal husbandry, the greater was the reason to have a picture of what should be done to advance it, so that the work may be accelerated in future. He was therefore in favour of having an expert not only on dairying but on the subject of animal husbandry generally.

Dr. Burns supported the proposal as stated in the memorandum as there was considerable congestion of approved schemes and remarked that our principal difficulties were due to a variety of causes, one being the modification in the Council itself, as compared to the original proposals, the other being that of finance. He was also in favour of getting outside opinion, especially when everybody connected with the Council was likely to be biased however unconsciously. Regarding the point raised by Mr. Raghaviah he said that the work financed by the Council was being constantly reviewed by the Council's staff and there should be no difficulty in having the material ready for the experts in the time available.

Sardar Datar Singh was in favour of additional funds being given for projects of animal husbandry. He was also in favour of having the scope of stock-taking extended to embrace dairying and animal husbandry.



Mr. Ritchie suggested that the terms of reference of the proposed committee should include the lines on which future research work should be carried out in this country and whether the present financial resources at the disposal of the Council were sufficient for the work in hand.

Dr. Shaw agreed with Dr. Burns. He agreed with Sir Chunilal Mehta that the Indian officers to be associated with the experts should be more in the capacity of equals rather than of secretaries.

Sir Bryce Burt said that the latter point had received very careful consideration. It was not desirable that any one except the two British experts should be bound by the reports. It was not a question of status. The last word in this matter would lie with this Board which would recommend to the Governing Body what should be done on the report. He suggested that the point about the extension of the scope in the animal husbandry work should now be settled one way or the other.

Mr. Kerr suggested that it would perhaps be safer not to enlarge the scope of stock-taking in view of the risk of having some of our schemes being delayed as a result of it. Mr. Quirke and Col. Olver also agreed.

Rao Bahadur Ananda Rao did not understand what the danger was, if the scope of the enquiry was enlarged to include animal husbandry schemes and suggested that the stock-taking, if it was to be properly and efficiently done should include both agriculture and animal husbandry. Dr. Hyder was also for enlarging the scope of the proposed enquiry, especially as the progress of dairying depended fundamentally on the progress in cattle breeding. He suggested that instead of the words 'and one a specialist in dairy science' at the end of line 8 on page 4 of the memorandum (not printed) the following should be substituted: "and one a specialist with special knowledge of cattle improvement and dairy science and general knowledge of animal husbandry matters." The Offg. Vice-Chairman accepted the suggestion.

Sir Chunilal Mehta said that he was not quite satisfied with the proposal to associate Indians with the two British experts without any responsibility, for what he wanted was that whenever such stock-taking was necessary in future, there should be some one in the country to whom they could look up. He did not consider that it was primarily a matter of status. After a brief discussion it was agreed that the two Indian technical officers should be associated with the two British experts as 'advisers' and also work as secretaries.

With the above modifications in detail the Board approved the proposal. Three sub-committees of the Board were constituted as follows:—

*Crops Committee.*

The Vice-Chairman, Imperial Council of Agricultural Research.

Dr. F. J. F. SHAW, Offg. Agricultural Expert, Imperial Council of Agricultural Research.

Dr. BURNS.

Prof. EKAMBARAM.

Mr. McDougall.

Mr. JENKINS.

Mr. McLEAN.

Mr. ALLAN.

*Soils Committee.*

The Vice-Chairman, Imperial Council of Agricultural Research.

The Agricultural Expert, Imperial Council of Agricultural Research.

Mr. P. H. CARPENTER.

Rao Bahadur VISWANATH.

Mr. M. CARBERY.

Prof. J. N. MUKHERJEE.

Dr. DUBEY.

*Dairy Science and Cattle Improvement Committee.*

The Animal Husbandry Expert.

Sir CHUNLAL MEHTA.

The Imperial Dairy Expert.

The Director of Military Farms (or the Assistant Director).

Mr. BRUEN.

Sardar DATAR SINGH.

Mr. WARE.

Mr. QUIRKE.

Mr. PARR.

Dr. BADAMI.

Mr. AGGARWALA.

4. *Report on the Scheme of Agricultural Meteorology for the year ending 31st August 1935 (Subject No. 26 (b) on the agenda). Appendix XII and XII-A.*

The subject was introduced by the Vice-Chairman who said that the report of the work done was extremely interesting and that in view of the importance of agricultural meteorological work it was desirable to continue it as a permanent measure. Dr. Burns pointed out certain points in the report which required elucidation more particularly in section 4 "—analysis of crops yields and meteorological factors" and suggested that the data should be set out in greater detail. This was accepted. It was agreed that a more detailed report should be called for and discussed by a committee at the next meeting of the Board.

Dr. Nazir Ahmed suggested that the work on cotton yields overlapped work undertaken at the Technological Laboratory of the Indian Central Committee.

The Board approved the proposals contained in the supplementary note.

5. *Application from the Government of Madras for a grant of Rs. 92,487 spread over a period of three years for a scheme of research for improving the fishing industry and developing the supply of fish manure. (Subject No. 40 on the agenda.) (Appendix XIII).*

Rao Bahadur Ananda Rao introduced the subject and said that the work was not entirely of local importance and the results which were likely to be obtained by the Madras Department would be of use in other parts of India. The Standing Finance Committee, Madras, had approved the proposal to engage a fisherman for the Yorkshire Coble. It was pointed out that the request of the Governing Body had not been complied

with and that in view of the existing financial circumstances it was useless to proceed further with the matter. The Board decided that the scheme should be dropped.

6. The Board then adjourned till 10-30 A.M. on the 13th to allow some Sub-Committees to meet in the afternoon of the 11th and on the 12th.

N. C. MEHTA,  
*Secretary.*

NEW DELHI;

*The 12th February, 1936.*

PROCEEDINGS OF THE MEETING OF THE ADVISORY BOARD OF  
THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH  
HELD AT NEW DELHI, ON THURSDAY, THE 13TH FEBRUARY  
1936.

The following were present:—

1. Sir BRYCE BURT, *Chairman*.
2. Mr. R. G. ALLAN.
3. Rao Bahadur D. ANANDA RAO.
4. Dr. B. K. BADAMI.
5. Rao Bahadur BHIMBHAI R. NAIK.
6. Dr. W. BURNS.
7. Mr. M. CARBERY.
8. Mr. J. N. CHAKRAVARTY.
9. Mr. J. CHARLTON.
10. Dr. J. K. DUBEY.
11. Sardar DATAR SINGH.
12. Mr. T. J. EGAN.
13. Mr. E. S. FARBROTHER.
14. Mr. S. GHOSE.
15. Dr. L. K. HYDER.
16. Mr. W. J. JENKINS.
17. Mr. P. J. KERR.
18. Dr. V. N. LIKHITE.
19. Mr. A. M. LIVINGSTONE.
20. Mr. J. C. McDOUGALL.
21. Mr. MAHMUD HASSAN KHAN.
22. Sir MOHAMMAD YAKUB.
23. Mr. A. N. MONTIRO.
24. Mr. A. M. MUSTAFA.
25. Dr. NAZIR AHMAD.
26. Mr. NIZAMUDDIN HYDER.
27. Col. A. OLVER.
28. Mr. R. V. PILLAI.
29. Mr. T. F. QUIRKE.
30. Diwan Bahadur T. RAGHAVIA.
31. Major P. B. RILEY.
32. Mr. J. H. RITCHIE.
33. Mr. P. T. SAUNDERS.
34. Mr. D. R. SETHI.
35. Mr. S. M. A. SHAH.
36. Dr. F. J. F. SHAW.
37. Mr. G. T. TAIT.
38. Rao Bahadur M. VAIDYANATHAN.

39. Prof. C. N. VAKIL.
40. Rao Bahadur B. VISVANATH.
41. Mr. F. WARE.  
Mr. N. C. MEHTA, I.C.S., *Secretary*.  
Mr. WYNNE SAYER and Dr. B. P. PAL acted as recorders.

*Visitors—*

1. Dr. S. P. AGHARKAR.
  2. Dr. D. V. BAL.
  3. Dr. J. K. BASU.
  4. Prof. D. R. GADGILL.
  5. Dr. J. C. GHOSH.
  6. Dr. S. HEDAYETULLAH.
  7. Mr. H. C. JAVARAYYA.
  8. Mr. N. V. KANITKAR.
  9. Dr. R. D. KAPUR.
  10. Mr. ZAL R. KOTHAWALA.
  11. Dr. P. G. KRISHNA.
  12. Mr. G. S. KURPAD.
  13. Major C. E. MACGUCKIN.
  14. Dr. E. MACKENZIE TAYLOR.
  15. Dr. T. J. MIRCHANDANI.
  16. Dr. J. N. MUKERJEE.
  17. Mr. K. RAMIAH.
  18. Mr. A. SUBBA RAO.
  19. Rao Bahadur V. A. TAMHANE.
  20. Mr. TEHL RAM.
  21. Khan Bahadur DOST MOHD. KHAN.
  22. Mr. C. VIJAYARAGHAVAN.
2. The meeting commenced at 10-30 A.M. and terminated at 5-15 P.M. with an interval for lunch from 1 to 2-30 P.M.

3. *Encouragement to the cultivation of medicinal plants and herbs in India.* (Subject No. 48 of the Agenda.) (Appendix XIV).

Dr. Shaw, in introducing the subject, said that what was needed was first a survey in each province of the medicinal plants either growing wild or under cultivation. From such a survey the more important medicinal plants could be selected and tried under cultivation on Government farms with a view to discover which areas in a province were suited climatically, and from the point of view of soils, to the growth of these plants. When this was discovered, it would be possible to carry out trials of some of the medicinal plants in those areas which had proved suited to their growth and cultivation. At the same time when these enquiries were being made the Agricultural Departments should ascertain the demand for each drug and the standard required in respect of each drug. It would be useless to encourage the cultivation of medicinal plants for which there was a very limited market or of which the standard of purity of the product was not such as was required by the trade.

It was pointed out by the Chairman that this Council had already made a grant to Col. Chopra and there was another scheme financed by the Council for research on indigenous insecticides in Mysore. Messrs. Allan, Ritchie, McDougall and Jenkins referred to the difficulties of marketing the small supplies of medicinal plants which were at present available. Mr. Allan doubted whether the cultivation of medicinal plants could be effectively dealt with by the Departments of Agriculture as they did not have suitable men for the purpose. Rao Bahadur Ananda Rao referred to the difficulties of securing 'potency' certificates, especially when the quantities handled were small as these had at present to be obtained from Great Britain. Diwan Bahadur T. Raghaviah said that a survey of the drugs grown in the Madras Presidency had been made by a committee under the late Dr. Koman and the material there collected should be utilised. He also pointed out that certain drugs were widely grown even at present and referred to lemon grass which was distilled for its oil. Mr. Allan stated that 4,000 acres were planted with *Plantago officinalis* in the Mehsana District of the Baroda State and the output was exported to U. S. A.

Col. Jolly was surprised to find that a great deal had already been done in the direction of growing indigenous drugs. It seemed to him that what was wanted was perhaps something in the nature of an Intelligence Bureau to supply the provinces with information as to the demand for particular drugs. He wanted to know whether the Council would be able to obtain information from commercial sources regarding the demand and distribution of drugs. Some sort of co-ordination and direction was also required. As regards the potency of drugs he thought that it was an important point. In order to get a market it was essential to know whether the drugs were of sufficient quality. At present there was difficulty in obtaining potency tests unless they were sent to England. There should be a well-equipped laboratory where products could be tested in this country. That was a step forward, and would enable them to certify that the produce of a particular place or of a particular variety was of such and such a quality. If they knew that there was a demand and if they could give the public evidence that a drug of quality could be produced on which they could depend, every encouragement to its growing could be given. In answer to a query from the Chairman, Col. Jolly suggested that the Medical Stores Departments should be able to furnish some quantitative information as regards the various drugs for which there was a market in this country. He thought that it was best at present to confine the surveys to cultivated medicinal plants and not include those which were collected. The suggestion was accepted and it was resolved to obtain more definite information about the state of demand in respect of medicinal drugs and to ask the provinces to undertake a survey of medicinal plants cultivated by the ryots. It was also agreed to make enquiries from Ayurvedic and Unani Institutions.

4. Application from the Government of Bombay for the grant of Rs. 56,795 spread over a period of five years for research on the study of the Deccan wingless grass-hopper (*Colemania Sphenarioidis*). (Subject No. 52 on the agenda). (Appendix XV).

The scheme was not recommended by the Locust Committee and the Director of Agriculture said that he did not press it. It was decided not to proceed with the scheme.

5. (a) Annual Report on the Rice Research Scheme in the Madras Presidency for the year 1934-35. (Not printed).

(b) Annual Report on the Rice Research Scheme in Bengal for the year 1934-35. (Not printed).

(c) Annual Report on the Rice Research Scheme in the United Provinces for the year 1934-35. (Not printed).

(d) Annual Report on the Rice Research Scheme in Burma for the year 1934-35. (Not printed).

(e) Annual Report on the Rice Research Scheme in Bihar and Orissa, for the year 1934-35. (Not printed).

(f) Annual Report of the deep water paddy research farm, Habiganj, Assam, for the year 1934-35. (Not printed).

(g) Progress report on the scheme of research on quality in crops for the year ending 30th November 1935. (Not printed). (Subject No. 8 of the Agenda). (Appendix XVI).

Dr. Shaw pointed out the following corrections to the report (Appendix XVII):—

(1) Add the words "from the 1936 crop" at the end of section (d) on page 3 of the report.

(2) Delete the words "to avoid the energies of the staff" at the bottom of page 3 of the report.

He also drew the attention of the Board to the principal recommendations of the Committee, and laid stress on the following points:—

(1) That yields should be recorded in pounds and ounces which would be understood all over the world and not in tolas and chataks.

(2) That the size of the reports in some cases should be reduced.

The research officers who were in charge of these schemes and who were present at the meeting of the Board explained the nature of work done by them and undertook to give effect to the various suggestions that had been made for work in the future. Rao Bahadur M. Vaidyanathan said that the statistical data connected with these experiments should be sent to the Secretary of the Council two or three months earlier than the report as it took time to verify them. Sir Bryce Burt considered that this was desirable and requested the various officers to send the statistical data in advance. The report of the sub-committee (Appendix XVII) was then adopted. It was also resolved that Local Governments should be required to make a contribution on the basis of 50:50 in all cases of renewals of these schemes.

6. *Application from the Government of the Punjab for a grant of Rs. 38,380 spread over a period of five years for a scheme for investigation of fungal diseases of the rice crop. (Subject No. 9 on the Agenda). (Appendix XVIII).*

Dr. Shaw explained that the Committee examined the scheme and had concluded that with the establishment of the Imperial Agricultural Research Institute at Delhi the study of diseases of rice in Northern India could be carried out by the Mycological Section of that Institute. (Appendix XVII). Dr. Shaw pointed out that the Agricultural Research Institute at Delhi possessed a large farm at Karnal which contained land suitable for experiments with rice and that the staff of the Imperial

Agricultural Research Institute would be near the Punjab and would be able to tour in the Punjab and take observations on the incidence of fungal diseases of rice. The Committee therefore did not recommend the scheme to the Board.

The report of the Committee (Appendix XVII) was adopted by the Board and the scheme was not approved.

7. *Application from the Government of Mysore for a grant of Rs. 1,39,145 spread over a period of 10 years for a scheme of research on sheep breeding. (Subject No. 6 on the agenda). (Appendix XIX).*

The Sub-Committee's proposals (Appendix XX) were accepted and it was decided to postpone consideration of the scheme till the matter of co-ordinated sheep breeding had been again discussed at the next meeting of the Animal Husbandry wing of the Board of Agriculture. The suggestion was accepted by Mr. Montiro.

8. *Extension for a period of five years of the scheme for breeding experiments in connection with the improvement of goats in the United Provinces by Mr. A. E. Slater. (Subject No. 10 on the agenda). (Appendix XXI).*

The committee considered the work being done under this scheme to be valuable and that it should be continued. Col. Oliver asked that this scheme should be treated as an extension for a second 5 years, on the same lines as all other breeding schemes which it would be remembered were recommended for 10 years, subject to review after the first 5. He pointed out that results were only now being obtained and that the value of the work was evident from the fact that a large number of goats had been sold for breeding purposes all over India. Moreover, the United Provinces Government had undertaken to make provision for extra accommodation and for the rearing of young males to maturity for breeding purposes. In dealing with the scheme in committee every effort had been made to keep expenditure as low as possible and it was agreed that the present scale of pay of Mr. Bhatia with yearly increments of Rs. 5/- was adequate. A clerk was essential but against this it was anticipated that the receipts would increase to some extent beyond the estimate given in the scheme. With these modifications continual of the scheme was recommended. The report of the Committee (Appendix XX) was adopted by the Advisory Board.

9. *Application from the Government of the Punjab for investigation and research of indigenous goat breeding at Government Cattle Farm, Hissar, at a cost of Rs. 38,000. (Subject No. 43 on the agenda). (Appendix XXII).*

Col. Oliver pointed out that this might be considered as an amplification of the work at Etah where owing to limited accommodation and the fact that two breeds were being dealt with, the flocks were necessarily small and where it would be necessary, in any case, to provide for fresh blood. In discussing the scheme it had been agreed by Mr. Quirke that the returns should be divided between the Punjab Government and the Imperial Council of Agricultural Research on a 50:50 basis and that



the same basis should apply as regards the disposal of male goats, on the understanding that if the Imperial Council of Agricultural Research did not require all of its quota—those not required would revert to the Punjab. With these modifications the report of the Committee (Appendix XX) was adopted by the Advisory Board.

10. *Application from the Government of the Punjab for a lump sum grant of Rs. 29,000 for sending an officer of the Punjab Veterinary Service, Class I, on deputation to South Africa to study the Angora goat breeding industry. (Subject No. 42 on the agenda). (Appendix XXIII).*

The Committee agreed that an officer should be selected by the Imperial Council of Agricultural Research and sent to South Africa on deputation for a period of six months, including travelling, and as this was a modification of the proposal put up by the Punjab Government it was considered that the scheme should be sent back for resubmission for consideration at the summer meeting of the Advisory Board. The recommendation of the Committee (Appendix XX) was adopted.

11. *Application from the Government of Travancore for a grant for a scheme for improving the cattle in the West Coast of India at a cost of Rs. 2,89,136 spread over a period of ten years. (Subject No. 23 on the agenda). (Appendix XXIV).*

The consideration of this scheme was postponed at the request of the Government of Travancore.

12. *Establishment of pedigree herd books in India. (Subject No. 45 on the agenda). (Appendix XXV).*

Col. Olver pointed out that these proposals had been on the tapis for a very long time and he was anxious now to make a start with the registration of some of the most important breeds of Indian cattle. The Committee, after discussion, had recommended that herd-books should be formed for the following breeds, viz. Sahiwal, Sindi, Gir, Tharparkar, Haryana, Ongole and Kankrej cattle and Murrah Buffaloes. The question of the nomenclature of the red Sindi cattle was discussed by the Committee and it was suggested that Karachi would be a better name as there were other breeds of cattle indigenous to Sind. For purposes of defining breed characteristics it was recommended that a convener should be appointed for each breed who should get in touch with the most important breeders and after obtaining their views should arrange a meeting in a suitable place in order to arrive at an agreed schedule of breed points, including careful measurements and descriptions, with photographs of typical animals. These should be submitted to the Cattle Breeding Committee of the Advisory Board for consideration and, when accepted, should be published by the Council in the form of a brochure for general guidance. The Committee suggested Mr. Wynne Sayer for the Sahiwal and Tharparkar breeds, Mr. Kothawala for Sindis and Girs, Mr. Sontokh Singh for Haryana cattle and Murrah Buffaloes, Mr. Bruen for Kankrej and Mr. Littlewood for Ongoles.

In the course of the discussion Mr. Jenkins suggested that Mr. Henderson of Mirpur Khas should deal with the Tharparkar breed but

after further discussion it was decided that the final decision as to conveners should be left to the Vice-Chairman, in consultation with the Animal Husbandry Expert. It was recommended that each convener should submit an estimate of costs for the Vice-Chairman's sanction, as was done in the case of the sub-committees of the Dairy Legislation Committee. On Mr. Ware's suggestion it was recommended that the Animal Husbandry Bureau should maintain these herd-books. The question of arranging for the periodical checking of milk records was left over decision after breed characteristics had been defined. The recommendation of the Committee (Appendix XX) was adopted subject to the remarks mentioned above.

13. *Application from Khan Sahib S. Dost Mohd. Khan, Proprietor, Cattle Farm, Jehangirabad, for a grant of Rs. 720 spread over a period of two years for the appointment of a milk tester in his Zail. (Subject No. 50 on the agenda). (Appendix XXVI).*

Col. Olver explained that the Committee had decided that the scheme could only be considered if the Punjab Government accepted the responsibility for its proper working and it was agreed that as it had not been put up through the Punjab Government it should be referred back for consideration by the Punjab Provincial Research Council. The report of the Committee (Appendix XX) was adopted.

14. (a) *A brief report of the Cold Storage trials on the Alphonso Mango for the 1935 season. (Not printed) (Appendix XXVII-A).*

(b) *Annual Report of the Hill Fruit Research Scheme in the United Provinces, for the year 1934-35. (Not printed).*

(c) *Annual Report of the Horticultural Research Station, Krishnagar, Bengal, for the year 1934-35. (Not printed).*

(d) *Annual Report of the Horticultural Research Station, United Provinces and Bihar and Orissa, Sabour for the year 1934-35. (Not printed) (Subject No. 12 of the Agenda).*

14-A. *Application from the Government of Bombay for a grant of Rs. 78,650 spread over a period of five years for a scheme for improvement of papaya breeding and cultural practices. (Subject No. 13 of the Agenda). (Appendix XXVII).*

The Committee's recommendations (Appendix XXVIII) were adopted.

In regard to the report of the Horticultural Research Station, United Provinces and Bihar and Orissa for the year 1935, Dr. Shaw referred to several undesirable features of this report. According to the report there were 267 varieties of fruits which were being tried on an area of 13.3 acres. There was an acre of ornamental garden which did not seem to be a legitimate charge on the Imperial Council of Agricultural Research. Mr. Sethi explained that the 13 acres referred to in the report were really not within the area devoted to the Imperial Council of Agricultural Research Scheme at all and that there were 267 trees rather than varieties of fruits. He regretted his absence from the Committee and suggested the deletion of the portion referred to in the sub-committee's report. The Chairman pointed out that these corrections would be necessary both in the report submitted by the Bihar and Orissa Horticulturist and in the sub-committee's report; the latter after all

could only comment on the material placed before it. The amended report was adopted.

15. *Application from the Government of Bombay for a recurring grant of Rs. 59,465 to test the value of different methods of controlling or eradicating ticks in this country. (Subject No. 19 of the Agenda.) (Appendix XXIX).*

Colonel Oliver explained that this was an important scheme and that no work had been done on this general subject in this country. He added that the improvement of cattle depended to an important extent on the control of ticks. The scheme was then adopted. (See Appendix XXXIII).

16. *Application from the Government of Bombay for a grant of Rs. 30,030 spread over a period of two years for a scheme of research on agricultural economics by the Director, Gokhale Institute of Politics and Economics. (Subject No. 27 of the Agenda.) (Appendix XXX).*

Mr. Mehta explained that this was a scheme of methodology and that the results of the survey method which was to be tried under the auspices of the Gokhale Institute of Economic and Politics should be of general application. It was also to be noted that the Gokhale Institute was to contribute half the amount estimated for the scheme, the other half being met by the Imperial Council of Agricultural Research. Dr. Burns supported the scheme and the Committee's report (Appendix XXXI) was then adopted.

17. *Application from the Director, Imperial Institute of Veterinary Research, Muktesar, for a grant of Rs. 16,342 (11,298 recurring and 5,044 non-recurring) spread over a period of 2 years and 8 months for a scheme for research on an anti-rabic vaccine for dogs. (Subject No. 41 of the Agenda.) (Appendix XXXII).*

Colonel Oliver said that it would be generally agreed that research work on Rabies was very much required in India from the Animal husbandry as well as the human points of view, and mentioned that a resolution had been passed at the last meeting of the Medical Research Worker's Conference in Calcutta that the veterinary authorities in India should be asked to take up this work. He pointed out that no exact experimentation had so far been carried out in India to determine the real value of the numerous single-dose vaccines which were extensively employed for the control of rabies in other countries. Accordingly the Director, Imperial Institute of Veterinary Research, had put up a scheme to carry out a series of carefully controlled tests of such vaccines, starting with the single dose vaccine of Umeno and Doi, which was very extensively used in Japan. If single dose vaccines did not prove satisfactory it was proposed that work on double dose vaccines should be carried out. One of the reasons for putting up a scheme now was that Mr. S. R. Hassan, M.R.C.V.S., L.M. who is now in charge of the Imperial Veterinary Serum Institute, Izatnagar, had already done work on Rabies and had received special training suitable for the work. Mr. Ware pointed out that he had been anxious for a long time to get research on these lines carried out but he did not wish it to be done at Muktesar, partly because of the lack of suitable facilities. Moreover at Izatnagar

it would be much easier to obtain rabid dogs which was important as it was intended that as far as possible, infection of experimental animals should be carried out in the natural way, i.e., by the bite of a rabid dog. He suggested that if these vaccines proved satisfactory they should be adopted by municipalities and local authorities throughout India and should be given free to all dogs, when being licensed. After discussion it was agreed that in view of its general importance to the health of the people the scheme should be strongly supported by the Board and that the Education, Health and Lands Department should be approached with a view to their financing it as part of the normal work of the Imperial Veterinary Research Institute. (See Appendix XXXIII).

18. (a) *Second progress report on the scheme for the study of soil problems by the Physical Assistant appointed on the staff of the Agricultural Chemist, Bengal, for the year 1933-34. (Not printed). (Appendix XXXV.)*

(b) *Report of the work done in the Agricultural Research section of the Department of Chemistry, Dacca University, during the year 1934-35. (Not printed.) (Appendix XXXVI.)*

(c) *Annual report on the work done during 1934-35 on the scheme for research into the properties of colloid soil constituents by Professor J. N. Mukherjee of the Dacca University. (Not printed.) Appendix XXXVII.)*

*Application from the Government of Bengal for a grant of Rs. 27,720 spread over a period of five years on account of the extension of the scheme sanctioned for studying soil problems in Bengal. (Appendix XXXVIII.)*

*Application from the Government of Bombay for a grant of Rs. 21,672 spread over a period of four years for a scheme to investigate the changes in the microflora of kalar soils in Sind. (Appendix XXXIX.)*

*Application from the Government of Mysore for a grant of Rs. 10,000 spread over three years for a scheme of study of the colloids in tropical soils at the Chemistry Department, Central College, Bangalore, by Dr. B. Sanjiva Rao. (Appendix XL.)*

*Application from the Government of Bihar and Orissa for a grant of Rs. 13,708 spread over a period of three years for a scheme for the determination of nutrient content in Indian soils. (Appendix XLI.)*

*Sanction for the purchase of apparatus required for the scheme for investigation on the physico-chemical properties of the clay fraction of lateritic soils and of the Dacca mixed soils and the nutrition of the rice plant out of the grant already sanctioned by the Council. (Appendix XLII.)*

[Subject Nos. 28(a), (b), & (c), 29, 32, 33, 34 & 35 of the Agenda.]

The Committee's report (Appendix XXXIV) was adopted after the technical items had been explained by Drs. Ghosh and Mackenzie-Taylor, Professor Mukherjee and Rao Bahadur Tamhane.

19. *Progress Reports on Veterinary Research Schemes sanctioned by the Imperial Council of Agricultural Research:—*

(i) *Annual Report on the work of the Veterinary Investigation Officer, Bombay, for 1934-35.*

(ii) *Annual Report on the work of the Veterinary Investigation Officer, Bombay, for 1934-35.*

(iii) *Annual Report on the work of the Veterinary Investigation Officer, Bengal, for 1934-35.*

(iv) *Annual Report on the work of the Veterinary Investigation Officer, United Provinces, for 1934-35.*

(v) *Annual Report on the work of the Veterinary Investigation Officer, Punjab, for 1934-35.*

(vi) *Annual Report on the work of the Veterinary Investigation Officer, Bihar and Orissa, for 1934-35.*

(vii) *Annual Report on the work of the Veterinary Investigation Officer, Central Provinces, for 1934-35.*

(viii) *Annual Report on the work of the Veterinary Investigation Officer, Assam, for 1934-35.*

(ix) *Annual Report on the work of the Veterinary Investigation Officer, Hyderabad, for 1934-35.*

Not  
printed.

(Subject No. 7 of the Agenda.) (Appendix XLIII.)

*Application from the University of Madras for a grant of Rs. 21,300 for a scheme of enquiry into helminthiasis of cattle in the Madras Presidency spread over a period of five years. (Subject No. 39 of the Agenda.) (Appendix XLIV.)*

The report of the Committee (Appendix XXXIII) was adopted.

20. *Report of the Dry-Farming Research Schemes Co-ordination Committee on:—*

(a) *Progress Report of the Madras Dry Farming Research Scheme for the year 1934-35. (Not printed.) [Subject 36 (a) of agenda.]*

(b) *Progress Report on the Bombay Dry Farming Research Scheme for the period October 1933 to March 1935. (Not printed.) [Subject No. 36 of the Agenda.]*

Dr. Shaw said that the report on this scheme (not printed) was a very excellent one. It was the first report of the scheme and dealt chiefly with the lay-out and the soil conditions of two very dissimilar stations, it was naturally somewhat lengthy. The Committee had made various recommendations with regard to the lay-out and conduct of certain experiments. For instance, experiments on bunding and mulching should be randomised and that in physical and chemical experiments the methods employed should be indicated and the average results of replications given with plus and minus determinations. With regard to the bulk of the report, the Committee recommended that in the case of field experiments, the original data, the lay-out and the result should be given but that it was not necessary in every case to give full details of the analysis of variance.

The report (Appendix XLV) was adopted.

21. *Application from the Government of Cochin for a grant of Rs. 40,580 spread over a period of five years for a scheme of investigation of the coconut leaf disease in the Cochin State.*

*Application from the Government of Madras for a grant of Rs. 74,705 spread over a period of five years for a scheme of research work on coconuts in the Madras Presidency. (Subject Nos. 24 and 25 of the Agenda.) (Appendix XLVI & XLVII.)*

Dr. Shaw said that the Committee had considered the application from the Government of Cochin (Appendix XLVIII) and came to the conclusion that in view of the fact that at the previous meeting a scheme of coconut diseases for Travancore had been approved, it was unnecessary to duplicate the work. The Committee therefore suggested that the investigation on this coconut disease should be carried out in the laboratories to be set up in Travancore, that to deal with the increased work an Assistant be appointed and that a slightly increased provision be made for travelling allowance, i.e., Rs. 500 to meet the cost of touring in Cochin.

(Subject No. 25).—Dr. Shaw said that the Committee considered that the coconut problem was one of all-India importance as it affected the provinces of Madras and Bombay and the states of Cochin and Travancore. The scheme of investigations proposed by the Madras Government was of a practical nature and likely to yield results of economic importance. The Madras Government had already incurred a capital expenditure of about one lakh of rupees and were incurring a recurring expenditure of about Rs. 24,000 a year in the maintenance of four stations on the West Coast for the study of coconut problems. The Committee approved of the scheme and recommended it to the Board but had made the reductions in cost which were indicated in the Committee's report, (Appendix XLVIII). These were largely due to the fact that the Madras Government in putting up the scheme had made their demands for salaries on the calculation of the average pay of the post based on apparently about 30 years service. This was unnecessary as the scheme was for five years and in most cases the men appointed to the posts would begin at the bottom of their respective scales of pay. The Committee had deleted a sum of Rs. 2,600/- from the travelling allowance provision of Rs. 3,000/- in the first year. The proposal of Rs. 3,000 for travelling allowance in the first year had been made by the Madras Government to meet the travelling expenses of an officer who was to tour in Malaya and the Philippine Islands. As the Director of Agriculture, Madras, had explained that the officer whom it was proposed to send on tour was the Oilseeds Specialist, Madras, who was not employed under this scheme, the Committee considered that the inclusion of this proposal in the scheme was improper and that if it was desired to send the Oilseeds Specialist on tour outside India, a separate proposal should be made.

The Report of the Committee (Appendix XLVIII) was adopted.

22. The meeting then adjourned till 10 A.M., on Saturday, the 15th February, 1936.

N. C. MEHTA,  
Secretary.

PROCEEDINGS OF THE MEETING OF THE ADVISORY BOARD  
OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH  
HELD AT NEW DELHI ON SATURDAY, THE 15TH FEBRUARY  
1936.

The following were present :—

1. SIR BRYCE BURT, *Chairman*.
2. MR. R. G. ALLAN.
3. RAO BAHADUR D. ANANDA RAO.
4. DR. B. K. BADAMI.
5. DR. W. BURNS.
6. MR. M. CARBERY.
7. MR. J. N. CHAKRAVARTY.
8. MR. J. CHARLTON.
9. DR. J. K. DUBBY.
10. SARDAR DATAR SINGH.
11. MR. T. J. EGAN.
12. MR. E. S. FARROTHER.
13. MR. S. GHOSE.
14. MR. W. J. JENKINS.
15. MR. P. J. KERR.
16. DR. V. N. LIKHITE.
17. MR. A. M. LIVINGSTONE.
18. MR. J. C. McDUGALL.
19. MR. MAHMUD HASAN KHAN.
20. MR. A. N. MONTIRO.
21. MR. A. M. MUSTAFA.
22. DR. NAZIR AHMAD.
23. MR. NIZAMUDDIN HYDER.
24. COLONEL A. OLVER.
25. MR. R. V. PILLAI.
26. MR. T. F. QUIRKE.
27. MAJOR P. B. RILEY.
28. MR. J. H. RITCHIE.
29. MR. P. T. SAUNDERS.
30. MR. S. M. A. SHAH.
31. DR. F. J. F. SHAW.
32. MR. G. T. TAIT.
33. RAO BAHADUR M. VAIDYANATHAN.
34. PROFESSOR C. N. VAKIL.
35. RAO BAHADUR B. VISVANATH.
36. MR. F. WARE.

MR. N. C. MEHTA, I.C.S., *Secretary*.

*List of Visitors.*

1. KHAN BAHADUR MIAN M. AFZAL HUSAIN.
2. MAJOR W. M. AYKROYD.
3. MR. E. J. BRUEN,
4. MR. M. C. CHERIYAN.
5. MR. A. P. CLIFF.
6. MR. G. R. DUTT.
7. MR. L. D. GALLOWAY.
8. MR. INDU BHUSAN CHATTERJEE.
9. MR. P. V. ISAAC.
10. MR. H. C. JAVARAYA.
11. MR. D. N. KHURODY.
12. MR. Z. R. KOTHAWALA.
13. DR. P. E. LANDER.
14. PROFESSOR L. S. S. KUMAR.
15. DR. K. C. MEHTA.
16. MR. C. H. PARR.
17. MR. G. PFAFF.
18. DR. H. S. PRUTHI.
19. MR. K. RAMIAH.
20. MR. P. B. RICHARDS.
21. MR. C. B. SAMUEL.
22. MR. K. C. SEN.
23. MR. SUBRAMANIYA IYER.
24. MR. A. M. THOMSON.

2. The meeting commenced at 10 A.M. and adjourned at 12-15 to allow the holding of the Annual General Meeting of the Council. The meeting resumed at 12-45 P.M.

3. *Report (not printed) by Dr. B. P. Pal, Second Economic Botanist Imperial Institute of Agricultural Research on the scheme for breeding rust-resistant wheats (report circulated vide Memorandum No. F. 35-1/35-Agr., dated the 3rd October, 1935.) (Appendix XLIX.)*

*Progress report (not printed) for the year 1934-35 on the investigations on 'Cereal rusts' by Dr. K. C. Mehta, Agra College, Agra. [Subject No. 16(a) and (b) of the Agenda.] (Appendix L).*

Dr. Shaw in introducing the report of the Committee said that the scheme for the breeding of rust-resistant wheats commenced in April 1935 when an Assistant was posted to the rust research laboratory at Simla. The work was under the control of the Second Economic Botanist and 112 crosses had been made at Simla. This large number of crosses was made because at the time Dr. Mehta's experiments for determining parental resistance were not completed. These experiments had now been completed and those crosses of which the parents had shown satisfactory resistance would be used for continuing the work. Due attention would of course be paid not merely to the



quality of rust resistance but to the production of wheats with desirable economic qualities. Dr. Mehta explained the direction in which the scheme for investigating cereal rusts had progressed during the last year and drew attention to the progress made in the study of the location of foci of infection and the course of wind currents which served for the dissemination of infection. The report of the Committee (Appendix L) was adopted by the Board.

4. *Application from the Government of Assam for a grant of Rs. 30,688 spread over a period of four years for mycological research on potatoes. (Subject No. 17 of the Agenda.) (Appendix LI.)*

Dr. Shaw said that the Committee were unable to recommend the scheme as they considered that potato diseases should be investigated by the Imperial Mycologist in collaboration with the Imperial Economic Botanist who is in charge of the Council's potato breeding scheme. Mr. Chakrabarti accepted the report (Appendix L) which was then adopted.

5. *Report on:—(a) the preliminary potato breeding experiments on the hills; and (b) the non-recurring grant for the hills portion of the potato breeding scheme for Northern India. (Subject No. 18 of the Agenda.) (Appendix LII.)*

On the motion of Dr. Shaw the report on the co-operative trials (not printed) was adopted. It was explained that the Committee came to the conclusion that Simla was the best place for the proposed potato breeding sub-station. As regards the cost of buildings Dr. Shaw asked the Board to consider whether or not the Government of India should be asked to meet this charge in view of the fact that the scheme was under the administrative control of the Director, Imperial Institute of Agricultural Research. On the other hand the scheme had been initiated by the Imperial Council of Agricultural Research and in that sense there was a case for the expenditure falling on the Imperial Council of Agricultural Research.

Mr. Kerr was of the view that the cost of the buildings should be borne by the Government of India.

The Vice-Chairman stated that this was a scheme initiated by the Imperial Council itself. In the circumstances the Board might adopt the report of the Committee (Appendix L) with a proviso that the Government of India should be requested to meet the cost of the buildings, if possible. This was accepted by the Board.

6. *Application from the Government of Bombay for a grant of Rs. 49,360 spread over 5 years for a scheme of investigation into the attack on Jowar by the parasite Striga by the Economic Botanist to the Government of Bombay.*

*Application from the Government of Bombay for a grant of Rs. 37,510 spread over five years for a scheme for the investigation of the attack on tobacco by the phanerogamic parasite Orobanche. (Subject Nos. 20 and 21 of the Agenda.) (Appendices LIII and LIV.)*

Dr. Shaw presented the report of the Committee (Appendix LV) and explained that very considerable progress had been made in the study of Striga in South Africa. In view of the progress which had been made in South Africa, it was possible to modify considerably the scheme proposed

by the Bombay Government in order that work should be intensified in those directions in which information from South Africa was lacking and which promised to give economic results in India. The Committee therefore recommended that work should be carried out as outlined in the scheme in the sections physiological, histological and breeding. The Committee considered that the most promising line of work was in the breeding and production of resistant types of Sorghum and considered that special prominence should be given to this subject in the scheme. In the light of the changes recommended by the Committee in the scheme, the estimates had been revised as shown in the report of the Committee and the total expenditure reduced from Rs. 49,360 to Rs. 27,060.

As regards the *Orobancha* scheme, the Committee considered that the proposal for this work was not of such urgency and importance as the proposal for the investigation on Striga and that it would be advisable to see what progress was made with the Striga investigation before embarking upon a precisely similar scheme with another crop.

Dr. Burns accepted the report of the Committee, (Appendix LV) and the report was adopted by the Board.

The Board then considered whether the Local Government should be asked to meet a share of the cost and if so what should be the proportion. In answer to a question the Vice-Chairman said that he thought the term 'share of the cost' should be taken to mean share of the new expenditure required. Dr. Shaw proposed 50 per cent. Mr. Allan felt that this was a scheme of all-India importance and almost every provincial and State Department of Agriculture would benefit from the results of the scheme. If a provincial contribution was necessary at all, it should not be more than 20 per cent. Rao Bahadur Ananda Rao and Mr. Nizamuddin Hyder were of the opinion that no contribution need be insisted on in the present case.

On being put to vote, 15 voted in favour of 20 per cent contribution by the Government of Bombay, two for 50 per cent, and three against any contribution. In the result the report of the committee was adopted with the recommendation that the Government of Bombay should meet 20 per cent. of the cost of the scheme.

*7. Application from the Government of the Punjab for a grant of Rs. 29,286 spread over a period of five years for a scheme for the study of the effects of phosphatic manuring on grass land in an area of low rainfall. (Subject No. 31 of the Agenda.) (Appendix LVI.)*

Colonel Olver in introducing the report of the Animal Nutrition Committee (Appendix LVII) drew attention to the fact that the Committee had recommended a grant of Rs. 35,000 instead of Rs. 29,000 asked for by the Government of the Punjab. This was done because it was considered that a second chemist would be needed from the start in order to carry out the large numbers of analyses which would be required under the scheme. He considered that work of this nature was very much needed in relation to the better utilisation of forest grazing areas in many parts of India.

Mr. Quirke said that this scheme was of very important application to the Punjab and also to other provinces. It particularly benefited the poorer type of people.

Mr. Charlton asked what was the yield per acre of hay in the table given on page 4 of Mr. Read's detailed scheme. This yield could not be stated.

Mr. Jenkins was doubtful whether the results obtained could be put to any practical use in other provinces. In any case the scheme was not of great practical importance and the results would not be of much benefit to general cultivators.

The Vice-Chairman pointed out the importance of cattle breeding in such *barani* tracts which constituted a great reservoir of bullock power for the intensely cultivated irrigated areas. In such tracts grazing was of economic importance.

Mr. Allan was also of the view that practical results from the scheme were likely to be remote. Dr. Burns considered that it was well worth while to undertake this piece of research and that Hissar was a very suitable place for carrying it out. He considered that there would be great possibilities of improving grazing areas along the lines proposed in the scheme.

In regard to the amount of the provincial contribution to the scheme Mr. Quirke suggested 20 per cent. and Dr. Badami supported this. Dr. Shaw proposed 50 per cent. On being put to the vote 16 members voted for a 50 per cent. contribution and 12 for 20 per cent. The scheme was accordingly approved with the recommendation that the Local Government would meet 50 per cent. of the cost.

*8. Annual reports (not printed) for the years 1931-32, 1932-33, 1933-34 and 1934-35 on the scheme for the appointment of a Physiological Chemist to study animal nutrition problems at Dacca. (Subject No. 14 of the Agenda.) (Appendix LVIII).*

*Proposal for the extension of the Bengal Animal Nutrition Scheme, for a further period of 5 years from January 1937, (total cost of scheme Rs. 99,276). [Item Nos. 14 and 15 of the Agenda.] (Appendix LIX.)*

Col. Olver introduced the proposal and stated that the Animal Nutrition Committee had agreed (Appendix LVII) that the work originally proposed at Dacca was valuable and should be carried to a conclusion. It had however extended to some extent beyond its original purpose into problems of method. It was considered that these should be further investigated but that work of this nature should generally be done at a Central Nutrition Research Institute. After discussing the proposed programme of work it was recommended that work should be confined to items 1 and 4, as shown on pages 6 and 7 of the printed scheme, and as much of item 3 as was necessary to obtain a complete picture. In carrying out this work the new method would be incidentally tested. As regards expenditure it was agreed that the Assistant Physiological Chemist's pay should be fixed at a flat rate of Rs. 200 a month and that in view of the restricted scale of the work the second Physiological Assistant, the Junior Assistant and the two stall watchmen could be deleted. It was also agreed that the scale of pay of the Physiological Chemist should be continued as at present and that he should not be given the enhanced scale. Consequently provision for travelling expenses could be reduced to Rs. 1,000 a year, for chemicals and apparatus to Rs. 800 a year for contingencies to Rs. 600 a year and for books and periodicals to Rs. 500 in the first year and

Rs. 200 in subsequent years. He mentioned that the Committee considered it very important that work of this nature should be carried on in eastern India. Messrs. Carbery and Ware and Dr. Aykroyd spoke in favour of the proposal and Mr. Kerr moved that the sum of Rs. 24,000, offered as the Local Government's contribution, should be accepted in this case as the work would be of value to a large portion of India outside the Bengal Province. This was agreed to and the recommendations of the Committee (Appendix LVII) were accepted.

9. Report of the Committee of Entomologists on:—

(i) Sugarcane insect pests scheme. (Appendices LX to LXII.)

(ii) Occurrence of Codling Moth in the Quetta Valley. (Appendix LXIII). (Item No. 37 of the Agenda).

Dr. Shaw said that the committee considered the scheme (Appendix LXIV) and a note by Mr. Isaac (Appendix LXII). The most important point was his proposal to have a sub-station at Poona. The committee decided that there was no need to embark on this sub-station at Poona immediately, as it was desirable to wait and see the results of the main investigations for a period of two or three years. The committee considered the question of collaboration between the proposed central scheme and the research workers in the provinces, and came to the conclusion that the work in the provinces was essential to the success of the scheme. The committee therefore recommended that Local Governments should be requested to create posts of regional entomologists to work on borers and Pyrilla.

Mr. Richards drew attention to the resolution of the sub-committee on page 2 of the report and said that the restriction on the activities of the regional entomologists should be removed. "Disease resistance" should read as "pest resistance".

These two amendments were accepted.

Mr. Richards felt that the wording of the resolution regarding increase in the entomological staff in the provinces should be stronger. After discussion Mr. Sethi moved the following resolution:—

"In the opinion of this Board, it is essential to the success of this scheme that regional field entomological staff as contemplated in the recommendations of the entomological committee of 1933 be provided by provincial governments concerned for carrying out work on the lines indicated in this report."

Dr. Shaw seconded this resolution which was adopted.

Mr. Afzal Hussain pointed out that the words "composition of the soil" under item 5 of the lines of work should read as "soil conditions". This was accepted. In regard to the report of the Committee on the question of ratooning. Mr. Allan observed that what the Committee decided was "that second and third ratoons are not more deleterious from entomological point of view than first ratoons". This amendment was accepted.

In view of the need for a further discussion of details the report of the committee on Subject No. 37 (i) (Appendix LXIV) was not adopted. Sir Bryce Burt then requested the entomological schemes committee, to meet him that afternoon at 5-30 P.M. to consider the technical programmes of work. (The report of the meeting is at Appendix LXIV-A.).

*Report of the Committee of Entomologists on—Occurrence of Codling moth in the Quetta Valley. [Subject No. 37 (ii) of the Agenda]. (Appendices LXIII and LXIV).*

Dr. Shaw introduced the report of the committee. Dr. Pruthi said that survey work should be undertaken in the United Provinces orchards also. This might be added to the Baluchistan scheme.

Mr. Richards said that so far as the United Provinces were concerned he had not heard about the occurrence of this pest. Likely places of the occurrence of this pest were the orchards in and round about Naini Tal. No information about this pest in India was available and it was essential to obtain it. There was however no need to have staff throughout the year as the pest could appear only during the fruiting period which was from the middle of July to the middle of November. He recommended that instead of two assistants throughout the year it would be useful to sanction 4 assistants for a period of 6 months. This was accepted by the Board.

Mr. Mustafa said that in Baluchistan they had been carrying on a survey for the last two and a half years and that before the scheme was started the Imperial Entomologist might be requested to pay a visit to Baluchistan in May to chalk out a programme of work. He had information of value to give him.

This request was noted.

The report of the committee (Appendix LXIV) was then adopted. The Board recommended that the Government of India need not be asked to meet a share of the cost of the scheme.

10. *Scheme for work on the biological standardisation of insecticides and fumigants in India received from the Director, Imperial Institute of Agricultural Research (Estimated cost Rs. 15,770 spread over three years) —(Item No. 38 of the Agenda). (Appendix LXV).*

Dr. Shaw said that the committee considered that in drawing up this scheme, sufficient attention had not been paid to work done in other countries and recommended that the Imperial Entomologist should correspond with workers abroad and particularly at Rothamsted and the Stored Products Research Laboratory and communicate such information as is obtained together with the scheme revised if necessary to the July meeting of the Board.

11. *Progress report of the scheme regarding the insecticidal investigation of plant fish poisons and other forest products in Mysore during January to December 1935. (Item No. 44 of the Agenda). (Appendix LXVI).*

Dr. Shaw said that the report of the Committee (Appendix LXIV) was far too brief to enable an opinion to be given on the value of the work. As the final report of the scheme will be submitted next year, the committee hoped that it would be sufficiently detailed to enable them to express an opinion then.

Dr. T. V. Subramaniam, Entomologist to the Government of Mysore, explained that they had worked on the toxic properties of about twenty-four plants, that they had come to know that the keeping qualities of these extracts were not the same in all cases and that some deteriorated after two or three days. They tried these insecticides with soap-water and

with molasses. Molasses was found to be the best wetting agent and the properties of the insecticide were preserved for over two months.

The report of the committee was then adopted.

12. *Scheme for research in Economic Ornithology at a cost of Rs. 41,075 spread over a period of five years submitted by Mr. Salim Ali through the Government of Bombay. (Item No. 5 of the Agenda). (Appendix VIII).*

Dr. Shaw said that as many members of the Entomological Committee had only reached Delhi on the day of the meeting and had only received the scheme at the meeting, the committee had not been able to give sufficient examination to the scheme to express an opinion. It was decided that the matter should be discussed again at the meeting of the Entomologists Committee that afternoon and the scheme brought before the next meeting of the Board. If necessary an *ad hoc* Committee would then be appointed.

13. (a) *Annual report of the Agricultural Marketing Adviser to the Government of India for the Calender year 1935. (Appendix LXVIII).*

(b) *Note by Mr. R. G. Allan regarding rate of progress of market surveys and adequacy of funds and staff. (Subject No. 46 of the Agenda). (Appendix LXIX).*

Mr. Mehta who presided over the Sub-Committee which considered the Annual Report of the Marketing Scheme, introduced the Sub-Committee's report. (Appendix LXX).

Mr. Livingstone explained that it was essential to have the statistics of imports and exports of important commodities from and to important centres in a province. A certain number of provincial reports had not arrived, and after the committee had met four provincial reports were received two of which were complete and two were not complete, and that he was examining the reports received.

Dr. Burns pointed out the difficulties in obtaining information from provincial centres and said that the material collected was inadequate. Recommendations (i) and (iii) of the committee were carried. As regards recommendation (ii) Mr. McDougall pointed out the inadequacy of the staff for the collection of statistics and he said that that the central marketing staff should ask the Railway Board to arrange for special facilities for the collection of import and export statistics. He also suggested that the information which was not available to the provincial staff might be obtained by the Central Staff from Headquarters.

Mr. Livingstone said that statistics for one station was not sufficient as due to various reasons the course of the trade varied from place to place and from season to season. The average for one season would be misleading and it was for that reason that he suggested the collection of figures for five years. As regards the prices of commodities it was only the Provincial staff that could supply the figures. Mr. Tait remarked that as result of conversations with two or three Agents of the Railways he got the idea that there was lack of co-operation between the marketing staff and the railway staff. The Agents were prepared to give every possible assistance in the collection of statistics from the stations as it was also to their interest to know the movement of goods.

Mr. Bruen said that he differed from the views put forward by several speakers as his experience was to the contrary. He explained that his staff had to go to stations to collect statistics. The Railway authorities gave them facilities but the information required for the marketing surveys was not compiled at Railway Headquarters and had to be abstracted from station records. Mr. Livingstone remarked that in Madras they had a system of card index at headquarters from which the provincial marketing officers could obtain information in regard to the movement of important commodities from different stations. Mr. Tait said that the Bengal Nagpur Railway had got a very good system of collecting this sort of information and by referring to their headquarters much of the information required could be obtained. He also suggested that when the Agents or the Traffic Managers (Commercial) came to Delhi in March Mr. Livingstone should arrange for an informal meeting with them. Mr. Bruen said that in the Bombay Presidency they were dealing with every commodity in every district. He suggested that if they had to do justice to this work some more staff would be required. He suggested that four more men should be appointed on a pay of Rs. 100 each per month. Mr. Tait said that the information regarding certain commodities was probably available and if the Board wanted any information on certain commodities which was not maintained by the railways now, the Railways would be prepared to keep accounts of them also.

Recommendation No. 2 was carried.

Mr. Livingstone said that by April most of the reports of provincial marketing officers would be received and that these reports would be placed before a conference of Provincial Marketing Officers which would be convened shortly after for formulating recommendations.

Sardar Datar Singh said that the questionnaire received by him from the Punjab Provincial Marketing Officer regarding dairy and its products contained about 80 questions which would fully engage one of his clerks to compile. He therefore suggested that the questionnaire should be simplified.

Recommendation No. 4 was adopted.

Mr. Livingstone explained that due to difficulties of communications in Assam, the Government had applied for an additional grant for more staff. It was proposed to defer the application for the next meeting of the Advisory Board.

Mr. Vakil pointed out the importance of having a complete survey instead of an incomplete one inasmuch as the Government of India were spending about Rs. 20 lakhs. He suggested that the conference shortly to be called for should go into the question of simplifying the method of the survey.

Sir Bryce Burt explained the genesis of the marketing scheme. The present scheme had been worked out in the knowledge that only a definite sum was available. He said that he saw no hope of getting further grants for this purpose until some results were forthcoming. The Government of India had already contributed Rs. 10 lakhs to the Provincial portion of the scheme and it was premature to ask for more. The marketing surveys should be completed within the present allotment by putting down the list of commodities to be surveyed if necessary.

Mr. McDougall enquired if it would be permissible to employ more men on lower salaries within the allotted amount. Sir Bryce Burt replied that as this involved a question of efficiency he could not give a general answer.

Recommendation No. 5 was adopted.

*Report on the working of Johne's disease investigation among cattle in Mysore, under the Imperial Council funds for the period ending November 1935. (Subject No. 53 of the Agenda). (Appendix LXXII).*

The Chairman said that the progress report would be considered at the next meeting of the Board.

Dr. Burns moved a vote of thanks to the Chair which was seconded by Mr. Kerr.

The meeting of the Advisory Board then concluded.

N. C. MEHTA,  
*Secretary.*

NEW DELHI,



## APPENDIX I.

**Note by the Secretary, Imperial Council of Agricultural Research, on Subject No. 1: Decisions of the Governing Body on the recommendations of the Advisory Board made at the latter's meetings held in February and July 1935.**

## I.—February, 1935. Meeting.

1. Recommendations of the Locust Committee at its sixth meeting held in January 1935. Proposals for continuance and future programme of work.

Sanctioned.

2. Revival of Dr. Uppal's scheme of investigations into the virus diseases of plants originally sanctioned by the Council, with certain modifications introduced by Dr. Uppal as a result of his deputation abroad.

Sanctioned.

3. Application from the Government of Bombay for a grant of Rs. 29,070 spread over three years for a scheme of research in Apiculture by Mr. C. J. George, Professor of Botany, Wilson College, Bombay.

The recommendation of the Advisory Board to refer the scheme back to the Bombay Government was accepted.

4. Application from the Government of Baroda for a grant of Rs. 16,900 spread over five years for a scheme of research on bee-keeping for Gujerat.

The recommendation of the Advisory Board to refer the scheme back to the Government of Baroda was accepted.

5. Application from the Government of Bombay for a grant of Rs. 1,22,310 spread over a period of ten years for research in goat breeding in the Bombay Presidency.

Sanctioned.

6. Application from the Government of Bombay for a scheme of research in Poultry Husbandry to be conducted in the Bombay Presidency at a cost not exceeding Rs. 61,033 (Rs. 22,023 non-recurring and Rs. 39,030 recurring) spread over a period of 5 years.

Sanctioned, subject to the proviso that the Council's liability should not exceed Rs. 40,000.

7. Application from the Government of the United Provinces for a grant of Rs. 10,000 spread over three years for undertaking cotton seed crushing and supply of decorticated cake for educative propaganda.

Sanctioned.

8. Application from the Government of the Central Provinces for a grant of Rs. 19,500 spread over a period of five years for a scheme of research work on *pan* cultivation.

Approved.

9. Scheme of research on sunn hemp manufactures in Bombay.

The recommendation of the Advisory Board that the scheme be rejected was approved.

10. Application from the Government of Baroda for a grant of Rs. 12,000 spread over a period of three years for a scheme for research on (i) the preservation of *mahura* flowers, and (ii) the manurial value of spent flowers.

The recommendation of the Advisory Board that the scheme be rejected was accepted.

11. Central Tobacco Research Station at Guntur in the Madras Presidency.

Approved.

12. Appeal for an endowment Fund for a Central Library for animal diseases from the Royal College of Veterinary Surgeons.

The amount of £100 recommended by the Advisory Board was reduced to £50.

13. Application by the University of Edinburgh for a grant towards the cost of courses of instruction for the Diploma in Tropical Veterinary Medicine.

As recommended by the Advisory Board, a grant of £100 for 1935-36 was sanctioned.

14. Application from Mr. J. J. De Valois of the Agricultural Institute, Katpadi, for a scheme of research on goat breeding at a cost not exceeding Rs. 84,172 (Rs. 5,480 non-recurring and Rs. 78,692 recurring) spread over a period of ten years.

Sanctioned.

15. Application from the United Provinces Poultry Association for a grant for research into the preservation and handling of eggs and poultry prior to their disposal in the market at a cost not exceeding Rs. 32,570 (Rs. 5,784 non-recurring and Rs. 26,786 recurring) spread over a period of three years.

Postponed as suggested by the Advisory Board.

16. Proposal for the continuance of statistical section for five years from the 1st December 1935 (with special reference to the Advisory

Board's previous recommendations regarding the planning and interpretation of field experiments).

Sanctioned.

17. Proposal for the appointment of a Disease Investigation Officer for Sind and Ajmer Merwara.

Sanctioned.

## II.—July, 1935, Meeting.

1. Continuance of the locust research scheme for the study of the biology and bionomics of the locust conducted at Lyallpur for a period of three years from April 1936 at a cost of Rs. 6,200 a year.

Sanctioned.

2. Application from the Government of Bengal for a grant of Rs. 11,800 spread over five years for the continuance of the Sugarcane Seedling Testing Station at Dacca.

Sanctioned.

3. Application from the Government of the United Provinces for a grant of Rs. 9,924 spread over a period of five years for the continuance of the study of sugarcane seedlings at Shahjahanpur.

Sanctioned.

4. Proposal for the continuation of the Karnal Sugarcane Sub-station.

Sanctioned.

5. Application from the Government of Bengal for a grant of Rs. 4,290 spread over two years for a scheme for improving the quality of sugar produced in small open-pan factories by the Department of Agriculture, Bengal.

Rejected, as recommended by the Advisory Board.

6. Application from the Government of Bombay for a grant of Rs. 8,206 spread over three years for an investigation into the manufacture of white sugar and molasses from *Gul* by the Open Pan Process on Poona Furnace.

Rejected, as recommended by the Advisory Board.

7. Application from the Government of Baroda for a grant of Rs. 20,000 spread over five years for an investigation of suitable types of canes for Gujerat.

Sanctioned.

8. Proposal for a Bureau for Sugar Standards under the Sugar Technologist.

Accepted.

9. *Insect Pests of Sugar Cane*.—Application from the Director, Imperial Institute of Agricultural Research, for a grant of Rs. 1,49,366 spread over a period of five years for a scheme of work in accordance with the Sugar Committee's recommendations.

Accepted.

10. Participation of India in the Sixth World Poultry Congress, Berlin. July—August 1936.

Approved.

11. Application from Mr. H. C. Verma, Supervisor, Imperial Institute of Animal Husbandry and Dairying (now on leave in England) for a grant of a scholarship not exceeding Rs. 1,500 to enable him to make a special study of national marketing of milk and dairy products, and of factory methods of manufacture of the condensed and evaporated milk and cream, dried milk, casein, etc., in Great Britain and Ireland and on the Continent of Europe.

Sanctioned.

12. (a) Application from the National Institute of Sciences of India for a recurring or non-recurring grant from the funds of the Imperial Council of Agricultural Research in aid of its work.

(b) Application from the Indian Academy of Sciences for a recurring grant from the funds of the Imperial Council of Agricultural Research in aid of its work.

The recommendation of the Advisory Board for an annual grant of Rs. 1,000 for 5 years was modified and an annual grant of Rs. 500 for 3 years was sanctioned.

13. Application from the Government of Bengal for a grant of Rs. 6,200 spread over three years for a scheme for the cultivation of edible mushrooms in fields by Dr. S. R. Bose, Professor of Botany, Carmichael Medical College, Calcutta.

The scheme was rejected, as recommended by the Advisory Board.

14. Application from the Government of Bombay for a grant of Rs. 87,240 spread over a period of five years for a scheme for combating of the Koleroga disease of betel nuts.

The scheme was rejected, as recommended by the Advisory Board.

15. Application from the Government of Bengal for a grant of Rs. 5,000 spread over a period of five years for a scheme for investigation into the method of extraction of flax fibre.

Approved.

16. Application from the Government of Bombay for a grant of Rs. 6,000 spread over three years for a scheme of investigations of problems of sunn-hemp cultivation.

The scheme for a modified grant of Rs. 3,860 recommended by the Advisory Board, was approved.

17. Application from the Government of Bombay for a scheme of research in Poultry Husbandry to be conducted in the Bombay Presidency at a cost not exceeding Rs. 61,053 spread over a period of five years.

Sanctioned.

18. Application from the United Provinces Poultry Association for a grant for research into the preservation and handling of eggs and poultry prior to their disposal in the market at a cost not exceeding Rs. 32,570 spread over a period of three years.

Postponed.

19. Application from the Government of the Punjab for a grant of Rs. 25,860 spread over a period of five years for a scheme of research in the improvement of poultry for table purposes in Northern India.

The recommendation of the Advisory Board that the scheme be sanctioned at a cost not exceeding Rs. 12,000, was accepted.

20. Application from the Government of the Central Provinces for a grant of Rs. 61,400 spread over a period of five years for research on oil-seeds in the Central Provinces.

Approved.

21. Application from the Government of Bengal, for a grant of Rs. 63,880 spread over a period of five years for research on the linseed crop by the Department of Agriculture, Bengal.

Approved.

22. Application from the Government of the Punjab for a grant of Rs. 65,510 spread over a period of five years for a scheme for additional research on oil seed crops in the Punjab.

Approved.

23. Application from the Agricultural Institute associated with the Allahabad University, Allahabad, for a grant of Rs. 37,847 spread over five years to carry out a detailed study of the nutritive values of the proteins of the principal nitrogenous food crops grown and consumed in India by Dr. Burch H. Schneider.

Approved.

24. Scheme from the Government of Bihar and Orissa on the feeding of minerals to cattle in Bihar and Orissa at a cost of Rs. 73,540 spread over a period of five years.

Sanctioned.

25. Application from the Government of the United Provinces for a grant of Rs. 1,86,700 spread over five years for a scheme of practical research into the feeding of cattle at the Departmental farms.

Accepted.

26. Application from the Government of the United Provinces for a grant of Rs. 32,400 spread over a period of five years for a scheme of research into nitrogen loss from soils and nitrogen fixation in soils by Dr. N. R. Dhar, D.Sc., I.E.S., Head of the Department of Chemistry Allahabad University.

The scheme as revised by the Advisory Board for a grant of Rs. 9,360 for 3 years, was approved.

27. Application from the Government of the Punjab for a grant of Rs. 2,000 towards the cost of training of an Assistant of the Agriculture Department, Punjab, in Agriculture in America and other countries.

Sanctioned.

28. Application from the Benares Hindu University for a grant of Rs. 1,11,060 spread over five years for research in physiology of cane and wheat.

The scheme, as amended by the Advisory Board, which involved a grant of Rs. 65,520, was sanctioned.

29. Application from the Baluchistan Administration for a grant of Rs. 5,000 spread over a period of five years for a scheme for the vegetative propagation of root-stocks.

The recommendation of the Advisory Board, that the scheme be financed departmentally, was accepted.

30. Contribution by the Imperial Council of Agricultural Research to the Imperial Institute of Entomology from 1935-36 and onwards.

The recommendation of the Advisory Board for an annual grant of £350 per annum was modified and a grant of £200 per annum was sanctioned.

31. Application from the Government of the Punjab for a grant of Rs. 42,820 spread over a period of ten years for investigation of indigenous sheep breeding.

Sanctioned.

32. (a) Application from the Government of Bombay for a grant of Rs. 29,070 spread over three years for a scheme for research in apiculture by Mr. George, Professor of Biology, Wilson College, Bombay.

(b) Application from the Government of Baroda for a grant of Rs. 16,900 spread over five years for a scheme of research on bee-keeping for Gujerat.

(c) Application from the Government of Mysore for a grant of Rs. 57,540 (Rs. 10,160 non-recurring and Rs. 47,380 recurring) spread over a period of 5 years for research in apiculture.

The Advisory Board's proposal to refer the schemes back to the Governments concerned was approved.

**APPENDIX II.**

**Note by the Secretary, Imperial Council of Agricultural Research, dated January 1936, on Subject No. 2:—Appointment of Committees.**

There are a number of schemes, progress reports, etc., on the Agenda of the Advisory Board which, the Vice-Chairman to the Council considers, might with advantage be examined in the first instance by suitable standing Committees of the Council or *ad hoc* Committees. The attached statement (Annexure) furnishes information in regard to the personnel of the various Committees, the subjects that they will consider and the date, time and place of the meeting.



## ANNEXURE.

| Serial No. | Name of Committee.          | Personnel.  | Agenda.   | Date and time of meeting.  |
|------------|-----------------------------|---|---|----------------------------|
| 1          | Rice Research Subcommittee. | <p>1. The Vice-Chairman, Imperial Council of Agricultural Research, Chairman (<i>Ex-officio</i>).</p> <p>2. The Agricultural Expert, Imperial Council of Agricultural Research.</p> <p>3-7. The Directors of Agriculture, Hyderabad, Mysore, Baroda, Cochin and Travancore.</p> <p>8. The Paddy Specialist, Madras.</p> <p>9. The Crop Botanist, Bombay.</p> <p>10. The Economic Botanist, Bengal.</p> <p>11. The Economic Botanist (Rice), United Provinces.</p> <p>12. The Rice Research Officer, Barma.</p> <p>13. The Paddy Specialist, Bihar and Orissa.</p> <p>14. The Officer-in-Charge, Central Provinces Rice Research Scheme.</p> <p>15. The Economic Botanist, Assam.</p> <p>16. The Senior Marketing Officer (Rice), Mr. A. M. Thomson.</p> | <p>8. (a) Annual Report on the Rice Research Scheme in the Madras Presidency for the year 1934-35 [report circulated, <i>vide</i> Memorandum No. F. 196-(1)/35-Agri., dated the 2nd December 1935].</p> <p>(b) Annual Report on the Rice Research Scheme in Bengal for the year 1934-35 [report circulated, <i>vide</i> Memorandum No. F. 196-(1)/35-Agri., dated the 14th December 1935].</p> <p>(c) Annual Report on the Rice Research Scheme in the United Provinces for the year 1934-35 [report circulated, <i>vide</i> Memorandum No. F. 196-(1)/35-Agri., dated the 2nd December 1935].</p> <p>(d) Annual Report on the Rice Research Scheme in Barma for the year 1934-35 [report circulated, <i>vide</i> Memorandum No. F. 196-(1)/35-Agri., dated the 2nd December 1935].</p> <p>(e) Annual Report on the Rice Research Scheme in Bihar and</p> | 10th February 1936, 3 p.m. |

| Serial No. | Name of Committee.                   | Personnel.   | Agenda.   | Date and time of meeting.    |
|------------|--------------------------------------|--|---|------------------------------|
| 1          | Rice Research and Subcommittee.      | 17. The Statistician, Imperial Council of Agricultural Research.<br>The Secretary, Imperial Council of Agricultural Research, <i>(Ex-officio)</i> .  | Orissa for the year 1934-35 [report circulated, <i>vide</i> Memorandum No. F. 106-(1)/35-Agri., dated the 21st December 1935].<br>(f) Annual Report of the deep water paddy research farm, Habiganj, Assam, for the year 1934-35 [report circulated, <i>vide</i> Memorandum No. F. 196-(1)/35-Agri., dated the 2nd January 1936].<br>(g) Progress report on the scheme of research on quality in crops for the year ending 30th November 1935.<br>9. Application from the Government of the Punjab for a grant of Rs. 38,380 spread over a period of five years for a scheme for investigation of fungal diseases of the rice crop.<br>16. (a) Report by Dr. B. P. Pal, Second Economic Botanist, Imperial Institute of Agricultural Research, on the scheme for breeding rust resistant wheats (report circulated, <i>vide</i> Memorandum No. F. 35.1/35-Agri., dated the 3rd October 1935).<br>(b) Progress report for the year | 11th, February 1936, 10 A.M. |
| 2          | Wheat Breeding and Potato Committee. | 1. The Vice-Chairman, Imperial Council of Agricultural Research, Chairman ( <i>Ex-officio</i> ).<br>2. The Agricultural Expert, Imperial Council of Agricultural Research.<br>3. The Director of Agriculture, Madras.<br>4. The Director of Agriculture, Bombay.<br>5. The Director of Agriculture, Bengal.<br>6. The Director of Agriculture, United Provinces. |   |                              |

Committee to examine Schemes regarding attack on (a) Jowar by the parasite *striga*, and (b) tobacco by the phanerogamic parasite *Orobancha*.

7. The Director of Agriculture, Punjab.
8. The Director of Agriculture, Bihar and Orissa.
9. The Director of Agriculture, Central Provinces.
10. The Director of Agriculture, Assam.
11. The Director of Imperial Institute of Agricultural Research.
12. Dr. B. P. Pal, Second Imperial Economic Botanist, Imperial Institute of Agricultural Research.
13. Dr. K. C. Mehta, Professor of Botany, Agra College, Agra.
14. The Imperial Mycologist, Imperial Institute of Agricultural Research.
- The Secretary, Imperial Council of Agricultural Research, Secretary (*Ex-officio*).

1. The Vice-Chairman, Imperial Council of Agricultural Research, Chairman (*Ex-officio*).
2. The Agricultural Expert, Imperial Council of Agricultural Research.
3. The Director of Agriculture, Bombay.
4. The Director of Agriculture, Punjab.
5. Professor S. P. Agbarkar, Calcutta University.
6. Professor T. Ekambaram.
7. The Director of Agriculture, Madras.
8. The Director of Agriculture, Bihar.
9. Either Imperial Agriculturist or Offic. Imperial Economic Botanist. (Subject to the approval of the Government of India.)
10. Professor L. S. S. Kumar, Economic Botanist to Government, Bombay. (Subject to the approval of the Government of Bombay.)
- The Secretary, Imperial Council of Agricultural Research, Secretary (*Ex-officio*).

1934-35 on the investigations on "Cereals" by Dr. K. C. Mehta, Agra College, Agra.

17. Application from the Government of Assam for a grant of Rs. 30,688 spread over a period of four years for mycological research on potatoes.

18. Report on—

- (a) the preliminary potato breeding experiments on the hills; and
- (b) the non-recurring grant for the hills portion of the potato breeding scheme for Northern India.

20. Application from the Government of Bombay for a grant of Rs. 49,360 spread over 5 years for a scheme of investigation into the attack on Jowar by the parasite *striga* by the Economic Botanist to the Government of Bombay.

21. Application from the Government of Bombay for a grant of Rs. 37,510 spread over 5 years for a scheme for the investigation of the attack on tobacco by the phanerogamic parasite *Orobancha*.

| Serial No. | Name of Committee.                  | Personnel.   | Agenda.   | Date and time of meeting.  |
|------------|-------------------------------------|--|---|----------------------------|
| 4          | Fruits Subcommittee.                | <ol style="list-style-type: none"> <li>1. The Vice-Chairman, Imperial Council of Agricultural Research, Chairman (<i>Ex-officio</i>).</li> <li>2. The Agricultural Expert, Imperial Council of Agricultural Research.</li> <li>3. The Director of Agriculture, Madras.</li> <li>4. The Director of Agriculture, Bombay.</li> <li>5. The Director of Agriculture, Bengal.</li> <li>6. The Director of Agriculture, United Provinces.</li> <li>7. The Director of Agriculture, Punjab.</li> <li>8. The Director of Agriculture, Bihar and Orissa.</li> <li>9. The Director of Agriculture, Central Provinces.</li> <li>10. The Director of Agriculture, Assam.</li> <li>11. The Director of Agriculture, North-West Frontier Province.</li> <li>12. The Director of Agriculture, Hyderabad.</li> <li>13. The Director of Agriculture, Mysore.</li> <li>14. The Director of Agriculture, Baroda.</li> <li>15. The Chief Publicity Officer, Indian State Railways.</li> <li>16. The Agricultural Officer, Baluchistan.</li> <li>17. Mr. H. C. Javaraya, Senior Marketing Officer (Fruit).</li> <li>18. Professor S. P. Agharkar, Calcutta University.</li> </ol> <p>The Secretary, Imperial Council of Agricultural Research, Secretary (<i>Ex-officio</i>).</p> | <ol style="list-style-type: none"> <li>12. (a) A brief report of the Cold Storage trials on the Alphonso Mangos for the 1935 season (report circulated, <i>vide</i> Memorandum No. F. 52-II/35-Agri., dated the 6th December 1935).</li> <li>(b) Annual Report of the Hill Fruit Research Scheme in the United Provinces for the year 1934-35 (report circulated, <i>vide</i> Memorandum No. F. 52-(10)/35-Agri., dated the 30th November 1935).</li> <li>(c) Annual report of the Horticultural Research Station, Krishnagar, Bengal, for the year 1934-35 [report circulated, <i>vide</i> Memorandum No. F. 52-(10)/35-A., dated the 2nd January 1936].</li> <li>(d) Annual report of the Horticultural Research Station, United Provinces and Bihar and Orissa, Sabour, for the year 1934-35.</li> </ol> | 11th February 1936, 2 P.M. |
| 5          | Gokhale Institute Scheme Committee. | <ol style="list-style-type: none"> <li>1. The Vice-Chairman, Imperial Council of Agricultural Research, Chairman (<i>Ex-officio</i>).</li> <li>2. The Agricultural Expert, Imperial Council of</li> </ol>  | <ol style="list-style-type: none"> <li>13. Application from the Government of Bombay for a grant of Rs. 78,650 spread over a period of five years for a scheme for improvement of papaya breeding and cultural practices.</li> <li>27. Application from the Government of Bombay for a grant of Rs. 30,030 spread over a period of</li> </ol>   | 11th February 1936, 3 P.M. |

|  |  |                                    |
|--|--|------------------------------------|
| <p>Agricultural Research.</p> <ol style="list-style-type: none"> <li>3. The Agricultural Marketing Advisor to the Government of India.</li> <li>4. The Director of Agriculture, Bombay.</li> <li>5. The Director of Agriculture, United Provinces.</li> <li>6. The Director of Agriculture, Punjab.</li> <li>7. The Director of Agriculture, Central Provinces.</li> <li>8. Dr. L. K. Hyder.</li> <li>9. Professor C. N. Vakil.</li> <li>10. Professor D. R. Gadgil, Director, Gokhale Institute.</li> <li>11. Dr. B. D. Kapur, Chief Economist.</li> </ol> <p>The Secretary, Imperial Council of Agricultural Research, Imperial Council of Agricultural Research, Secretary (<i>Ex-officio</i>).</p> <ol style="list-style-type: none"> <li>1. The Vice-Chairman, Imperial Council of Agricultural Research, Chairman (<i>Ex-officio</i>).</li> <li>2. The Agricultural Expert, Imperial Council of Agricultural Research.</li> <li>3. The Deputy Director of Agriculture, III Circle, Bellary.</li> <li>4. The Soil Physicist, Coimbatore.</li> <li>5. The Superintendent, Hagari Farm, Hagari (Madras Presidency).</li> <li>6. The Director of Agriculture, Bombay Presidency, Poona.</li> <li>7. The Soil Physicist to Government, Bombay, Poona.</li> <li>8. The Deputy Director of Agriculture, Karnataka Division (Hyderabad-Deccan).</li> <li>9. The Agricultural Chemist, Hyderabad (Deccan).</li> <li>10. The Imperial Agricultural Chemist.</li> </ol> <p>The Secretary, Imperial Council of Agricultural Research, Secretary (<i>Ex-officio</i>).</p> | <p>two years for a scheme of research on agricultural economics by the Director, Gokhale Institute of Politics and Economics.</p>  | <p>12th February 1936, 10 A.M.</p> |
| <p><b>Dry Farming Schemes Commission</b></p>   | <p>(a) Progress Report of the Madras Dry Farming Research Scheme for the year 1934-35.</p> <p>(b) Progress Report on the Bombay Dry Farming Research Scheme for the period October 1933 to March 1935.</p> |                                    |

| Serial No. | Name of Committee.      | Personnel.   | Agenda.  | Date and time of meeting.      |
|------------|-------------------------|--|--|--------------------------------|
| 7          | Coconut Committee.      | <ol style="list-style-type: none"> <li>1. The Vice-Chairman, Imperial Council of Agricultural Research, Chairman (<i>Ex-officio</i>).</li> <li>2. Agricultural Expert, Imperial Council of Agricultural Research.</li> <li>3. Director of Agriculture, Madras.</li> <li>4. Director of Agriculture, Bombay.</li> <li>5. Director of Agriculture, Mysore.</li> <li>6. Director of Agriculture, Travancore.</li> <li>7. The Superintendent of Agriculture, Cochin.</li> <li>8. Professor T. Ekambaram.</li> <li>9. Imperial Mycologist.</li> </ol>   | <ol style="list-style-type: none"> <li>24. Application from the Government of Cochin for a grant of Rs. 10,580 spread over a period of five years for a scheme of investigation of the coconut leaf disease, in the Cochin State.</li> <li>25. Application from the Government of Madras for a grant of Rs. 74,705 spread over a period of five years for a scheme of research work on coconuts in the Madras Presidency.</li> </ol>   | 12th February 1936, 11-30 A.M. |
| 8          | Soil Science Committee. | <ol style="list-style-type: none"> <li>1. The Vice-Chairman, Imperial Council of Agricultural Research, Secretary (<i>Ex-officio</i>).</li> <li>2. The Vice-Chairman, Imperial Council of Agricultural Research, Chairman (<i>Ex-officio</i>).</li> <li>3. The Agricultural Expert, Imperial Council of Agricultural Research.</li> <li>4. Dr. J. K. Basu, Soil Physicist, Sugarcane Research Scheme, Bombay Division.</li> <li>5. Dr. E. Mackenzie Taylor, Director, Irrigation Research, Punjab.</li> <li>6. Mr. A. P. Clift, Deputy Director of Agriculture, North Bihar Range, Muzaffarpur.</li> <li>7. The Agricultural Chemist to the Government of the Central Provinces.</li> <li>8. Dr. P. G. Krishna, Agricultural Chemist, Hyderabad.</li> <li>9. Dr. J. C. Ghosh, Dacca University.</li> </ol> | <ol style="list-style-type: none"> <li>28. (a) Second progress report on the scheme for the study of soil problems by the Physical Assistant appointed on the staff of the Agricultural Chemist, Bengal, for the year 1933-34 (<i>vide</i> Memorandum No. F. 44-1/35-Agri., dated the 28th November 1935).</li> <li>(b) Report of the work done in the Agricultural Research Section of the Department of Chemistry, Dacca University, during the year 1934-35 [report circulated, <i>vide</i> Memorandum No. F. 37-(1)/35-A., dated the 30th November 1935].</li> </ol> | 12th February 1936, 2 P.M.     |

10. Professor J. N. Mukerjee, Calcutta University.
11. One irrigation representative from the Government of Bombay.
12. Rao Babadur V. A. Tamhane, Sind.
13. The Director of Agriculture, Punjab.
14. Dr. Nazir Ahmad.
15. Mr. P. H. Carpenter.
16. Mr. T. J. Mirchandani, Agricultural Chemist, Bihar and Orissa (visitor).  
The Secretary, Imperial Council of Agricultural Research, Secretary, (*Ex-officio*).
- (c) Annual report on the work done during 1934-35, on the schemes for research into the properties of colloid soil constituents by Professor J. N. Mukerjee of the Dacca University (report circulated, *vide* Memorandum No. F. 39-1/35-Agr., dated the 10th October 1935).
29. Application from the Government of Bengal for a grant of Rs. 27,720 spread over a period of five years on account of the extension of the scheme sanctioned for studying soil problems in Bengal.
31. Application from the Government of the Punjab for a grant of Rs. 29,286 spread over a period of five years for a scheme for the study of the effects of phosphatic manuring on grass land in an area of low rainfall.
32. Application from the Government of Bombay for a grant of Rs. 21,472 spread over a period of four years for a scheme to investigate the changes in the microflora of *Kallar* soils in Sind.
33. Application from the Government of Mysore for a grant of Rs. 10,000 spread over three years for a scheme of study of the colloids in tropical soils at the Chemistry Department, Central College, Bangalore, by Dr. B. Sanjiva Rao.

| Serial No. | Name of Committee.        | Personnel.  | Agenda.  | Date and time of meeting.  |
|------------|---------------------------|---|--|----------------------------|
| 9          | Entomologists' Committee. | <p>1. The Vice-Chairman, Imperial Council of Agricultural Research, Chairman, (<i>Ex-officio</i>),<br/> 2. The Agricultural Expert, Imperial Council of Agricultural Research.<br/> 3. The Director of Agriculture, Bombay.<br/> 4. The Director of Agriculture, Bengal.<br/> 5. The Director of Agriculture, Bihar and Orissa.<br/> 6. Dr. H. S. Prud'homme, Imperial Entomologist, Imperial Council of Agricultural Research.<br/> 7. Mr. P. V. Isac, 2nd Entomologist, Imperial Institute of Agricultural Research.<br/> 8. The Government Entomologist, Madras.</p> | <p>34. Application from the Government of Bihar and Orissa for a grant of Rs. 13,708 spread over a period of three years for a scheme for the determination of nutrient content in Indian soils.<br/> 35. Sanction for the purchase of apparatus required for the scheme for investigation on the physico-chemical properties of the clay fraction of laterite soils and of the <i>Dacca</i> mixed soils and the nutrition of the rice plant out of the grant already sanctioned by the Council.</p> | 13th February 1936, 2 P.M. |

(i) Sugarcane insect pest Scheme.  
(ii) Occurrence of Codling moth in the Quetta Valley.  
Scheme for work on the biological standardisation of insecticides and fungicides in India received from the Director, Imperial Institute of Agricultural Research (Estimated cost Rs. 15,770 spread over three years).



|   |   |  |
|---|---|--|
| <p>9. Mr. F. B. Richards, Entomologist to Government, United Provinces.</p> <p>10. Khan Bahadur M. Afzal Hussain, Entomologist to Government of the Punjab.</p> <p>11. Rai Sahib G. R. Dutt, Entomologist to Government, Central Provinces.</p> <p>12. The Government Entomologist, Mysore State. The Secretary, Imperial Council of Agricultural Research, Secretary, (<i>Ex-officio</i>).</p> | <p>10</p> <p>Cattle Breeding Committee.</p> | <ol style="list-style-type: none"> <li>1. The Vice-Chairman, Imperial Council of Agricultural Research.</li> <li>2. The Animal Husbandry Expert, Imperial Council of Agricultural Research.</li> <li>3. Mr. T. F. Quinke, Director of Veterinary Services, Punjab, Lahore.</li> <li>4. Captain C. E. McGuckin, Assistant Director, Military Dairies, Lahore Unit, Poona.</li> <li>5. Mr. E. J. Bruen, Livestock Expert, Bombay.</li> <li>6. Khan Sahib S. Dost Mohd. Khan, Proprietor, Jahangirabad Cattle Farm, District Montgomery.</li> <li>7. Mr. C. H. Parr, Deputy Director of Agriculture, Bundelkhand.</li> <li>8. Mr. Z. R. Kothavala, Imperial Dairy Expert.</li> <li>9. Major P. B. Riley, Director of Veterinary Services, Bihar and Orissa.</li> <li>10. Mr. Wynne Sayer, Imperial Institute of Agricultural Research, Pusa.</li> <li>11. Mr. T. J. Egan, Director, Civil Veterinary Department, United Provinces.</li> </ol> |
|   |   | <ol style="list-style-type: none"> <li>1. Application from the Government of Mysore for a grant of Rs. 1,39,145 spread over a period of 10 years for a scheme of research on Sheep Breeding (Subject No. 6 on the Agenda of the Advisory Board).</li> <li>2. Extension for a period of 5 years of the scheme for breeding experiments in connection with the improvement of goats in the United Provinces, conducted by Mr. A. E. Slater. (Subject No. 10 on the Agenda of the Advisory Board.)</li> <li>3. Application from the Government of Travancore for a grant for a scheme for improving the Cattle in the West Coast of India at a cost of Rs. 2,88,136 spread over a period of 10 years. (Subject No. 23 on the Agenda of the Advisory Board.)</li> </ol>  |
|   |   | <p>10th February 1936, 2-45 P.M. and 11th February 1936, 10-30 A.M.</p>  |

| Serial No. | Name of Committee.          | Personnel.  | Agenda.   | Date and time of meeting.     |
|------------|-----------------------------|---|---|-------------------------------|
| 11         | Animal Nutrition Committee. | <p>12. Mr. C. B. Samuel, Senior Marketing Officer, Delhi.</p> <p>13. Sardar Datar Singh, Montgomery.</p> <p>14. Rao Bahadur M. Vaidyanathan, Statistician, Imperial Council of Agricultural Research.</p> <p>15. Mr. K. P. R. Kartha, Statistical Assistant, Animal Husbandry Bureau, Imperial Council of Agricultural Research.</p> <p>The Secretary, Imperial Council of Agricultural Research, Secretary, (<i>Ex-officio</i>).</p> <p>1. The Vice-Chairman, Imperial Council of Agricultural Research.</p> <p>2. The Animal Husbandry Expert, Imperial Council of Agricultural Research.</p> <p>3. Mr. A. V. Iyer, Offg. Physiological Chemist, Bangalore.</p> <p>4. Dr. P. E. Lander, Agricultural Chemist, Punjab, Lyallpur.</p> | <p>4. Application from the Government of the Punjab for a lump-sum grant of Rs. 25,000 for sending an officer of the Punjab Veterinary Service (Class I) on deputation to South Africa to study the "Angora" goat breeding industry. (Subject No. 42 on the supplementary Agenda of the Advisory Board.)</p> <p>5. Application from the Government of the Punjab for investigation and research of indigenous goat breeding at Government Cattle Farm, Hissar, at a cost of Rs. 38,000. (Subject No. 43 on the supplementary Agenda of the Advisory Board.)</p> <p>6. Establishment of Pedigree Herd Books in India. (Subject No. 45 on the supplementary Agenda of the Advisory Board.)</p> <p>1. Annual reports for the years 1931-32, 1932-33, 1933-34 and 1934-35 on the scheme for the appointment of a Physiological Chemist to study animal nutrition problems at Dacca.</p> <p>2. Proposal for the extension of the Bengal Animal Nutrition</p> | 11th February 1936, 2-45 P.M. |

5. Dr. K. C. Sen, Bio-Chemist, Imperial Institute of Veterinary Research, Muktesar.
6. Rao Bahadur B. Viswanath, Offg. Director, Imperial Institute of Agricultural Research.
7. Mr. J. R. Haddow, Veterinary Research Officer, Imperial Institute of Veterinary Research, Muktesar.
8. Mr. Z. R. Kothavala, Imperial Dairy Expert, Bangalore.
9. Mr. F. Ware, Director, Imperial Institute of Veterinary Research, Muktesar.
10. Col. H. C. Dibben, Offg. Director of Veterinary Services, Army Headquarters.
11. Dr. W. R. Akroyd, Director, Nutrition Research, Indian Fund Association, Coonoor.
12. Mr. T. F. Quinke, Director of Veterinary Services, Punjab.
13. Mr. M. Carbery, Agricultural Chemist, Bengal Government, Dacca.
14. Mr. J. K. Duley, Director of Agriculture, Bhopal.
15. Mr. P. J. Kerr, Director of Veterinary Services, Bengal.
16. Mr. E. S. Farbrother, Director of Veterinary Services, Bombay.
- The Secretary, Imperial Council of Agricultural Research, Secretary, (*Ex-officio*).
- Scheme, for a further period of 5 years from January 1937, (total cost of scheme Rs. 99,276).
3. Application from the Government of the Punjab for a grant of Rs. 29,286 spread over a period of five years for a scheme for the study of the effects of phosphatic manuring on grass land in an area of low rainfall.

| Serial No. | Name of Committee.  | Personnel.   | Agenda.   | Date and time of meeting.      |
|------------|---|--|---|--------------------------------|
| 12         | Committee to consider Bombay scheme for control of ticks and reports of Veterinary Investigation Officers, etc. | <p>1. Vice-Chairman, Imperial Council of Agricultural Research,<br/> 2. The Animal Husbandry Expert, Imperial Council of Agricultural Research,<br/> 3. Mr. F. Ware, Director, Imperial Institute of Veterinary Research,<br/> 4 to 13. Directors of Veterinary Services in the Provinces.<br/> 14. Rao Bahadur M. Vaidyanatham, Statistician, Imperial Council of Agricultural Research.<br/> 15. Mr. R. N. Naik, Veterinary Investigation Officer, Bombay.<br/> 16. Mr. K. P. R. Kartha, Statistical Assistant, Animal Husbandry Bureau, Imperial Council of Agricultural Research,<br/> The Secretary, Imperial Council of Agricultural Research, Secretary, (<i>Ex-officio</i>).</p> | <p>1. Application from the Government of Bombay for a grant of Rs. 44,000 (Recurring Rs. 40,800) plus Non-recurring Rs. 3,200) to test the value of different methods of controlling or eradicating ticks in this country. (Subject No. 19 of the Agenda.)<br/> 2. Progress Reports on Veterinary Research Scheme sanctioned by the Imperial Council of Agricultural Research :—<br/> (i) Annual Report on the work of the Veterinary Investigation Officer, Madras, for 1934-35.<br/> (ii) Annual Report on the work of the Veterinary Investigation Officer, Bombay, for 1934-35.<br/> (iii) Annual Report on the work of the Veterinary Investigation Officer, Bengal, for 1934-35.<br/> (iv) Annual Report on the work of the Veterinary Investigation Officer, United Provinces, for 1934-35.<br/> (v) Annual Report on the work of the Veterinary Invest-</p> | 12th February 1936, 10-30 A.M. |

gation Officer, Punjab, for 1934-35.

(vi) Annual Report on the work of the Veterinary Investigation Officer, Bihar and Orissa, for 1934-35.

(vii) Annual Report on the work of the Veterinary Investigation Officer, Central Provinces, for 1934-35.

(viii) Annual Report on the work of the Veterinary Investigation Officer, Assam, for 1934-35.

(ix) Annual Report on the work of the Veterinary Investigation Officer, Hyderabad, for 1934-35.

(Subject No. 7 of the Agenda.)

3. Progress report of the scheme regarding the insecticidal investigation of plant fish poisons and other forest products in Mysore during January to December 1935. (Subject No. 44 of the Agenda.)

4. Application from the Director, Imperial Institute of Veterinary Research, Muktesar for a grant of Rs. 16,342 (Rs. 11,298 recurring and Rs. 5,044 non-recurring) spread over a period of 2 years and 8 months for a scheme for research on an anti-rabies vaccine for dogs. (Subject No. 41 of the Agenda.)

| Serial No. | Name of Committee.              | Personnel.   | Agenda.   | Date and time of meeting.      |
|------------|---------------------------------|--|---|--------------------------------|
| 13         | Marketing Scheme Sub-Committee. | <ol style="list-style-type: none"> <li>1. Vice-Chairman, Imperial Council of Agricultural Research.</li> <li>2. Agricultural Expert, Imperial Council of Agricultural Research.</li> <li>3. Animal Husbandry Expert, Imperial Council of Agricultural Research.</li> <li>4. Agricultural Marketing Adviser to the Government of India.</li> <li>5 to 14. All provincial Directors of Agriculture.</li> <li>15. Mr. E. J. Bruen, Live-Stock Expert to the Government of Bombay.</li> <li>16 to 18. 3 Senior Marketing Officers.</li> <li>19. Sir C. V. Mehta, K.C.S.I.</li> <li>20. Diwan Bahadur T. Raghaviab, C.S.I. Secretary, Imperial Council of Agricultural Research, Secretary, (<i>Ex-officio</i>).</li> </ol> | <p>46. (a) Annual Report of the Agricultural Marketing Adviser to the Government of India.</p> <p>(b) Note by Mr. R. G. Allan regarding rate of progress of Market Surveys and adequacy of funds and staff.</p> | 12th February 1936, 10-30 A.M. |
| 14         | Wool Committee.                 | <ol style="list-style-type: none"> <li>1. Vice-Chairman, Imperial Council of Agricultural Research.</li> <li>2. Animal Husbandry Expert, Imperial Council of Agricultural Research.</li> <li>3. Agricultural Marketing Adviser to the Government of India.</li> <li>4. Live-stock Expert to the Government of Bombay.</li> <li>5. Live-stock Expert to the Government of Madras.</li> <li>6. Superintendent, Civil Veterinary Department, Sind.</li> </ol>   | <p>The Subjects to be considered by the Wool Committee are not included in the Agenda for the next (February 1936) meeting of the Advisory Board.</p>   | 12th, February 1936, 2-45 P.M. |

|    |  |  |  |
|----|--|--|--|
| 15 | <p>Dairy Standards Committee.</p> <p>7. Deputy Superintendent, Civil Veterinary Department, Baluchistan.</p> <p>8. Mr. W. S. Read, Superintendent, Government Cattle Farm, Hissar.</p> <p>9. Mr. G. V. Lewis, British India Corporation, Carnapor.</p> <p>10. Pir Akbar Ali, M.L.C., Junior Vice-Chairman District Board, Ferozepore.</p> <p>11. Mr. Shamjuna, Wool and Hide Merchant, Amritsar.</p> <p>12. Sheikh Sadiq Hassan, Carpet Manufacturer, Amritsar.</p> <p>13. Mr. A. K. Watal, Kailash Carpet Factory, Agra.</p> <p>14. Mr. T. F. Quirke, Director of Veterinary Services, Punjab.</p> <p>15. Mr. T. J. Egan, Director of Civil Veterinary Department, United Provinces.</p> <p>16. Dr. B. K. Bedami, Director of Veterinary Services, Hyderabad.</p> <p>17. Mr. C. B. Samuel, Senior Marketing Officer, Delhi.</p> <p>18. Rao Bahadur M. Vaidyanathan, Statistician, Imperial Council of Agricultural Research.</p> <p>Secretary, Imperial Council of Agricultural Research, (Ex-officio).</p> |  |  |
| 16 | <p>1. Vice-Chairman, Imperial Council of Agricultural Research.</p> <p>2. Animal Husbandry Expert, Imperial Council of Agricultural Research.</p> <p>3. Mr. F. Ware, Director, Imperial Institute of Veterinary Research.</p> <p>4. Mr. T. F. Quirke, Director of Veterinary Services, Punjab.</p>   | <p>The Subjects to be considered by the Committee are not included in the Agenda for the meeting of the Advisory Board, February 1936.</p> | <p>13th February<br/>1936, 2-45 P.M.</p> |

| Serial No. | Name of Committee. | Personnel.  | Agenda. | Date and time of meeting. |
|------------|--------------------|---|---------|---------------------------|
|            |                    | <p>5. Mr. Zal R. Kothawala, Imperial Dairy Expert, Bangalore.</p> <p>6. Professor Godbole, Benares Hindu University.</p> <p>7. Mr. Byramji Cowasji, Representative of the Indian Butter Manufacturer's Association.</p> <p>8. Mr. P. S. Caprihan, Representative of the Dayalbagh Dairy Farm.</p> <p>9. Mr. F. S. MacMahon, Public Analyst, United Provinces.</p> <p>10. Mr. D. N. Khurody, Marketing Officer, Delhi.</p> <p>11. Mr. P. H. Carpenter, Indian Tea Association.</p> <p>12. Mr. N. H. Madsen, Representative of Messrs. Polsons Manufacturing Company.</p> <p>13. Rao Bahadur B. Viswanath, Offg. Director, Imperial Institute of Agricultural Research.</p> <p>14. Mr. E. J. Brien, Live-stock Expert to the Government of Bombay.</p> <p>15. Mr. C. H. Parr, Deputy Director of Agriculture, United Provinces.</p> <p>16. Mr. K. P. B. Keriba, Statistical Assistant, Animal Husbandry Bureau, Imperial Council of Agricultural Research.</p> <p>Secretary, Imperial Council of Agricultural Research, Secretary, (<i>Ex-officio</i>).</p> |         |                           |



## CHART.

Name of Committee, place and time of its meeting.

| Date.              | Agriculture.  | Place. | Time.      | Animal Husbandry.                         | Place. | Time.      |
|--------------------|---|--------|------------|---|--------|------------|
| February,<br>1936— |   |        |            |   |        |            |
| 10th               | Rice Sub-Committee  | ..     | 3 P.M.     | Cattle Breeding Committee                 | ..     | 2-45 P.M.  |
| 11th               | (1) Wheat breeding and<br>Potato Committee.   | ..     | 10 A.M.    | Cattle Breeding Committee<br>(continued). | ..     | 10-30 A.M. |
|                    | (2) Committee to examine<br>schemes of investiga-<br>tion—<br>(a) into the attack on<br>Jowar by the para-<br>site <i>Striga</i> ;<br>(b) of the attack on<br>tobacco by the<br>phanerogamic Para-<br>sita <i>Orobancha</i> . | ..     | 11-30 A.M. | Animal Nutrition Committee                | ..     | 2-45 P.M.  |
|                    | (3) Fruits Sub-Committee  | ..     | 2 P.M.     |   |        |            |
|                    | (4) Gokhale Scheme Com-<br>mittee.  | ..     | 3 P.M.     |   |        |            |

| Date. | Agriculture.  | Place. | Time.                          | Animal Husbandry.  | Place. | Time.   |
|-------|---|--------|--------------------------------|--|--------|---|
| 12th  | (i) Dry Farming Research Schemes Co-ordination Committee.<br>(ii) Coconut Scheme Committee. | ..     | 10 A.M.                        | (i) <i>Ad Hoc</i> Committee to consider Bombay scheme for control of ticks and D. I. O. Progress Reports.<br>(ii) Marketing Scheme Sub-Committee.      | ..     | 10-30 A.M.  |
| 13th  | (iii) Soil Science Committee<br>Entomologists' Committee.                                   | ..     | 11-30 A.M.<br>2 P.M.<br>2 P.M. | (iii) Wool Committee<br>Special Dairy Committee<br>Committee to judge on the entries for the award of prizes in 1935 for dairying and care of animals. | ..     | 10-30 A.M.<br>2-45 P.M.<br>2-45 P.M.<br>3-30 P.M. |

NOTE 1.—The Editorial Committee will meet at 10 A.M. on Thursday the 13th February 1936.

2.—Indian Society of Soil Science meets at 5 P.M. on 14th February.

## APPENDIX II-A.

Supplementary Note dated the 5th February 1936 by the Secretary, Imperial Council of Agricultural Research, on Subject No. 2:— Appointment of Committees.

A programme of work of the full Board and of the various Sub-Committees that will meet from the 10th to the 15th February 1936, is enclosed (Annexure). The dates and time of the meetings of the various Committees as shown in the programme are in modification of those already circulated and may kindly be noted.

## ANNEXURE.

Programme of work of the full Advisory Board and of the various sub-committees, February 1936.

|                                   | Forenoon.  | Afternoon.   |
|-----------------------------------|--|--|
| Monday, 10th February 1936.       | 11 A.M. Full Board.<br>Items—1, 2, 4, 11, 22, 26(c) and 47.  | (i) Cattle Breeding Committee 2-00 P.M.<br>(ii) Rice Research Committee 3-00 P.M.  |
| Tuesday, 11th February 1936.      | 10-30 A.M. Full Board.<br>Items—49, 3, 5, 26(a), (b) & (d), 40, 48 and 52.   | (i) Fruit Committee . . . 2-00 P.M.<br>(ii) Wool Committee . . . 2-45 P.M.<br>(iii) Agricultural Economics (Gokhale's Scheme) Committee . . . 3-00 P.M.  |
| Wednesday, 12th February 1936.    | (i) DRY Farming Research Schemes Co-ordination Committee . . . 10-00 A.M.<br>(ii) <i>Ad hoc</i> Committee to consider Bombay scheme for control of ticks and D. I. O.'s Progress Reports . . . 10-30 A.M.<br>(iii) Coconut Schemes Committee . . . 11-30 A.M.  | (i) Soil Science Committee . . . 2-00 P.M.<br>(ii) Marketing Schemes Committee . . . 2-30 P.M.<br>(iii) Cattle Breeding (contd.) . . . 2-45 P.M.   |
| Thursday, the 13th February 1936. | 10-30 A.M. Full Board.<br>Report—Rice Committee Items 8 and 9<br>Report—Cattle Breeding Committee—Items 6, 10, 23, 42, 43, 45 and 50.<br>Report—Fruit Committee—Items 12 and 13.<br>Report—Agricultural Economics Committee (Gokhale's Scheme). Item 27.   | 2-45 P.M. Full Board.<br>Report—Dry Farming Committee—Items 36 and 51.<br>Report—Coconut Committee—Items 24 and 25.<br>Report—Soil Science Committee—Items 28, 29, 32, 33, 34 and 35.<br>Report—Disease Investigation Officers, etc.—Items 7, 19, 39 and 41. |
| Friday, 14th February 1936.       | (i) Wheat Breeding and Potato Committee . . . 10-30 A.M.<br>(ii) Animal Nutrition Committee 10-30 A.M.<br>(iii) Committee to examine schemes of investigation—<br>(a) into the attack of Juar by the parasite "Striga"<br>(b) into the attack on tobacco by the phanerogamic parasite <i>Orobanchae</i> — . . . 11-30 A.M. | (i) Committee of Entomologists 2-00 P.M.<br>(ii) Committee to adjudicate upon the entries for the award of prizes for improvements in science and art of Animal Husbandry . . . 2-45 P.M.<br>(iii) Special Dairy Committee 3-15 P.M.                         |
| Saturday, 15th February 1936.     | 10-00 A.M. Full Board.<br>Report—Wheat Committee—Items 16, 17 and 18.<br>Report—Striga Committee—Items 20 and 21.<br>Report—Animal Nutrition Committee—Items 14, 15 and 31.<br>Report—Committee of Entomologists—Items 37, 38, and 44.<br>Report—Marketing Schemes Committee—Item 46.                                      | 12-15 P.M. <i>Annual General Meeting</i> .<br>Full Board will meet in the afternoon (2-45 P.M.) if any item on the agenda is left over.  |

Indian Society of Soil Science meets at 5 P.M. on Friday, the 14th February.  
Vice-Chairman is the Chairman of the Full Board as well as of the Committee. Failing his attendance in the Committee due to his absence in the Assembly, Agricultural Expert will preside over the Agricultural Committees, Animal Husbandry Expert over the Animal Husbandry Committees and Secretary over the Gokhale Committee and the Marketing Schemes Committee.  
N. B.—Full Board will meet in the Conference Room and the Committee in the various Committee Rooms attached to the Conference Room.

## APPENDIX III.

Note dated the 11th January 1936, by the Secretary, Imperial Council of Agricultural Research, on Subject No. 22:—**Re-Constitution of those Sub-Committees of the Imperial Council of Agricultural Research, appointed under Rule 30, which have been in existence for two years or more.**

In accordance with the marginally-noted resolution of the Governing Body, reached at its meeting held on the 22nd January 1935, Standing Committees of the Imperial Council of Agricultural Research appointed under Rule 30 of its Rules and Regulations, which have been in existence for 2 years or more, have to be re-constituted. The Sugar, Locust, Indian Oil Seeds and Vegetable Oils, Fertilisers and Standing Soil Science Committees, have already been re-constituted by the Governing Body in September 1935, on the recommendations of the Advisory Board made at its meeting held in February 1935.

The Animal Nutrition, Cattle Breeding and Dairying Committees completed two years in November 1935, and the question of their re-constitution is now for the consideration of the Advisory Board. The present composition of these committees is as under:—

(i) *Animal Nutrition Committee.*

|  | Date of<br>appointment. |
|--|-------------------------|
| 1. Vice-Chairman, Imperial Council of Agricultural Research . . . . .  | 24-11-33.               |
| 2. Animal Husbandry Expert, Imperial Council of Agricultural Research . . . . .                                      | Do.                     |
| 3. Mr. F. J. Warth, Physiological Chemist, Bangalore . . . . .   | Do.                     |
| 4. Dr. P. E. Lander, Agricultural Chemist Punjab, Lyallpur . . . . .   | Do.                     |
| 5. Dr. K. C. Sen, Bio-Chemist, Imperial Institute of Veterinary Research<br>Muktesar . . . . .                       | Do.                     |
| 6. Rao Bahadur B. Viswanath, Offg. Director, Imperial Institute of Agricultural<br>Research . . . . .                | Do.                     |
| 7. Mr. J. R. Haddow, Veterinary Research Officer, Imperial Institute of Veteri-<br>nary Research, Muktesar . . . . . | 22-1-35.                |

*N. B.*—Subject to the approval of the Governing Body of the Imperial Council of Agricultural Research, and the concurrence of the Indian Research Fund Association, it is proposed to appoint Dr. W. R. Aykroyd, M.D., Director, Nutrition Research, Indian Research Fund Association, Coonoor (South India) as a member of this Committee, as his association will secure liaison between research workers on animal and human nutrition.

(ii) *Cattle Breeding Committee.*

|  | Date of<br>appointment. |
|--|-------------------------|
| 1. Vice-Chairman, Imperial Council of Agricultural Research . . . . .                                    | 24-11-33.               |
| 2. Animal Husbandry Expert, Imperial Council of Agricultural Research . . . . .                          | Do.                     |
| 3. Mr. T. F. Quirk, Director of Veterinary Services, Punjab, Lahore . . . . .                            | Do.                     |
| 4. Major C. E. MacGuokin, Assistant Director, Military Dairies, Lahore Cantt. . . . .                    | Do.                     |
| 5. Mr. E. J. Bruen, Livestock Expert, Bombay, Poona . . . . .  | Do.                     |
| 6. Khan Sahib S. Dost Mohd. Khan, Proprietor, Jahangirabad Cattle Farm,<br>District Montgomery . . . . . | Do.                     |
| 7. Mr. C. H. Parr, Deputy Director of Agriculture, Bundelkhand . . . . .                                 | 22-1-35.                |

(iii) *Dairying Committee.*

|   | Date of<br>appointment: |
|---|-------------------------|
| 1. Vice-Chairman, Imperial Council of Agricultural Research . . . . .           | 24-11-33.               |
| 2. Animal Husbandry, Expert Imperial Council of Agricultural Research . . . . . | Do.                     |
| 3. The Director, Military Farms, Army Headquarters, Simla . . . . .             | Do.                     |
| 4. Mr. Zal R. Kothavala, Imperial Dairy Expert, Bangalore . . . . .             | Do.                     |
| 5. Mr. F. J. Gossip, Dairy Expert, Bengal, Dacca . . . . .                      | Do.                     |
| 6. Sardar Datar Singh, Montgomery Dairy Farm, Montgomery . . . . .              | Do.                     |

## APPENDIX IV.

**Note dated the 30th December 1935 by the Secretary, Imperial Council of Agricultural Research on Subject No. 26-(c):—Report on the working of the Oil Technological Section of the Harcourt Butler Technological Institute, Cawnpore, for the year 1934-35.**

At its meeting held in August 1933 (pp. 183—213 of the printed proceedings) the Advisory Board considered a proposal from the United Provinces Government for financial assistance to the Oil Technological Section of the Harcourt Butler Technological Institute, Cawnpore. A grant of Rs. 30,000 per annum was made to the Government of the United Provinces during the years 1934-35 and 1935-36. A copy of the report on the working of the Oil Section of the Institute during the year 1934-35 is attached (Enclosure) for the consideration of the Advisory Board.

## ENCLOSURE

REPORT OF THE WORKING OF THE OIL SECTION AT THE  
HARCOURT BUTLER TECHNOLOGICAL INSTITUTE AT  
CAWNPORE DURING THE YEAR 1934-35.

The temporary grant of Rs. 30,000 which the Imperial Council of Agricultural Research was pleased to make to this Department of the Institute during the year 1934-35, and which has been continued for 1935-36 has enabled the Local Government to continue the Oil Section on its existing strength. As stated by the Accountant General, United Provinces, in his audit report on the expenditure from the Imperial Council's grant, a sum of Rs. 33,306-13-9 was spent exclusively on the Oil Section in 1934-35. This did not however include the pay—Rs. 18,000 of the Head of the Oil Section, who also held charge of the duties of Deputy Director or Director of Industries during the period. Besides this, indirect expenditure had to be incurred on account of the part-time staff employed in the laboratories, the stores, the Workshops and the Drawing Office, the Institute Office, etc., the proportionate share of which debitable to the Oil Section amounts to Rs. 7,500 per annum. Account has also to be taken of (i) the depreciation charges on both buildings and machinery, and (ii) overhead charges. In short, the total expenditure on the Section roughly amounts to Rs. 67,500 every year, and the Imperial Council's contribution just about covers the expenditure on the training of the Council's nominees who number about half the number of total admissions made for the 1934-35 session of the Institute.

2. In accordance with the terms and conditions of the grant, five nominees of the Imperial Council of Agricultural Research were admitted to the Oil Diploma course in July, 1934: the number of students from the United Provinces admitted to that course was the same. Unfortunately, one of the Council's nominees had to leave the Institute in the middle of the session owing to ill-health. The remaining students completed the first year's training.

3. In addition to the diploma-course students, two short-course students from other provinces were admitted to the section last year. Both these students have since completed their training satisfactorily and have returned to their respective places.

4. In order to make the practical training of the students as thorough as possible, a provision of about Rs. 1,000 for students' travelling allowances is made in the Institute budget every year to enable the students to visit important centres of the oil industry all over India.

5. *Assistance to the Industry.*—The section continued to render assistance to the Indian Oil industry wherever situated—whether in the United Provinces or outside. Such help may be classified as follows:—

- (a) *Solving difficulties as to the working processes.*—As many as ten mills in Bombay, Central Provinces, the Punjab and Bihar and Orissa were assisted in this manner.
- (b) *Selection of plant and its erection.*—Six mills outside the United Provinces were assisted in this direction.
- (c) *Provision of trained technical staff.*—Such staff was provided to four non-U. P. mills and engineering concerns.
- (d) *Personal assistance by officers of the Section on the spot.*—Two mills outside this province were visited for the purpose during the year 1934-35.

6. *General condition of the Oil Industry.*—During the year under review, the oil industry in India had to mark time owing to fluctuations in the prices of raw materials and finished products. The sudden rise of more than 50 per cent. in the prices of oils and oil seeds during the months of January and February, 1935, caused some disturbance in the industry; this was due partly to the closing of a big export firm and partly to speculation. The disturbance lasted two months and conditions are again normal and the industry is doing fairly well. The export trade in refined castor oil is improving and there is scope for its expansion in future.

7. *Research Work.*—The following research work was undertaken and completed during the year:—

- (a) *Examination of seeds crushed in Bengal, Bihar, the Punjab and the United Provinces under the name of mustard and rape seeds.*
- (b) *Study of the processes used for the bleaching of castor and mahua oils for technical uses.*
- (c) *Preparation of light-coloured ester gums from rosin in an inactive atmosphere.*

8. The Local Government again take this opportunity of conveying their thanks to the Imperial Council of Agricultural Research for the Council's very opportune grant which has enabled the Section to continue to render useful service to the oil industry all over India. The brief account of its activities furnished above will show that it is fully deserved and that this section has established its title to be considered as an all-India Institute of Oil Technology.

S. P. SHAH,

Secretary to Government, United Provinces,  
Industries Department.

The 29th August 1935.

## APPENDIX V.

**Note dated 23rd January 1936 by the Secretary Imperial Council of Agricultural Research, on Subject No. 47:—Financial Assistance to the Oil Section of the Harcourt Butler Technological Institute, Cawnpore, for the year 1936-37.**

A proposal from the Government of the United Provinces for financial assistance to the Oil Technological Section of the Harcourt Butler Technological Institute, Cawnpore, and for its conversion into an all-India Institute of oil technology under the Imperial Council of Agricultural Research was considered by the Advisory Board at its meeting held in August 1933, (pages 183—213 of the Printed Proceedings). The recommendation of the Board was that the scheme should receive assistance as soon as the funds from the proposed oil-seed cess became available. A proposal to give at least a partial and temporary assistance to the extent of Rs. 30,000 to Rs. 35,000 for a year was also considered and rejected by a majority. After considering the recommendation of the Advisory Board and the further information placed before it by the Hon'ble Minister, United Provinces, the Governing Body decided to give a temporary assistance of Rs. 30,000 for the year 1934-35 and decided to reconsider the matter at the close of that year in the light of the decisions reached on the proposal for the levy of a cess on oilseeds. The question was further considered at the January 1935 meeting of the Governing Body which sanctioned the continuance of the grant for the year 1934-35. The grant has accordingly been made by the Council during 1934-35 and 1935-36, one condition being that the Government of the United Provinces will accommodate on the same terms as those from the United Provinces students from other Provinces nominated by the Council for training in oil technology at the Institute. A copy of the report on the working of the Oil Section of the Institute during the year 1934-35 has been circulated separately.

2. The Government of the United Provinces have now requested that if a final decision on the question of a cess on oilseeds and on their original scheme for the conversion of the Harcourt Butler Technological Institute, into an all India Institute of oil technology, is not likely to be reached before the close of 1935-36, the Imperial Council should continue the temporary grant of Rs. 30,000 during 1936-37 also.

3. It is probable that the oilseeds cess proposal will not be proceeded with but on the other hand the newly created Industrial Research and Intelligence Bureau has taken up this question and will place proposals before its Advisory Council in July next. It is for the consideration of the Advisory Board whether a grant of Rs. 30,000 for one more year should be recommended in order to avoid a *hiatus*.



## APPENDIX VI.

**Note by the Secretary, Imperial Agricultural Research, dated the 27th December 1935 on Subject No. 4:—Application from Dr. Bosi Sen, Director, Vivekananda Laboratory, Calcutta, for a Recurring Grant of Rs. 2,500 per annum for 3 years or 5 years for Research in Plant Physiology.**

Attention is invited to the attached copy of a letter from the Government of Bengal No. 7038, dated the 7th December 1935 (Enclosure I), forwarding, *inter alia*, the application mentioned above (Enclosure III). An advance copy of the scheme (Enclosure III) was considered by a Special Technical Committee in July 1935, whose recommendations will be found at page 3 of Enclosure III.

The scheme (Enclosure III) which has now been received through the local Government duly recommended by the Provincial Agricultural Research Committee (*vide* Enclosure II) is for the consideration of the Advisory Board.

## ENCLOSURE I.

COPY OF LETTER NO. 7038, DATED 7TH DECEMBER 1935, FROM THE SECRETARY TO THE GOVERNMENT OF BENGAL, AGRICULTURE AND INDUSTRIES DEPARTMENT (AGRICULTURE BRANCH), TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

SUBJECT:—*Thirteenth meeting of the Advisory Board, Imperial Council of Agricultural Research.*

I am directed to refer to your letter No. F.-2(10)/35/G., dated the 2nd October, 1935, on the above mentioned subject and to forward herewith, for favour of inclusion in the agenda of the meeting of the Advisory Board to be held in February, 1936, the undernoted schemes which have been approved by the Bengal Provincial Agricultural Research Committee, together with the relevant extracts from the minutes of the meeting of the Committee held on 30th November 1935. I am to say that Government (Ministry of Agriculture) recommend the schemes subject to the reservation that no financial liability will devolve on them.

\* \* \* \*

(4) Scheme for research work in plant physiology by Dr. B. Sen of the Vivekananda Laboratory, Calcutta.

2. I am to add that the proposed scales of pay of the staff to be employed in connection with the schemes are being examined with a view to bringing them into line with the provincial scales and that the decision of Government in the matter will be communicated to you later.

3. 150 spare copies each of the schemes will be forwarded to you direct by the Director of Agriculture, Bengal.

## ENCLOSURE II.

EXTRACT FROM MINUTES OF THE TENTH MEETING OF THE BENGAL PROVINCIAL AGRICULTURAL RESEARCH COMMITTEE, HELD AT WRITERS' BUILDINGS, CALCUTTA, ON SATURDAY THE 30TH NOVEMBER AT 11-30 A.M.

## PRESENT:

- (1) The Hon'ble Nawab K. G. M. Feroqui, Khan Bahadur, Minister for Agriculture and Industries—*President*.
- (2) H. S. E. Stevens, Esq., I.C.S., Secretary to the Government of Bengal, Department of Industries and Agriculture.
- (3) P. J. Kerr, Esq., Veterinary Adviser to the Government of Bengal.
- (4) Professor, J. C. Ghosh, D.Sc., Dacca University.
- (5) Professor J. N. Mukherjee, D.Sc., Calcutta University.
- (6) Professor S. Sinha, Krishnath College, Berhampore.
- (7) M. Carbery, Esq., M.A., B.Sc., I.A.S., Assistant Director of Agriculture, Bengal.
- (8) K. Mclean, Esq., B.Sc., I.A.S., Director of Agriculture, Bengal—*Secretary*.

\* \* \* \*

(4) The Scheme for research work in Plant Physiology by Dr. B. Sen of the Vivekananda Laboratory, Calcutta, was resubmitted to the Committee. At the last meeting of the Committee, it was decided that the scheme should be resubmitted in a more definite form. At the last meeting of the Advisory Board the Physiological Sub-Committee considered the scheme and accepted it with the proviso that Dr. Sen should consider rice, mustard, *Trapa bispinosa*. The Committee decided to recommend the scheme to the Imperial Council of Agricultural Research for acceptance provided Dr. Sen agrees to the suggestion made regarding the crops to be investigated.

## ENCLOSURE III.

**Scheme for research work in plant physiology, by Dr. B. Sen.**

No. F.131-35/Agri., dated Siuila, the 19th August 1935.

From—The Secretary, Imperial Council of Agricultural Research,  
To—The Secretary to the Government of Bengal, Agriculture and Industries Department.

*Scheme by Dr. B. Sen, for research work in plant physiology.*

With reference to item 6 of the minutes of the Bengal Agricultural Research Committee's meeting held on the 15th May 1935, copy of which was forwarded with your letter No. 131 T.—A. I., dated the 23rd May 1935, I am directed to say that Dr. B. Sen, Director, Vivekananda Laboratory, Calcutta, had also sent to this department a copy of his scheme of research work in plant physiology and cytology, the original of which was examined by the Bengal Agricultural Research Committee and referred back for revision.

2. Under the principles adopted for the consideration of applications for grants-in-aid from the Council no scheme is considered until and unless it has been received through the local Government with the recommendations of their Provincial Agricultural Research Committee. Dr. Sen's scheme mentioned above, was accordingly not submitted to the advisory Board of the Council at its last session held in July 1935. As, however, a special technical Sub-Committee had been appointed to consider a scheme of research in physiology of cane and wheat from the Benares Hindu University, in conjunction with the meeting of the Advisory Board of the Council held in July 1935, the Vice-Chairman to the Council considered that it would be an advantage to obtain the advice of this Sub-Committee on Dr. Sen's scheme also. A copy of Dr. Sen's scheme was accordingly placed before the aforesaid Sub-Committee of the Board, vide attached copy of memorandum No. 131-35/Agri., dated the 2nd July 1935, and I am now to forward herewith, for the information of the local Government, a copy of the report of this Sub-Committee on the scheme in question. It is requested, that, if there is no objection, this report may kindly also be placed before the Provincial Agricultural Research Committee.

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No. 4559, dated Calcutta, the 14th September 1935.

Memo. by—J. C. Sen, Esq., Assistant Secretary to the Government of Bengal, Agriculture and Industries Department.

The above-mentioned document is forwarded to the Director of Agriculture, Bengal, for information, with the request that the report of the Sub-Committee may be placed before the next meeting of the Provincial Agricultural Research Committee.

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**Report of Physiological Sub-Committee on scheme of work by Dr. Bosi Sen on plant physiology and cytology.**

PRESENT.

Mr. B. C. Burt.  
 Dr. F. J. F. Shaw.  
 Professor T. Ekambaram.  
 Dr. B. N. Singh.  
 Mr. R. L. Sethi.

The Sub-Committee considers that this is an appropriate piece of work for a grant by the Council. No work on the problem is being done elsewhere in India and Dr. Sen has already published good work on the subject. The results of this investigation have a definite agricultural application to crop production as a whole.

2. The Sub-Committee considers that the choice of plant should be left to the research worker himself. It is not so important to work on a particular crop as to choose a plant suitable to the special technique. The Sub-Committee tentatively suggests rice, mustard and *Trapa bispinosa* for Dr. Sen's consideration.

Dated Calcutta, the 21st December 1934.

From—B. Sen, Esq., Director, Vevekananda Laboratory,

To—The Secretary, Imperial Council of Agricultural Research, New Delhi (through the Director of Agriculture, Bengal, Dacca).

I have the honour to submit herewith an application for a grant-in-aid for my research work in plant physiology, which I have been carrying on independently for the past thirteen years, both in the West and in my laboratories in Calcutta and Almora.

*Previous Work.*—My specific researches have been concerned with the properties of living protoplasm. I began my research work in 1911 as an assistant to Sir J. C. Bose, with whom I continued to be associated for twelve years. Subsequently my first independent investigations were concerned with determining the change in, permeability induced in the protoplasmic membrane of living cells by electric and mechanical stimulation and by variation of temperature. I devised a very simple and accurate method for measuring the permeability of the protoplasmic membrane to ions. The intake and excretion of ions, necessary to the life of the cell, are determined by the permeability of the protoplasmic membrane. Two of my papers on this subject were published in the *Proceedings of the Royal Society* (Appendix A, Nos. 4 and 5).

During a visit to Europe and America in 1928-30 I acquired the recent micro-manipulation technique which enables one to work with single living cells and inject various solutions into them. I was able to devise a new type of micro-electrode (Appendix A, No. 6) by means of which it is possible for me to determine the difference of electric potential between the inside and outside of various types of cells (Appendix B, No. 2). With the help of the same type of electrode, I have measured the change of permeability of the plasma membrane to ions in a single cell under electric stimulation (Appendix A, No. 7).

In 1931, using an Ultra-microscope, I took up the study of the visible changes induced in the protoplasm of single living cells by electric current and anaesthetics. I also investigated the nature of the electric charge of the colloidal particles of protoplasm. This electric charge plays a fundamental part in the life history of an organism. Its importance lies in the fact that the similarly charged particles of protoplasm repel one another and thus remain in suspension, but when the charge is diminished the viscosity of the protoplasm increases, and when it is neutralised protoplasm coagulates and dies. I have been able to prove conclusively by photographically recording the cataphoretic migration of the protoplasmic particles of single living cells that these particles are negatively charged. This finding holds good for all types of cells, both plant and animal, I have so far investigated (Appendix A, Nos. 8 and 9). My conclusion happens to be directly opposite to the hitherto generally accepted conclusion of the late Sir William Hardy. An abstract of this work—incidentally the only paper from India—appeared in the *Proceedings of the XIVth International Physiological Congress, held in Rome, 1932*. A detailed paper was published in the *Annals of Botany, 1934*.

A list of my published scientific papers, together with available reprints (A), a list of references to my work appearing in standard

scientific text-books (B), and a list of the scientific societies of which I am a member (C), are appended herewith.

*Scheme of Research Work for which Grant-in-aid is requested.*— Since the protoplasmic particles carry a negative charge, it is apparent that positively charged cations absorbed by or injected into the cell will diminish or neutralise the charge, and thus the viscosity will be increased or coagulation of the protoplasm will take place. Negatively charged anions, on the other hand, will tend to decrease the viscosity. Preliminary experiments so far carried out on the protoplasm of root hairs corroborate this expectation. But since protoplasm is not a simple colloidal suspension but a very imperfectly understood colloidal complex no definite conclusions as to the effect of any particular reagent can be arrived at without further extensive and detailed studies.

I propose, therefore, the following investigations:—

I. A systematic study of the effects of the different cations and anions (*e.g.*, Na, K, Ca, Hg, Fe, and Cl, NO<sub>3</sub>, PO<sub>4</sub>, SO<sub>4</sub>) on living protoplasm of root hairs, using both single salts in various concentrations and different combinations of salts of varying acidities. The induced changes to be ascertained are—

- (i) Effect on the cell wall.
- (ii) Effect on the permeability of the plasma membrane.
- (iii) Effect on the viscosity of the cytoplasm as determined by the Brownian movement of single protoplasmic particles.
- (iv) The comparative duration of the life of the cell.

II. Application of any specific conclusions derived from the above investigation of the effects of ions on protoplasm to the life processes of the plant organism as a whole, *viz.*—

- (i) Seed germination.
- (ii) Growth of the plant.
- (iii) Inflorescence.

*Proposed Method of Investigation.*—The general technique I propose for these investigations will be found described in detail in my paper published in the *Annals of Botany* (Appendix A, No. 9). This method of observing in the dark field of the Ultra-microscope the visible changes induced in living protoplasm by different factors has not as yet been systematically applied in research work for the benefit of practical Agriculture. That it has interesting possibilities is evidenced by the number of requests received from agricultural institutions for reprints of the paper mentioned, namely, John Innes Horticultural Institution, London, Dominion Laboratory of Plant Pathology, Fredericton, N.B., Canada, Division of Agricultural Bio-chemistry, University of Minnesota, U. S. A., School of Agriculture and experiment Station, State College, Pennsylvania, U. S. A., Department of Hygiene and Bacteriology, University of Chicago, U. S. A. Further requests for reprints have also been received from departments of plant Physiology in universities of Czecho-Slovakia, Austria, Italy and Japan.

The changes in the living protoplasm of root hairs will be observed under the high magnifications of the ordinary microscope and the Ultra-microscope, and these changes will be recorded by micro-photographs. The effects of immersion in various solutions will be observed both on isolated root hairs and also on hairs in intact plants. The effect of injection of various solutions into single living cells by the micro-injection apparatus will also be observed.

It should be noted, however, that the direct method of injecting a solution inside the cell by the micro-injection apparatus, in order to study the effect on protoplasm of different ions, apart from the unnaturalness of introducing solutes in this manner inside the cytoplasm, involves a marked mechanical injury at the point of puncture. Moreover the effect on a tissue as a whole cannot be studied by this method, since injection of the solution into all the cells of a tissue is not practicable. I am now in process of evolving a new technique whereby I hope to subject the living protoplasm of a single cell, or of cells of a tissue, to intimate contact with various solutes, under comparatively normal conditions.

*Relation of this Scheme of Research Work to Agriculture.*— Knowledge of the properties and reactions of protoplasm, the material out of which all life is manufactured, is obviously of fundamental importance to all branches of biological science, alike theoretical and practical. Accurate data about even the elementary physical properties of living protoplasm is still very meagre. The vast amount of existing cytological literature is concerned mostly with protoplasm that has been killed and sectioned for microscopical studies. It is only recently, with the development of new techniques and instruments, that it has become possible to detect structural changes in the living protoplasm induced by various external factors. The chief difficulty involved in the investigation of the reactions of living protoplasm lies in the fact that protoplasm must be observed in its natural container, the living cell; for outside the cell, protoplasm dies. Therefore an important problem of cytology has been to discover suitable living cells which will permit the protoplasm to be observed under the Ultra-microscope.

For the past three years I have been working with root hairs of plants. These have not only proved to be the ideal material for studying the reactions of living protoplasm (all root hairs are single cells), but they are at the same time the most important cells of the plant. It is only through the root hairs that land plants can absorb water and dissolved nutrients from the soil. The components of the root hair which determine the processes of absorption of water and solutes from the environment and the transmission of these into the root system are the cell wall, the plasma membrane and the cytoplasm. It will be seen, therefore, that the investigation outlined above under I—effects of different ions on the three components of the root hair—is of fundamental importance to practical Agriculture. The whole process of plant nutrition is mainly dependent on the functions of the root hairs, and more accurate knowledge of their reactions to different ions will have a direct bearing on agricultural problems, particularly with regard to the practical application of chemical fertilisers for economic plants. The proposed investigation outlined under II is, of course,

purely an experimental agricultural research problem. It may be said, in conclusion, that despite their importance root hairs have as yet received comparatively little attention from physiologists. Given the necessary financial assistance, I hope to be able to make some contribution in this field of research, which is in direct line with the researches I have hitherto carried on in plant physiology.

*Financial Statement.*—The support for my work up to the present time has come exclusively from England and America. I originally received from the Royal Society a small grant of £100 for purchase of instruments. Mr. and Mrs. L. K. Elmhirst of Totnes, Devonshire, have generously been contributing an annual grant of £500 for the past ten years. This grant, originally sanctioned for three years only, was subsequently extended for a further period of seven years. With the recurring annual grant and other non-recurring gifts roughly amounting to £1,500 I have been able to visit the universities of Europe and America, to equip my two small research laboratories in Calcutta and Almora with the up-to-date instruments and appliances required for my work, to buy necessary books and periodicals, to maintain one research assistant, and to carry on independent research work along the lines indicated.

I have been notified, however, that the annual Elmhirst grant is now shortly to be terminated or to be very greatly reduced, and unless other funds become available, work now in progress will have to be seriously curtailed and the particular scheme of investigation outlined above cannot be undertaken. For furthering the above scheme of research work I, therefore, beg the Imperial Council of Agricultural Research to sanction an annual grant-in-aid of Rs. 2,500 extending over a period of at least three years and preferably five, commencing from 1935-36. This sum will be expended approximately as follows:—

|   | Rs.          |
|---|--------------|
| One research assistant at Rs. 75 per mensem . . . . . | 900          |
| Books and periodicals . . . . .                       | 300          |
| Instruments and appliances . . . . .                  | 700          |
| Contingencies : chemicals, glassware, etc. . . . .    | 600          |
| <b>Total</b>  | <b>2,500</b> |

It is proposed to spend the sum under instruments and appliances towards the construction and purchase of the following:—

- (1) Constant temperature glass chambers with automatic electric control.
- (2) Micro-thermo-couples for measuring temperature variations of microscopic objects, *e.g.*, the degree of temperature variation induced on single living cells by the light used for ultra and ordinary microscope observations; to determine whether living protoplasm maintains a difference of temperature from that of its immediate surrounding.

- (3) Micro-thermal Chamber to be used with the ultra-microscope for observing viscosity and other structural changes in the living protoplasm of root-hairs in different salt solutions under varying temperatures.
- (4) High Amplification Recording Oscillograph for continuous observation of changes in the ionic content of the medium surrounding living cells under varying external conditions.
- (5) Micro-balance.
- (6) Micro-manipulators.
- (7) Centrifuge.
- (8) Electric stimulation device with thermionic control.
- (9) Potentiometer for pH measurement.
- (10) Ultropak objectives and source of ultra-violet light to observe the path of translocation in roots.

It will be impossible to secure the above instruments at once with the sum asked for, so I intend to acquire them gradually according to the demands of the investigation in hand.

I give below the details of items of expenditure under "*Books and periodicals*"—

|   | Rs. |
|---|-----|
| New Books . . . . .   | 100 |
| Contribution towards subscription of the following scientific journals; Nature, Science, Current Science, Annals of Botany, American Journal of Botany, Biological Abstract, The Journal of Physiology, The Journal of General Physiology, Journal of Cellular and Comparative Physiology, The Journal of Experimental Biology, Ecology, Journal of the Marine Biological Association of United Kingdom Transactions of the Faraday Society and the New Phytologist . . . . . | 200 |

Under "*Contingencies*": Pure Chemicals, Platinum wire and full foil, acids and alcohols, vital stains, glassware, photographic material, gas and electricity and service.



**APPENDIX A.***Papers published by Sir J. C. Bose and B. Sen.*

1. Simultaneous Determination of Velocity of Excitation by Mechanical and Electric Methods. *Trans. Bose Institute*, Vol. IV, 1921, pp. 759-85.
2. Effect of Carbon Dioxide on the Mechanical and Electric Pulsations of *Desmodium gyrans*. *Trans. Bose Institute*, Vol. IV, 1921, pp. 771-75.
3. The Transmission of Death Excitation. *Trans. Bose Institute*, Vol. IV, 1921, pp. 776-85.

*Papers Published by B. Sen.*

4. On the Relation between Permeability Variation and Plant Movements, *Proceedings of the Royal Society*, B, Vol. 94, 1923.
5. The effect of Temperature on the Permeability of Protoplasmic Membrane. *Proceedings of the Royal Society*, B, Vol. 103, 1928.
6. A new Type of Micro-electrode, *Proceedings of the Society for Experimental Biology and Medicine*, Vol. 27, 1930.
7. A method for Measuring the Change of Permeability to Ions of Single Cells under Electric Stimulation. *Annals of Botany*. Vol. 45, 1931.
8. The Electric Charge of Colloids of Protoplasm, *Proceedings of the XIVth International Physiological Congress*. Rome, 1932.
9. The Electric Charge of the Colloid Particles of Protoplasm. *Annals of Botany*, Vol. 48, 1934.

**APPENDIX B.***References to Work of B. Sen in Standard Scientific Books.*

1. *General Cytology, a Text-Book of Cellular Structure for Students of Biology and Medicine*, Edited by Edmand V. Cowdry, University of Chicago, 1925, p. 269.
2. *Colloid Science Applied to Biology*, A General Discussion, held by the Faraday Society, 1930, pp. 676-77; p. 779.
3. *Recent Advances in Plant Physiology*, by L. C. Barton-Wright Churchill, London, 1930, p. 76.
4. *Plant Physiology*, by Edwin C. Miller, McGraw Hill Book Company, New York and London, 1931, p. 81.
5. *Annual Review of Biochemistry*, Vol. II, Edited by James Murray Luck, Stanford University, 1933, pp. 6-7.
6. *Electro-kinetic Phenomena and their Application to Biology and Medicine*, by Harold A. Abramson, American Chemical Society, Monograph Series, 1934, p. 282.

**APPENDIX C.**

*Member of the Following Scientific Societies.*

The Physiological Society (Great Britain).

The Faraday Society.

The Society for Experimental Biology.

The Marine Biological Association of the United Kingdom.

The Botanical Society of America.

The American Association for the Advancement of Science.

The American Society of Plant Physiologists.

Ecological Society of America.

## APPENDIX VII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 10th December 1935, on Subject No. 11:—Application from the Academy of Sciences of the United Provinces of Agra and Oudh for an Annual Recurring Grant of Rs. 1,000, from the Funds of the Imperial Council of Agricultural Research in aid of its work.**

Attention is invited to the attached letter (Enclosure I), dated the 19th October 1935, from the President, Academy of Sciences of the United Provinces of Agra and Oudh, on the subject noted above. This is the third Academy in India to apply for a subvention from the Council, the first two being the National Institute of Sciences of India, Calcutta, and the Indian Academy of Sciences, Bangalore. At its meeting held in July 1935 the Advisory Board recommended an annual grant of Rs. 1,000 each to these two Institutes for a period of five years, but the Governing Body decided, at its meeting held in September last, to sanction a grant of Rs. 500 per annum only for a period of three years. The grant for the current financial year has been paid to the above Institutes.

2. It will be observed that the United Provinces Academy of Sciences claims an all-India status—Lists of office-bearers, fellows and members are attached (Enclosure II), and also a list of papers of Agricultural and Veterinary interest published in the Academy's proceedings (Enclosure III). The Academy is in receipt of financial assistance from the United Provinces Government.

The application of the Academy is now for the consideration of the Advisory Board.

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 ENCLOSURE I.

LETTER DATED THE 19TH OCTOBER 1935, FROM THE PRESIDENT, ACADEMY OF SCIENCES (UNITED PROVINCES OF AGRA AND OUDH).

On behalf of the Academy of Sciences of the United Provinces of Agra and Oudh, I have the honour to approach the Imperial Council of Agricultural Research, with the request that it may be pleased to sanction an annual recurring grant of Rs. 1,000 to this Academy.

Attention is invited to the attached letter ((Enclosure I), dated the 19th provincial body it had from its very inception an all-India character. Eminent scientists from all parts of the country are its members and the researches carried out in various laboratories have been published in its journals. To give it now formally an all-India character, its Rules and Regulations have been modified and its name has unanimously been changed into "The National Academy of Sciences, India".

The Academy has been publishing for the last four years a Bulletin containing the researches of the Scientists of every part of the country and has been maintaining a library of many important journals of scientific interest for the use of its members. The Academy has published many papers of considerable importance to the Agricultural and Veterinary sciences.

Lately the number of contributions which have come in, has been so great that the Bulletin has been converted into 'Proceedings' and it has

been decided to publish the Proceedings more frequently so that there may not be undue delay in giving publicity to the original works of the scientists engaged in research.

The Academy is, however, unable to fully give effect to these ideas and extend the sphere of its useful activities with the funds at its disposal. I, therefore, hope that the Imperial Council of Agricultural Research will appreciate the work that the Academy is doing and render it some financial assistance to enable it to continue this work.

\* { The four volumes of the Bulletin and Proceedings of the Academy of  
 { Sciences, U.P., the list of journals received by us, the list of papers of  
 † { agricultural and veterinary interest and the list of Office-bearers for 1935  
 { and members of the Academy are enclosed for your kind perusal.

## ENCLOSURE II.

### LIST OF OFFICE-BEARERS AND MEMBERS OF THE ACADEMY OF SCIENCES OF THE UNITED PROVINCES OF AGRA AND OUDH.

The following members were elected Office-bearers and the Members of the Council for the year 1935:—

#### PRESIDENT:

1. N. R. Dhar, D.Sc., F.I.C., I.E.S.

#### VICE-PRESIDENTS:

2. Prof. K. N. Bahl, D.Sc., D.Phil.
3. Prof. A. C. Banerji, M.A., M.Sc., F.R.A.S., I.E.S.

#### HON. TREASURER:

4. Dr. H. R. Mehra, Ph.D.

#### GENERAL SECRETARIES:

5. Dr. S. M. Sane, B.Sc., Ph.D.
6. Dr. P. L. Srivastava, M.A., D.Phil.

#### FOREIGN SECRETARY:

7. Prof. B. Sahni, D.Sc., Sc.D., F.I.S., F.A.S.B.

#### OTHER MEMBERS OF THE COUNCIL:

8. Prof. K. C. Mehta, Ph.D.
9. Prof. M. N. Saha, F.R.S.
10. Prof. S. S. Joshi, D.Sc.
11. Prof. Ch. Wali Mohammad, M.A., Ph.D., I.E.S.
12. Dr. Shri Banjan, D.Sc.
13. Dr. Rudolf Samuel, Ph.D.
14. Prof. J. A. Strang, M.A.
15. Prof. D. R. Bhattacharya, D.Sc., Ph.D., F.Z.S.
16. Prof. K. C. Pandya, D.Sc.

\*Kept in the I. C. A. R. Department.

†Attached herewith.

## LIST OF OFFICE-BEARERS AND MEMBERS OF THE COUNCIL, 1934.

## PRESIDENT :

Prof. K. N. Bahl, D.Sc., D.Phil.

## VICE-PRESIDENTS :

Prof. M. N. Saha, D.Sc., F.R.S., F.A.S.B.

Prof. B. Sahni, D.Sc., Sc.D., F.L.S., F.A.S.

## HONY. TREASURER :

Prof. D. R. Bhattacharya, M.Sc., D.Sc., Ph.D.

## GENERAL SECRETARIES :

Prof. P. S. MacMahon, B.Sc., M.Sc., F.I.C.

Prof. A. C. Banerji, M.A., M.Sc., F.A.S.B., I.E.S.

## FOREIGN SECRETARY :

Prof. N. R. Dhar, D.Sc., F.I.C., I.E.S.

## OTHER MEMBERS OF THE COUNCIL :

Prof. Nihal Karan Sethi, D.Sc.

Dr. S. S. Nehru, M.A., Ph.D., I.C.S.

Prof. C. A. King, B.Sc., A.R.C.Sc., M.I.M.E.

Prof. Ch. Wali Mohammad, M.A., Ph.D., I.E.S.

Dr. H. R. Mehra, Ph.D.

Prof. Rudolf Samuel, Ph.D.

Dr. S. M. Sane, B.Sc., Ph.D.

Prof. C. Maya Das, B.Sc., M.A., I.A.S.

Prof. K. C. Pandya, D.Sc.

## ORDINARY MEMBERS.

R.—Resident. N.—Non-Resident.

\*—Denotes a Fellow.

†—Denotes a Fellow of the National Institute of Sciences, India.

Alphabetical List of Ordinary Members.

| Date of Election. |     |  |
|-------------------|-----|--|
| 17-4-1931         | R   | Asundi, (R.K.), Ph.D., Reader, Physics Department, Muslim University, Aligarh.   |
| 1-1-1930          | †R* | Bahl, (K.N.), D.Phil., D.Sc., Professor of Zoology, Lucknow University, Lucknow. |

## Alphabetical List of Ordinary Members.

| Date of Election. |     |  |
|-------------------|-----|--|
| 1-1-1930          | †R* | Banerji, (A. C.), M.A., M.Sc., F.R.A.S., I.E.S., Professor of Mathematics, Allahabad University, Allahabad.      |
| 29-2-1932         | R   | Banerji, (G. N.), The Scientific Instrument Company Ltd., Albert Road, Allahabad.                                |
| 22-12-1932        | †N  | Banerji, (S. K.), D.Sc., Meteorological Office, Ganeshkhind Road, Poona, 5.                                      |
| 17-4-1931         | N   | Basu, Saradindu, M.Sc., Meteorologist, Ganeshkhind Road, Poona 5.  |
| 19-3-1931         | R   | Bhargava, Saligram, M.Sc., Reader, Physics Department, Allahabad University, Allahabad.                          |
| 17-4-1931         | R   | Bhargava, Vashishta, M.Sc., I.C.S., Assistant Magistrate and Collector, Budaun.                                  |
| 17-4-1931         | R   | Bhatia, (K. B.), I.C.S., Joint Magistrate, Shahjahanpur.   |
| 21-4-1933         | †N* | Bhatnagar, (S. S.), D.Sc., Professor of Chemistry, Government College, Lahore.                                   |
| 20-12-1934        | R   | Bhattacharya, (A. K.), D.Sc., Chemistry Department, Allahabad University, Allahabad.                             |
| 1-1-1931          | †R* | Bhattacharya, (D. R.), M.Sc., Ph.D., Docteur ès Sciences, Professor of Zoology, Allahabad University, Allahabad. |
| 17-4-1931         | R   | Bhattacharya, (D. P.), M.Sc., Bareilly College, Bareilly.  |
| 3-4-1933          | R   | Chand, Tara, M.A., D.Phil., Principal, K. P. University College, Allahabad.                                      |
| 29-2-1932         | R   | Charan, Shyama, M.A., M.Sc., Agra College, Agra.   |
| 1-1-1930          | R*  | Chatterji, (G.), M.Sc., Meteorologist, Upper Air Observatory, Agra.  |
| 17-4-1931         | R   | Chatterji, (K. P.), M.Sc., A.I.C., F.C.S., Reader, Chemistry Department, Allahabad University, Allahabad.        |
| 17-4-1931         | R   | Chatterji, (A. C.), D.Sc., Chemistry Department, Lucknow University, Lucknow.                                    |
| 9-2-1934          | R   | Chaturvedi, Champa Ram, Pandit, Professor of Mathematics, St. John's College, Agra.                              |
| 19-3-1931         | R   | Chaudhury, Rabindra Nath, M.Sc., M.A., Mathematics Department, Allahabad University, Allahabad.                  |
| 17-1-1931         | R   | Chaudhury, (H. P.), M.Sc., Lucknow University, Lucknow.  |
| 19-3-1931         | R   | Das, Ramsaran, D.Sc., Zoology Department, Allahabad University, Allahabad.                                       |
| 17-4-1931         | R   | Das, C. Maya, M.A., B.Sc., I.A.S., Principal, Agricultural College, Cawnpore.                                    |

## Alphabetical List of Ordinary Members.

| Date of Election. |     |  |
|-------------------|-----|--|
| 28-10-1932        | N   | Das, (A. K.), D.Sc., Alipore Observatory, Alipore, Calcutta.   |
| 22-12-1932        | N   | Das, (B. K.), D.Sc., Professor of Zoology, Osmania University, Hyderabad, Deccan.                          |
| 15-9-1931         | R   | Dasannacharya, (B.), Ph.D., Professor of Physics, Benares Hindu University, Benares.                       |
| 17-4-1931         | R   | Deodhar, (D. B.), Ph.D., Reader, Physics Department Lucknow University, Lucknow.                           |
| 17-4-1931         | R   | Dey, (P. K.), M.Sc., I.A.S., Plant Pathologist to Government, United Provinces, Nawabganj, Cawnpore.       |
| 29-2-1932         | R   | Deb. Suresh Chandra, D.Sc., Research Physicist, Bose Institute, Calcutta.                                  |
| 1-1-1930          | †R* | Dhar, (N. R.), D.Sc., Docteur ès Sciences, F.I.C. Professor of Chemistry, Allahabad University, Allahabad. |
| 19-3-1931         | R   | Dutt, (S. K.), M.Sc., Zoology Department, Allahabad University, Allahabad.                                 |
| 17-4-1931         | R   | Dutt, (S. B.), D.Sc., Reader, Chemistry Department, Allahabad University, Allahabad.                       |
| 28-10-1932        | R   | Dutt, (A. K.), D.Sc., Bose Institute, Calcutta.  |
| 22-2-1933         | R   | Ghatak, Narendranath, M.Sc., D.Sc., Chemistry Department, Allahabad University, Allahabad.                 |
| 19-4-1931         | R   | Ghosh, (B. N.), M.Sc., St. Andrew's College, Gorakhpur.  |
| 8-11-1933         | †N* | Ghosh, (J. C.), D.Sc., The University, Dacca.  |
| 19-3-1931         | R   | Ghosh, (R. N.), D.Sc., Physics Department, Allahabad University, Allahabad.                                |
| 19-3-1931         | R   | Ghosh, Satveshwar, D.Sc., Chemistry Department, Allahabad University, Allahabad.                           |
| 15-9-1931         | N   | Gogate, (D. V.), M.Sc., Baroda College, Baroda.  |
| 15-9-1931         | R   | Gordon, (C. B.), B.A., Christ Church College, Cawnpore.  |
| 17-4-1931         | R   | Gupta, (B. M.), Ph.D., Deputy Public Analyst to Government, United Provinces, Lucknow.                     |
| 21-12-1931        | R   | Hansen, (W. J.), M.A., Allahabad Agricultural Institute, Naini, E.I.R., Allahabad.                         |
| 17-4-1931         | R   | Higginbottom, Sam, D.Phil., Principal, Allahabad Agricultural Institute, Naini, E. I. R., Allahabad.       |
| 17-4-1931         | R*  | Hunter, Robert, (F.), D.Sc., Ph.D., Professor of Chemistry, Muslim University, Aligarh.                    |
| 3-4-1934          | R   | Joshi, (A. D.), P.E.S., Lecturer, Training College, Allahabad.   |
| 21-12-1931        | R   | Joshi, (S. S.), D.Sc., Professor of Chemistry, Benares Hindu University, Benares.                          |

## Alphabetical List of Ordinary Members.

| Date of Election. |     |  |
|-------------------|-----|--|
| 15-9-1931         | N   | Kichlu, (P. K.), D.Sc., Department of Physics, Government College, Lahore.   |
| 1-1-1930          | †R* | King, (C. A.), B.Sc., (Hons.), A.R.C.Sc., M.I.M.E., Principal, Engineering College, Benares Hindu University, Benares. |
| 21-4-1933         | N   | Kishen, Jai, M.Sc., Professor of Physics, S. D. College, Lahore.   |
| 9-2-1934          | N   | Kothari, (D. S.), M.Sc., Ph.D., Professor of Physics, The University, Delhi.   |
| 3-4-1934          | †R  | Krishna, Shri, (Dr.), Chemist, Forest Research Institute, New Forest, Dehra Dun.                                       |
| 5-10-1933         | R   | Kureishy, (A.M.), M.A., Reader in Mathematics, Muslim University, Aligarh.   |
| 1-1-1930          | R*  | Luxmi Narayan, D.Sc., Reader, Mathematics Department, Lucknow University, Lucknow.                                     |
| 1-1-1930          | †R* | MacMahon, (P. S.), D.Sc. (Hons.), M.Sc., Professor of Chemistry, Lucknow University, Lucknow.                          |
| 26-9-1934         | R   | Malaviya, Braj Kishore, M.Sc., Lok Nath, Allahabad.  |
| 1-1-1930          | †R* | Mathur, (K. K.), B.Sc. (Hons.), A.R.S.M., Professor of Geology, Benares Hindu University, Benares.                     |
| 1-1-1930          | †R* | Mehta, (K. C.), Ph.D., M.Sc., Agra College, Agra.  |
| 1-1-1930          | R*  | Mitter, (J. H.), M.Sc., Ph.D., Professor of Botany, Allahabad University, Allahabad.                                   |
| 15-9-1931         | R   | Mathur, (L. P.), M.Sc., St. John's College, Agra.  |
| 8-11-1933         | N   | Mathur, Ram Behari, M.Sc., Professor of Mathematics, St. Stephen's College, Delhi.                                     |
| 19-3-1931         | R   | Mazumdar, Kanakendu, D.Sc., Physics Department, Allahabad University, Allahabad.                                       |
| 19-3-1931         | †R* | Mehra, (H. R.), Ph.D., Reader, Zoology Department, Allahabad University, Allahabad.                                    |
| 21-12-1931        | R   | Mehta, (N. C.), I.C.S., Collector, Muzaffarnagar, U.P.   |
| 21-4-1933         | N   | Mela Ram, M.Sc., Asst. Professor of Physics, Foreman Christian College, Lahore.  |
| 21-4-1933         | N   | Mukerjee, Ashutosh, M.A., Principal, Science College, P. C. Bankipore (Patna).   |
| 22-2-1933         | R   | Narliker, (V. V.), M.A., Professor of Mathematics, Benares Hindu University, Benares.                                  |
| 17-4-1931         | R   | Nehru, (S. S.), M.A., Ph.D., I.C.S., M.L.C., Deputy Secretary to Government, U. P., Publicity Department, Lucknow.     |
| 17-4-1931         | R   | Panday, (K. C.), D.Sc., St. John's College, Agra.  |
| 3-4-1933          | N   | Parija, (P. K.), M.A., I.E.S., Ravenshaw College Cuttack.  |



## Alphabetical List of Ordinary Members.

| Date of Election. |     |   |
|-------------------|-----|---|
| 5-10-1933         | R   | Prasad, Gorakh, D.Sc., Reader in Mathematics, Allahabad University, Allahabad.                                    |
| 21-4-1933         | N   | Prasad, Kamta, M.A., M.Sc., Professor of Physics, Science College, P.O., Bankipore (Patna).                       |
| 15-9-1931         | N   | Prasad, Mata, D.Sc., Royal Institute of Science, Bombay.  |
| 3-4-1933          | R*  | Prasad, Badrinath, Ph.D., Docteur ès Sciences, Mathematics Department, Allahabad University, Allahabad.           |
| 17-4-1931         | R   | Puri, (B. D.), M.A., Thomason Civil Engineering College, Roorkee.   |
| 22-12-1932        | †N  | Qureshi (M.), M.Sc., Ph.D., Professor of Chemistry, Osmania University College, Hyderabad, Deccan.                |
| 20-12-1934        | R   | Rai, Ram Niwas, M.Sc., Physics Department, Allahabad University, Allahabad.                                       |
| 3-4-1933          | R   | Raja Ram, M.A., B.E., Malarial Engineer, Kasauli.   |
| 19-3-1931         | R*  | Ranjan, Shri, M.Sc., Docteur ès Sciences, Reader, Botany Department, Allahabad University, Allahabad.             |
| 15-9-1931         | N   | Rao, A. Subba, D.Sc., Medical College, Mysore.  |
| 22-2-1933         | N   | Rao, G. Gopala, B.A., M.Sc., Chemistry Department Andhra University, Waltair.                                     |
| 21-12-1931        | R   | Rao, D. H. Ramchandra, B.E., A.M.I.E., Engineer, Allahabad University, Allahabad.                                 |
| 14-3-1934         | N   | Rao, K. Rangadhama, D.Sc., Physics Department, Andhra University, Waltair.  |
| 22-2-1933         | N   | Ray, Bidhubhushan, D.Sc., 92, Upper Circular Road, Calcutta.  |
| 21-12-1931        | R   | Ray, Satyendra Nath, M.Sc., Physics Department, Lucknow University, Lucknow.                                      |
| 1-1-1930          | R*  | Richards, (P. B.), A.R.C.S., F.E.S., Entomologist to the Government, United Provinces, Cawnpore.                  |
| 1-1-1930          | †R* | Saha, (M. N.), D.Sc., F.R.S., F.A.S.B., F.Inst.P., P.R.S., Professor of Physics, Allahabad University, Allahabad. |
| 20-2-1932         | R   | Saha, Jogendra Mohan, M.Sc., Manager, Srikrishna Desi Sugar Works, Jhusi (Allahabad).                             |
| 1-1-1930          | †R* | Sahni, (B.), D.Sc., Sc.D., F.L.S., F.A.S.B., Professor of Botany, Lucknow University, Lucknow.                    |
| 17-4-1931         | R*  | Samuel, Rudolf, Ph.D., Professor of Physics, Muslim University, Aligarh.  |
| 17-4-1931         | R   | Sane, (S. M.), B.Sc., Ph.D., Reader, Chemistry Department, Lucknow University, Badshah Bagh, Lucknow.             |
| 3-4-1933          | R   | Sen, (K. C.), D.Sc., Imperial Institute of Veterinary Research, Muktesar, Kumaun.                                 |

## Alphabetical List of Ordinary Members.

| Date of Election. |    |  |
|-------------------|----|--|
| 20-12-1934        | N  | Sen Gupta, (P. K.), M.Sc., Professor of Physics. Rajaram College. Kolhapur (Bombay Presidency).                              |
| 21-4-1933         | N  | Seth (J. B.), M.A., Government College, Lahore.  |
| 17-4-1931         | R  | Seth, (S. D.), M.Sc., Christ Church College, Cownpore.   |
| 1-1-1930          | R* | Sethi, (R. L.), M.Sc., M.R.A.S., Economic Botanist to Government, United Provinces, Cawnpore.                                |
| 19-3-1931         | R  | Sethi, Nihal Karan, D.Sc., Agra College, Agra.   |
| 3-4-1934          | R  | Shah, (S. M.), M.A. (Lond.), Mathematics Department, Muslim University, Aligarh, U.P.  |
| 15-9-1931         | R  | Sharma, Ram Kishore. M.Sc., Physics Department, Ewing Christian College, Allahabad.  |
| 3-4-1933          | N  | Siddiqi, (M. R.), Ph.D., Professor of Mathematics, Osmania University, Hyderabad, Deccan.                                    |
| 3-4-1933          | R  | Siddiqui, Mohd. Abdul Hamid, M.B.B.S., M.S., F.R.C.S., D.L.O., Professor of Anatomy, King George's Medical College, Lucknow. |
| 17-4-1931         | R  | Singh, Avadhesh Narain, D.Sc., Department of Mathematics, Lucknow University, Lucknow.                                       |
| 17-4-1931         | N  | Soonawala, (M. F.), M.Sc., Maharaja's College, Jaipur (Rajputana).   |
| 19-3-1931         | R* | Srivastava, (P. L.), M.A., D.Phil., Reader, Mathematics Department, Allahabad University, Allahabad.                         |
| 10-8-1933         | R  | Srivastava, (R. C.), B.Sc. (Tech.), Sugar Technologist, Imperial Council of Agricultural Research, India. Cawnpore.          |
| 15-9-1931         | N  | Srikantia, (C.), B.A., D.Sc., Medical College, Mysore  |
| 19-12-1933        | R  | Strang, (J. A.), M.A., B.Sc., Professor of Mathematics, Lucknow University, Badshah Bagh, Lucknow.                           |
| 24-1-1933         | N  | Subramanian, (S.), M.A., Mathematics Department, Annamalai University, Annamalainagar P. C., South India.                    |
| 17-4-1931         | R  | Sulaiman, (S. M.), Hon'ble Sir, Chief Justice, High Court, Allahabad.  |
| 19-3-1931         | R  | Taimini, Iqbal Kishen, Ph.D., Chemistry Department, Allahabad University, Allahabad.   |
| 19-3-1931         | R  | Tewari, Shri Govind, M.A., Mathematics Department, Allahabad University, Allahabad.  |
| 3-4-1933          | R  | Thompson, (C. D.), M.A., Professor of Economics Allahabad University.  |
| 19-3-1931         | R  | Toshniwal, (G. R.), M.Sc., Physics Department Allahabad University, Allahabad.   |
| 3-4-1934          | R  | Varma, Rama Shanker, M.Sc., Christ Church College Cawnpore.  |

## Alphabetical List of Ordinary Members.

| Date of Election. |     |   |
|-------------------|-----|---|
| 20-12-1934        | R   | Varma, (S. C.), M.Sc., Zoology Department, Allahabad University, Allahabad.                                       |
| 9-2-1934          | R   | Vaugh, Mason, B.Sc., Ing., Agricultural Engineer, Allahabad Agricultural Institute, Naini, E. I. Ry. (Allahabad). |
| 19-3-1931         | †N* | Vijayaraghavan, (T.), D.Phil., Reader, Mathematics Department, Dacca University, Ramna, Dacca.                    |
| 1-1-1930          | †R* | Wali Mohammad, Ch., M.A., Ph.D., I.E.S., Professor of Physics, Lucknow University, Lucknow.                       |
| 15-9-1931         | R   | Wall, (W. G. P.), M.Sc., I.E.S., Associate I.E.E., M.R.S.T., Principal, Training College, Allahabad.              |

*N.B.*—The Secretaries will be highly obliged if the members will kindly bring to their notice errors, if there be any, in their titles, degrees and addresses.

## ENCLOSURE. III.

## PAPERS OF AGRICULTURAL INTEREST PUBLISHED IN THE JOURNAL OF THE ACADEMY OF SCIENCES, U. P.

1. Photosensitised oxidation of ammonia and ammonium salts and the problem of nitrification in soils. Vol. I, page 69. 1931-32.
2. Photochemical Hydrolysis of cane sugar. Vol. I, page 45, 1931-32.
3. The Origin of Nitric nitrogen in the atmosphere. Vol. I, page 82, 1931-32.
4. Bio-Chemistry-Influence of Temperature and Light Intensity on Photosynthesis and Respiration and an Explanation of "Solarisation" and "Compensation Point". Vol. 2, No. 3, page 141.
5. Photosynthesis of Formaldehyde from 'Nascent Carbon Dioxide' *In Vitro* and the importance of Respiration in Photosynthesis. Vol. IV, Part I, page 83.
6. Origin of Combined Nitrogen in the Atmosphere. The Analysis of Tropical Rain and its Importance in Agriculture. Vol. IV, Part II, page 147.
7. The Effect of Temperature on the Bacterial Ammonification of Urea. Vol. IV, Part II, page 169.
8. Nitrogen fixation in soils on the application of molasses. Vol. IV, Part II, page 175.
9. Some Aspects of Nitrogen Fixation in Soil. Vol. IV, Part IV, page 330.
10. Determining Sizes of Mangum Terrace Outlets. Vol. IV, Part IV, page 392.

PAPERS OF VETERINARY INTEREST PUBLISHED IN THE JOURNAL OF THE ACADEMY OF SCIENCES, U. P.

Volume II, III and IV.

1. On two new species of the genus *Cephalogonimus* Poirier from Water Tortoises of Allahabad with remarks on the family Cephalogonomiidae Nicoll. Vol. 2, No. 2, page 85.
2. On an Echinostome *Cercaria*—*Cercaria Palustris*—with Notes on its Life History. Vol. 2, No. 3, page 193.
3. New Blood Flukes of the family Spirorchiidae Stunkard from Indian Fresh-water Tortoises with discussion on the Systematic Position of the Genus *Coeritrema* N. G. and the relationships of the Families of Blood Flukes—Part I, Vol. 2, No. 4, page 203.
4. On the Trematode Parasites of a Rangoon Siluroid Fish *Clarias Batrachus* (Linnæus, 1785). Vol. 3, No. 1, page 33.
5. On New Trematodes of Frogs and Fishes of the United Provinces. India. Vol. 3, No. 1, page 41.
6. New Trematodes of Frogs and Fishes. Vol. 3, No. 2, page 99.
7. New Trematodes to the Genus *Opegaster* Ozaki 1928. Vol. 3, No. 2, page 113.
8. New Blood Flukes of the Family Spirorchiidae Stunkard from Indian Fresh-water Tortoises with Discussion on the Synonymy of certain Genera and the Relationships of the Families of Blood Flukes—Part II. Vol. 3, No. 4, page 169.
9. On Amphistome Parasites of Sheep and Goat from Allahabad. Vol. IV, Part I, page 95.
10. On a New Trematode from an Indian Fresh-water Fish. Vol. IV, Part I, page 107.
11. On New Trematodes of Frogs and Fishes of the United Provinces, India. Vol. IV, Part I, page 113.
12. Studies on the Family Heterophyidae Odhner 1914. Part I.—On a New Distome from the Indian Fishing Eagle-*Haliaeetus leucoryphus*—with remarks on the Genera *Ascocotyle* Looss, 1899, and *Phagicola* Faust, 1920. Vol. IV, Part III, page 269.
13. On a New Species of *Catantropis* Odhner 1905, from an Indian Fowl-*Gallus Bankiva* Murghi. Vol. IV, Part III, page 283.
14. On Eight New Species of Genus *Cyclocoelum* Brandes from North Indian Snipes. Vol. IV, Part IV, page 342.
15. Contribution to the Digenetic Trematodes of Microchiroptera of Northern India. Vol. IV, Part IV, page 371.
16. New Hemiurids (Trematoda) from Indian Fresh-water Fishes. Vol. IV, Part IV, page 381.

## APPENDIX VIII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 17th September 1935, on Subject No. 5:—Scheme for Research in Economic Ornithology at a cost of Rs. 41,075 spread over a period of five years submitted by Mr. Salim A. Ali through the Government of Bombay.**

In February 1935, the Advisory Board considered the scheme mentioned above (Enclosure I not printed. See pages 77 to 83 of the Proceedings of the Meetings of the Advisory Board held in February, 1935) and recommended that information regarding similar work already done, or in progress, should first be invited from Provincial Departments, the Zoological Departments of India and Universities, and that the information and suggestions received should be placed before a Committee consisting of representatives of Universities, Provincial Agricultural and Veterinary Departments and the Zoological Survey, the Locust Research Entomologist and a representative of the Bombay Natural History Society.

2. A circular letter No. 99/35-A., dated the 11th May 1935 (Enclosure II) was accordingly sent to Local Governments, Constituent States and the other authorities concerned; the replies received will be found in Enclosure III.

3. The Vice-Chairman to the Council considers it desirable that the replies received should be considered by the Advisory Board before a Committee is appointed.

## ENCLOSURE I.

(not printed).

## ENCLOSURE II.

CIRCULAR LETTER TO ALL LOCAL GOVERNMENTS AND THE GOVERNMENTS OF HYDERABAD, MYSORE, BARODA, COCHIN, TRAVANCORE AND BHOPAL, No. F. 99/35-A., DATED THE 11TH MAY 1935.

I am directed to forward herewith a scheme (Appendix I) of research in Economic Ornithology by Mr. Salim A. Ali (lately of the Bombay Natural History Society) which was recommended for a grant by the Government of Bombay. The Advisory Board of the Council has recommended that further information regarding research work already carried out or in progress, on the subject, should be obtained from the Imperial and Provincial Departments concerned, the Zoological Survey of India and the Indian Universities, and that the suggestions of these bodies should be invited as to the most suitable method of encouraging research in Economic Ornithology as applied to agriculture and horticulture. It was decided that the replies received should be placed before a committee which would include representatives of Universities, Agricultural and Veterinary Departments and the Zoological Survey of India the Locust Research Entomologist to the Council and a representative of the Bombay Natural History Society and that the report of the Committee should be submitted to the Advisory Board at its next meeting.

2. I am now to request that if there is no objection this Department may kindly be furnished with such information and suggestions as the various provincial Departments \* (and the Departments of the Hyderabad State, etc.,

Universities in Madras ) may desire to put forward on the subject, etc. together with any observations which the local Government may have to make on the matter. Government of Hyderabad, etc.

The favour of an early reply is requested.

### ENCLOSURE III.

#### I.

COPY OF A MEMORANDUM FROM THE DIRECTOR, ZOOLOGICAL SURVEY OF INDIA.

As is stated by the author of the scheme for research in Economic Ornithology, Mr. Salim A. Ali, "the object (not objection) of the proposed work during the first year is mainly to convince the authorities of the importance and desirability of creating a department of Economic Ornithology to work in co-operation with those of Economic Botany and Economic Entomology". He has, therefore, not given details of the scheme beyond indicating that certain selected species of birds whose bearing on agriculture, horticulture and forestry is more or less apparent will be selected and studied from their time of hatching to the adult stage, with special reference to their food and feeding habits during various stages of growth and at different times of the year. The proposed work is of great economic importance and in view of the fact that Mr. Salim A. Ali is a recognised Ornithologist and has had a fair amount of experience in carrying out bird surveys in different parts of South India, I would very strongly recommend the scheme for consideration by the Imperial Council of Agricultural Research. I would, however, suggest that Mr. Salim A. Ali may be asked to submit a more detailed scheme for the information of the various Universities, institutions, etc., who are being addressed in connection with the scheme, as otherwise it would not be possible for these bodies to give detailed views regarding the usefulness of the work to be carried out.

A great deal of work in this connection has been done in the United States of America by the Department of Agriculture. In 1885 the 48th Congress appropriated a sum of 5,000 dollars for the promotion of Economic Ornithology and made the work a branch of the Division of Entomology. Dr. C. H. Merriam was appointed as the first Economic Ornithologist and in the following year the "scope of work was enlarged and its usefulness greatly increased since the appropriation of \$10,000 had been granted for the promotion of Economic Ornithology and Mammalogy; an investigation of the food habits, distribution and migrations of North American birds and mammals in relation to agriculture, horticulture and forestry". Since that date the work has been very greatly extended and made into a separate unit of the Department of Agriculture, called the "Bureau of Biological Survey" and in the Year Book of the U. S. Department of

\*Not to Assam, N. W. F. P., Baroda, Cochin, Travancore and Bhopal.

Agriculture for 1932, which is the latest volume available, the work of the Department in reference to the establishment of bird refuges on almost every farm in the United States is advocated and the usefulness of such refuges to agriculture is discussed in fair detail. Further, the question of attracting birds by planting trees the fruits of which have a distinct bird-food value, is advocated not only for attracting birds but to provide shelters for them. Suggestions are also made for providing artificial sources of water, where natural streams or pools are not found in the vicinity of farms. The Bureau of Biological Survey of America, I may also add from my personal knowledge, employs a permanent staff of a great many experts for carrying on investigations on economic ornithology, and is doing work of very great value in connection with agriculture, horticulture and forestry.

Work on economic ornithology in India has so far been very limited. Mr. C. W. Mason, who was for a time the supernumerary Entomologist of the Imperial Department of Agriculture in India, examined the stomach contents of 1,325 birds which were shot at Pusa during 1907—1909. The results of his investigations were published in the "Memoirs of the Department of Agriculture in India," (Entomological Series), Vol. III, 1912, in a joint paper by Mr. Mason and Dr. H. Maxwell Lefroy, but this work, as Mr. T. Bainbrigge Fletcher remarked in his "Some South Indian Insects" (Madras, 1914), p. 223, "relates solely to one small district in Bihar and the number of observations is too small to be satisfactory". Bainbrigge Fletcher in the work noted above published a few notes about some South Indian birds of economic importance, but this work also was not sufficiently extensive to be of any great use. Some further information is also to be found in a series of papers on birds of Indian gardens published in the "Agricultural Journal of India" (1915—1924) and later published as a separate work in 1924. Other scattered references are to be found in various ornithological works and in scientific journals, but the information available is far from adequate.

In this connection reference is also invited to the very interesting investigations carried out by Dr. Bernard Rensch of the Zoological Museum of the University of Berlin in the Lesser Sunda Islands where he found very peculiar modifications in the relative sizes of the stomach and intestine in some species of birds which are common both in the Sunda Islands and in Europe. His investigations showed that the European races of the birds investigated have relatively larger stomachs and longer intestines than the Malayan races and this he has explained by the comparatively shorter hours of daylight and the influence of the longer winter season in Europe\*. Investigations on these lines in reference to the races of birds of economic importance in different provinces of India would be very valuable and might explain to some extent the greater or less economic importance of the same species of birds in the different provinces of India.

The proposed line of investigations will not only fill up an unfortunate hiatus in our knowledge of the economic value of birds in relation to agriculture, horticulture and forestry, but also collect information regarding the life-history of Indian birds—a subject on which also our information is very meagre indeed.

\*See B. Rensch—Eine biologische Reise nach den Kleinen Sunda-Inseln Berlin, 1930).

## II.

## COPY OF A MEMORANDUM FROM THE PRESIDENT, FOREST RESEARCH INSTITUTE AND COLLEGE, DEHRA DUN.

1. The Advisory Board of the Council of Agricultural Research has restricted the scheme under consideration to economic ornithology as applied to agriculture and horticulture. The committee of referees contains no representative of the interests of forestry. It is presumed that Mr. Salim Ali's proposals for research on birds of economic importance to forestry are rejected, and we are therefore not directly interested in the scheme.

2. In reply to the enquiry regarding research work already carried out or in progress, it may be stated that the Entomological Branch of the Forest Research Institute has full information on all that has been published on the economic ornithology of India and analysis reveals that it amounts to very little of practical importance. Mr. Salim Ali's statement that "the scope and usefulness of the study of economic ornithology are unbounded" is endorsed.

3. With regard to the scheme for research (as restricted by the exclusion of forestry problem) on which suggestions are invited the following criticisms are offered.

4. I disagree that research for a few years by one officer and an assistant "must necessarily be of an academical rather than of a practical or remunerative character". It should be confined to the investigation of a few clearly defined problems with limited objectives; these problems should be selected by the provincial agricultural departments and not by the research officer. The possible value of the results to forest departments should also be ascertained. That work should be done "mainly to convince the authorities of the importance and desirability of creating a department of economic ornithology" is, in my opinion, a mistaken argument.

5. I disagree that the identification of stomach contents can be done efficiently by the provincial Economic Botanist and Economic Entomologist. The outturn of stomach contents from the investigations of a whole-time economic ornithologist is likely to be far greater than can be disposed of by these agencies, without extra staff. Moreover neither the Botanist nor the Entomologist can identify specifically plant and animal fragments without special study, special technique and special collection of materials in the bird's territory. Identifications unless specific are useless. They should be done by competent additional staff under the control of the ornithologist.

6. Aviaries are useful for studies on life histories and food-preferences but they imply permanent location and attendants and Mr. Salim Ali has not budgetted for any labour.

7. Census work if covering several bird territories implies staff but none is budgetted. Isolated visits by Mr. Salim Ali would scarcely suffice.

8. An important omission from the scheme is a study of the environmental factors which determine the colonisation of an area by a desired or undesired species of bird, and the practical possibilities of creating or destroying the essential factors.



## III

## COPY OF LETTER FROM THE DIRECTOR, IMPERIAL INSTITUTE OF AGRICULTURAL RESEARCH, No. 575/C. OF 1935, DATED THE 24TH JUNE 1935.

I have the honour to forward herewith a note (IV below) by the Imperial Entomologist containing his views on the proposal for carrying out a scheme of research in economic ornithology.

2. As birds play an important part in checking the ravages of insect pests of crops, a systematic study of their life histories with special reference to their food and feeding habits is likely to prove of great importance to agriculture and forestry. I am, however, of opinion that the most suitable method of attacking the problem should be worked out by the special committee, which the Imperial Council of Agricultural Research proposes to appoint on this subject, in the light of the work already done and the data available.

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COPY OF A NOTE FROM THE IMPERIAL ENTOMOLOGIST, TO THE DIRECTOR, IMPERIAL INSTITUTE OF AGRICULTURAL RESEARCH, DATED 12TH JUNE 1935.

I have already submitted a report on this Scheme in my U. O. No. 477, dated 11th February 1935, a copy of which is enclosed for ready reference (V below).

The Council now wants further information regarding research work on Economic Ornithology already carried out or in progress in this Institute and invites our suggestions as to the most suitable methods of encouraging research in this subject.

The only important work which has been done on Insectivorous birds at this Institute was published by C. W. Mason in the Memoirs Department of Agriculture, Entomological Series, Vol. III, 1912. Mr. Fletcher, in collaboration with Mr. Inglis also published a long series of articles on Indian Birds, including some of agricultural importance, in the Agricultural Journal of India.

Regarding the most suitable methods of encouraging research in Economic Ornithology I beg to submit as follows—

The study of Birds in reference to Agriculture includes:—

- (a) Preparation of lists of Birds which eat insects of economic importance and of those which damage or benefit agriculture in various other ways, *e.g.*, cross pollination agents, *etc.* For this purpose careful study of the nature (Insects, vegetation, otherwise) of the food of different birds and their nesting throughout the year is essential.
- (b) Study of the distribution, life-history and habits of birds of Economic importance, and methods of encouraging beneficial species and getting rid of harmful ones.

The work mentioned under (a) above, in my opinion, can best be done at Agricultural Institute where life-histories, habits, *etc.*, of

various insects are being actually studied. Every bird which one sees need not be shot and dissected but only those which frequent fields and gardens. The most suitable man for undertaking the study of insectivorous birds is one who is primarily a good entomologist and possesses some knowledge of birds in addition. He should be familiar with the habits of the insect fauna of the area and be able to identify himself the stomach contents of the birds immediately after their death. The chief man should have a taxidermist to assist him in the preservation of the birds, which can be got named by specialists afterwards.

Most of the work mentioned under (b) above, can best be carried out in Universities or under the auspices of Natural History Societies by men having special knowledge of birds and their habits. Post-graduate students of Zoology having inclination for work on birds can be encouraged by award of research scholarships to select birds of economic importance as subjects of their study.

Our lists of definitely beneficial and harmful birds are yet very small, it therefore need hardly be emphasized that before the co-operation of the universities and other academic bodies can be usefully enlisted a large amount of work mentioned under (a) above has yet to be done in India. Mason's work (op. cit.) was carried out at one locality only, viz., Pusa, and at time when our knowledge about the exact species of insects eaten and their status as pests was rather limited. Work on insectivorous birds has to be carried out at diverse localities before a particular bird can be definitely declared as beneficial or otherwise.

With regard to the methods of encouraging or discouraging particular species of birds, apart from the application of biological means based on the study of the biology of the species concerned, help of the legislature may have to be invoked for the protection of certain birds.

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## V.

COPY OF U.-O. FROM THE IMPERIAL ENTOMOLOGIST, PUSA, TO THE DIRECTOR, IMPERIAL INSTITUTE OF AGRICULTURAL RESEARCH, DELHI, NO. 477, DATED THE 11TH FEBRUARY 1935.

Birds play a very important part in checking ravages of Insect pests of crops. In fact next to predaceous and parasitic insects, insectivorous birds constitute the most important natural checks which can keep the number of injurious insects within reasonable limits. Whereas such useful birds should be encouraged, there are, on the other hand, some birds (e.g., the Parroquets, the Bee-eaters, etc.), which prey on beneficial insects and which, therefore, have to be discouraged. With the exception of a few works, no systematic attempt has so far been made in India to study the insect food of the common birds at different times of the year and in different parts of the country. Furthermore, in many cases the food of the nestling being different from that of the adult bird of the same species, the food of the various stages in the life history of a bird has therefore to be carefully studied. Very few insectivorous birds indeed have been studied in India from this point of view. It will thus be readily recognised that Economic Ornithology is an important part of Economic Entomology. The object of the scheme, therefore, is commendable.

With regard to the qualifications of the man suitable for undertaking a study of the insectivorous birds, he must primarily be a good entomologist and in addition should possess some knowledge of birds. He should be familiar with the nature, habits and life-history of the insect fauna of the area, and be able to determine himself the stomach contents of the birds immediately after their death. Of course the knowledge of the habits of the local birds is also essential but there is comparatively sufficient literature on these aspects of birds common in the plains of India.

The person selected for the study of insectivorous birds should in my opinion be attached to an Institution where the life-histories and biology of insect pests are being extensively studied. As far as my information goes, the entomological staff at the Agricultural College, Poona, is just sufficient for the teaching work in the College and has hardly any time for doing research work on insects.

The above remarks apply to the insect portion of the scheme only. I cannot possibly express an opinion on the value of birds as "pollination agents and in the dispersal of plant life".

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 VI

LETTER FROM THE UNDER SECRETARY-IN-CHARGE, DEVELOPMENT DEPARTMENT, GOVERNMENT OF MADRAS, No. 1087-MS., DATED THE 5TH AUGUST 1935.

I am directed to enclose copies of the remarks and suggestions of the Director of Agriculture, Chief Conservator of Forests and the Madras and Annamalai Universities on the scheme of research on Economic Ornithology. The Andhra University states that no research on this subject has till now been made by the University and that it has no suggestions to make in the matter.

2. The proposals made by the Director of Agriculture for similar work on the scheme in this Presidency have not been placed before the Provincial Agricultural Advisory Committee and examined by the Local Government. If the Council agrees that Provincial schemes may be invited, this procedure will be followed and the scheme forwarded with this Government's recommendation.

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 VII

COPY OF LETTER FROM THE DIRECTOR OF AGRICULTURE, TO THE SECRETARY TO GOVERNMENT, DEVELOPMENT DEPARTMENT, NO. D. DIS. D.-960-35, DATED THE 3RD JULY 1935.

I enclose a copy of a note of the Government Entomologist on the scheme for research on Economic Ornithology.

2. I am in agreement with him that the subject is of such importance that the scheme should be for all-India and not confined to Bombay. The staff for Madras will be as follows:—

|  | Average cost for<br>a year. |
|--|-----------------------------|
|  | Rs.                         |
| One Assistant on Rs. 75—105 . . . . .                                      | 1,124                       |
| One Fieldman on Rs. 30—48 . . . . .  | 488                         |
| Pensionary contribution at 8-1/6 per cent. on the maximum<br>pay . . . . . | 150                         |
| Leave contribution at 12½ per cent. of Rs. 1,612 . . . . .                 | 201                         |
|  | <hr/>                       |
|  | 1,963                       |
|  | or                          |
|  | 2,000                       |
|  | <hr/>                       |
|  | per year.                   |

The total cost for 5 years comes to Rs. 10,000.

*Report by the Government Entomologist, Madras.*

I propose to discuss the scheme under the following headings:—

1. *Need for research in Economic Ornithology.*—Economic Ornithology is a subject of great importance to the agriculturist. Birds affect man in various ways, either for good or bad. A study of the bird friends and foes is of great help to the farmer so as to enable him to find out those deserving protection and destruction at his hands.

It is a fact that while considerable attention has been bestowed on the study of birds in Europe and America, in India, where birds of all sorts are found in large numbers, the study has received only very meagre attention. It is true that there are some publications on Indian birds but these are very few and do not contain in many cases detailed information. Hence, there is need for the study of birds in India and the move on the part of the Bombay Agricultural Department is a move in the right direction.

2. *Research work already done in the Madras Presidency.*—As far as the Madras Presidency is concerned, the earliest attempt to study bird life was that of Mr. T. B. Fletcher, Government Entomologist, from April 1912 to December 1913. In his spare time he devoted some attention to the study of some of the common birds found in and around Coimbatore and the information gathered by him is found on pages 222 to 230 of his book on "Some South Indian Insects" published by the Government Press in 1914. Since Mr. Fletcher left Madras for Pusa to accept the post of the Imperial Entomologist, Mr. P. Susainathan on the staff of the Government Entomologist continued the study of birds in addition to other work. The results of his observations were embodied in his paper on "Bird friends and foes of the farmer" published as bulletin No. 81 of the Madras Agriculture Department. Since he left the Section to take up appointment elsewhere no further attention was bestowed on this study due to other pressing problems to be tackled by the Section. Occasionally, observations have, however, been made by the staff of the Entomologist on particular birds.

3. *Suggestions for further work.*—The Scheme of Mr. Salim Ali, as it stands, is only for the Bombay Presidency. As the subject of Econom

Ornithology is of all-India importance, I would suggest a scheme for the whole of India, similar to that proposed to be financed by the Imperial Council of Agricultural Research for work on sugarcane pests, to be worked out not only in the Provinces but also in the Native States.

The scheme may, in the first instance, be for five years but need not be costly as in the case of sugarcane. The all-India officer may be on the same grade as indicated in the scheme of Mr. Salim Ali but provision should be made for the appointment of one assistant and one fieldman in each of the Provinces and the States, the grades of the staff concerned being the same as those in vogue in their respective places.

If this scheme is accepted, the grade of the assistant in Madras will be Rs. 75—7½/2 (biennial)—105 and that of the fieldman Rs. 30—3/2 (biennial)—48. It will be possible for the Government Entomologist to give facilities for work at the Insectary, loan of microscopes etc. He will also be prepared to supervise the work of the staff employed for the purpose. As some work has already been done in Madras it will be easy for the staff to make a good beginning.

Regarding the items of research work, in addition to the detailed study of the food of the birds of selected species, some attention should be bestowed on the different species of birds found in the locality. The systematic study of birds should not be neglected. If the scheme for the whole of India is accepted the headquarters could still be at Poona.

### VIII

COPY OF LETTER FROM THE CHIEF CONSERVATOR OF FORESTS, No. 4012/35-C.-2, DATED THE 7TH JULY 1935.

#### *Scheme of Research on Economic Ornithology.*

There is no doubt that birds are of great importance in forestry. This fact has been recognised in Germany and France very many years ago and special measures to protect and attract the birds to the forest undertaken as long ago as 1907. Little is known about Indian birds; a few British Officers and still fewer Indian Officers of the Forest Department possess much knowledge of birds other than game birds. The possibility of birds destroying teak defoliators and sandal spike vectors and other vermin is an example of the useful assistance which birds may render to the forests. Their utility as agents in cross-pollination of flowers and in the dissemination of seed are other examples. It is more than probable that if we know which were the more voracious birds that feed on insects we can by encouraging their increase in the forests, control the defoliators, spike vectors and other vermin successfully at little expense.

2. It is intended that the study of Natural History should be made a subject for the students of the Madras Forest College and it is desirable that Government obtain from the new Institution of Ornithology when it begins to function, simple instructions as to the lines on which Rangers should be taught at the College about the identification of birds, their habits, food, etc., and the lines on which they should work thereafter.

The Forest Department is, therefore, interested in the scheme and will be glad to render such assistance as it can to help the proposed research.

## IX

COPY OF LETTER FROM THE REGISTRAR, UNIVERSITY OF MADRAS, No. X.A.  
-968, DATED THE 18TH JULY 1935.

I have the honour, by direction, to forward herewith the views of this University on the scheme of research on Economic Ornithology, submitted to the Imperial Council of Agricultural Research by Mr. Salim Ali through the Bombay Government. I may state that the remarks forwarded herewith contain the opinions expressed on the Scheme by the Chairman of the Boards of Studies in Botany, Zoology and Agriculture.

## UNIVERSITY OF MADRAS.

The scheme outlined by Mr. Salim Ali suggests that bird life in India should be studied (1) from the point of view of gathering more information on the food and breeding habits of birds and (2) with a view to determining the extent to which the life cycles of insects are controlled by the habits of birds and periodical changes in bird life.

In regard to the first proposal, there can hardly be any doubt that, as in other countries, particularly America, France and Germany, a special attempt should be made, by competent research officers to study the life histories of birds in general and of specially selected species in particular. In India a good deal of information exists on the subject but this has not been pooled together and made available in a consolidated form to the public. A good beginning was made by Mason and Lefroy (Mem. Dept. Agri., India, Entomol. Ser. 3) so far as the food of Indian birds is concerned. Though several regional surveys have been made by experts, we still know very little about the breeding and migratory habits of Indian birds and the consequent part they play in the economy of nature. This aspect of study in an extensive country like India will take years, and must certainly be costly, but it is worthwhile undertaking.

In regard to the second aspect, one cannot be so optimistic. Progress in this direction must necessarily be slow. The life cycles of insects and birds cannot be definitely correlated until a good deal of accurate information has accumulated as a result of intensive studies on selected types, and it may take years before one could say that a particular bird is an effective check on any agricultural pest. Factors which control bird and insect life are not easily manipulated and the inter-relationships between the one and the other are sometimes so complicated that it often becomes very difficult to say accurately as to what will be the result of biological control measures taken to regulate insect life. Often such measures have ended unexpectedly in results certainly not desired. The greatest possible amount of caution is necessary in this matter. Further, the conditions governing the lives of insects and birds in the different parts of this sub-continent are not similar, and a set of control measures which may be good for one locality need not be so for another. These and other matters make one hesitate to express any definite views on the second part of the scheme proposed by Mr. Salim Ali.

But apart from the economic aspect of ornithology, there is the academic aspect of it, i.e., the study of birds and bird life for its own sake. This needs all possible encouragement. Important discoveries have resulted from work undertaken in a purely academical spirit; and

it is unlikely that if a scheme of this sort is sanctioned, much valuable data may be obtained in the course of a few years.

It is also suggested that, in addition to the staff proposed, a Botany Assistant would also be needed in order to carefully record the botanical portions of the investigation, *viz.*, the correct identification of the plants visited by the birds, careful observations regarding the methods of pollination, the identification of the plant-foods of the several birds from the droppings or the viscera of the birds and the identification of the seeds or fruits sticking to the feet, beaks or feathers of the birds. Very frequently it may be necessary, in cases of doubt to germinate the seeds or fruits in order to find out the plants to which these belong.

Though the scheme referred to is only for the Bombay Presidency, yet, considering the all-India importance of the work, an all-India scheme with the Assistants working in the different Provinces will be quite welcome.

In regard to the actual cost of the scheme, it appears to be very modest, and it will be extremely fortunate if the expenses are kept within the proposed amount.

As for the locality, Poona is eminently suited for the suggested piece of work, both by its natural environmental conditions, and also by its proximity to Bombay with the valuable collection of the Bombay Natural History Society always available for reference and consultation.

It is also felt that it will be necessary to request the co-operation of the several agricultural, botanical and ornithological research workers in the country

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X

ANNAMALAI UNIVERSITY.

*Suggestion of Dr. S. N. Chakravarti, M.Sc., D.Phil. (Oxon.), Dean,  
Faculty of Science.*

At present very little research in Economic Ornithology is being done in the University. The scheme of Mr. A. Salim Ali is not likely to produce any practical results. A much more comprehensive scheme is necessary, and even then the immediate economic benefit of such a scheme would be doubtful.

The best way of encouraging research in Economic Ornithology would be to create some special research studentships. These studentships should be made available at those Universities and Government Institutions where there are some distinguished specialists already working on the subject. Alternatively a Central Institute may be started. There should be provision for a Professor—who must be a well-trained expert in the subject—a lecturer, an assistant and about a dozen research students. The details of the recurring and non-recurring expenditure will have to be left to the expert.

(SD.) S. N. CHAKRAVARTI.

## XI

LETTER FROM THE SECRETARY TO THE GOVERNMENT OF BOMBAY, REVENUE DEPARTMENT, No. 3274-A./33, DATED THE 10TH JULY 1935.

With reference to your letter No. F. 99/35-Agri., dated 11th May 1935, I am directed by the Government of Bombay (Transferred Departments) to forward a copy of the letter from the Director of Agriculture, No. 493-L.-6974, dated 28th June 1935, and to state that they concur in the views expressed therein. No experiments on ornithology have been undertaken in Sind but the Chief Agricultural Officer in Sind considers it desirable to undertake such work. I am to state that the remarks of the University of Bombay will be communicated when received.

## XII

COPY OF LETTER FROM THE DIRECTOR OF AGRICULTURE, BOMBAY PRESIDENCY No. 493-L.-6974, DATED THE 28TH JUNE 1935.

SUBJECT:—*Scheme of research on Economic Ornithology.*

In continuation of my letter No. 493-L./8761, dated 21st instant, I have the honour to say that I now find from the copy of the reply, No. 7727 of 24th idem, from the Registrar, University of Bombay, to the address of Government, that Government have already addressed him in the matter and, therefore, it is not necessary for me to await his reply to me. I, therefore, beg to offer the following remarks:—

2. I would like to stress the point that the proposed research is essentially for an Ornithologist to undertake (provided he is at the same time a general Biologist), and not for an Entomologist as suggested in the note of the Imperial Entomologist, Pusa. Research in Economic Ornithology does not merely involve a consideration of the insect food of birds but also of their vegetable and other animal food and their general relation to and interaction with their animated and inanimated surroundings of which agriculture, forestry, animal husbandry, etc., are parts. As it is primarily an investigation of the living bird in its bearing on human industry that is to be studied, it is obviously imperative that an Ornithologist should be placed in charge of the research and not an Entomologist, who can deal with merely a part of the problem, viz., insect food.

3. Mr. Salim Ali has contributed the following four articles on Ornithology in the Journal of the Bombay Natural History Society:—

- (1) The Role of Sun-birds and flower peckers in the propagation distribution of the Tree-parasite, *Loranthus longiflorus* in the Konkan, Volume XXXV, No. 1, pages 144 to 149, 1931.
- (2) Flower birds and bird flowers in India—Volume XXXV, Nos. 3 and 4, Part II, pages 573—605, 1933.
- (3) The Hyderabad State Ornithological Survey. Pages 356 to 390, Volume XXXVI, Part I, 1933.
- (4) The Ornithology of Travancore and Cochin—Volume XXXVII, No. 4, pages 814—889, 15th April 1935.

I therefore, consider that he deserves encouragement.



## XIII

LETTER FROM THE REGISTRAR, UNIVERSITY OF BOMBAY, No. 11095, DATED THE 28TH AUGUST 1935.

I have the honour, by direction of the Syndicate of this University, to forward to you a copy of the minutes of the meeting of the Board of Studies in Agriculture to whom the matter was referred, and whose suggestions have been approved by the Syndicate.

*Minutes of the meeting of the Board of Studies in Agriculture held on Saturday the 17th August 1935.*

The Board proceeded to discuss the scheme for research on Economic Ornithology submitted by Mr. Salim Ali to the Imperial Council of Agricultural Research, and referred to the Board by the Government of Bombay for an opinion.

The Board further considered the question of co-operation of the Economic Botanist to Government, Bombay, and the Professor of Entomology, College of Agriculture, Poona, in scheme. Professor L. S. S. Kumar and Professor T. N. Jhaveri agreed to render all possible assistance; but it was suggested that there is a need for the following staff as it was not possible for the Economic Botanist and the Professor of Entomology to undertake any additional work with their present staff:

1. One Botanical Assistant and one Zoological Assistant in the grade of Rs. 70—5—100.
- (N. B.—A post of Assistant on Rs. 75—5—100 has been provided for in the scheme submitted by Mr. Ali. This post will be merged with one of the two posts of Zoological and Botanical Assistants.)
2. Three Agricultural Sub-overseers in the grade of Rs. 35—5/2—60.

It was also suggested that the scheme of research on Economic Ornithology should be located in the College of Agriculture, Poona, and the Government of Bombay may be requested to provide suitable office and laboratory accommodation at the College.

It was the unanimous opinion of the Board that both the harmful and beneficial aspects of birds should be kept in view in the research on Ornithology, since there is considerable damage caused every year by the harmful species of birds in this Presidency.

## XIV

LETTER FROM THE ASSISTANT SECRETARY TO THE GOVERNMENT OF BENGAL, AGRICULTURE AND INDUSTRIES DEPARTMENT, No. 3350, DATED THE 8TH JULY 1935.

With reference to your letter No. F-99/35-Agri., dated the 11th May 1935, I am directed to say that no research work on ornithology has been carried out either by the Agriculture Department in Bengal or by the University of Dacca and that they are not in a position to make any useful suggestions in the matter. The University of Calcutta was also addressed but their reply has not been received yet.

2. I am, however, to forward, for the information of the Council, copy of notes on the subject by the Conservator of Forests, Bengal, and by Dr. S. C. Law, M.A., Ph.D., a member of the Committee of Management of the Zoological Garden, Calcutta.

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XV

*A note by the Conservator of Forests, Bengal, on scheme of research on Economic Ornithology.*

Economic Ornithology is certainly a most important subject in an agricultural country like India and one which has been totally neglected; practically no systematic work has been done though in all Western countries this subject is considered of greatest importance.

So far as we are aware, the only systematic work, drawn out here, is that by Mason at Pusa from 1907 to 1909 and published as a Memoir in 1912 as mentioned by Mr. Salim Ali. Some species stomach contents were very fully investigated and certain conclusions come to, but these observations were practically confined to the vicinity of Pusa and except for a few articles published and a paper read by Mr. Susainathan at Nagpur in 1920 and a Memoir written by the same author and published as a Bulletin by the Madras Department of Agriculture in 1921, no other work appears to have been done anywhere else in India.

With regard to the Economic value of Birds there can be no doubt, it is most important especially to Agriculture and in a less, but by no means negligible, degree to Forestry.

Some species such as the Paroquets are known to be harmful; these birds may be considered pests on account of the incalculable damage done by them to standing crops but even amongst them, some members of the family are probably less harmful than others and this requires further research; others again, such as the Woodpeckers, are clearly beneficial, destroying many injurious grubs which infest and damage both forest and other trees; here again more investigation is required as to what extent each member of the family is beneficial, others may be termed neutral but the economic value of the vast number of species is still unknown.

There certainly is need of some sort of research, both Federal and Provincial, such as suggested by Mr. Salim Ali and if a special post, as Economic Ornithologist with his own staff, is feasible so much the better. Failing this, Provincial Governments may be moved to financially assist private individuals or those holding posts in Museums or Universities who are interested in the subject and give them all possible facilities to undertake the work. Nature study at schools and colleges should also be more encouraged. Some colleges have most excellent museums of their own and the forming of these should be encouraged by those in authority so that students of the present and future generations may be imbued with the desire to study and learn the habits of the creatures around them and thus help to elucidate the vast problems of Economic

*A note by Dr. S. C. Law, M.A., Ph.D., on Mr. Salim Ali's scheme for research in Economic Ornithology.*

The whole idea of the scheme apparently originates from the importance of bird-life in so far as it plays a spontaneous and useful part in checking the innumerable insect pests which affect agriculture and forestry of a country. It is stated that "in a vast agricultural country like India, where this subject (Economic Ornithology), has so far received practically no attention from the various provincial Agricultural Departments, properly conducted investigations into the life-histories of birds with special reference to their food and feeding habits, would prove of inestimable value".

The proposed investigation into insect food of birds is sought to be undertaken by the creation of a new Department of Government with a special financial grant.

It is clear that the work of the incumbent for the post (if newly created) has to be in co-operation with the Departments of Economic Entomologist and Economic Botanist for the purpose of "the identification of stomach contents of birds and advice on various matters connected with their departments of work".

The venue of research in Economic Ornithology has, therefore, been suggested to be "some place in the neighbourhood of Poona".

The scheme, as it stands, needs careful examination: first of all if a proper case has been made out so as to justify the creation of a new Government Department involving the financial burden as suggested and shown in the Five-year scheme. Secondly if the work done at Poona may be taken to be such far reaching in importance as to justify remedial measures based thereon, and also if such measures will be of all-India application. Regarding method of investigation very little detail is given, but it is proposed that the work is to continue on the lines of Mason and Lefroy.

It will not be out of place to point out that both Mason and Lefroy were late Entomologists, Imperial Department of Agriculture for India. They produced a very valuable piece of work based on investigations into the food of birds and their economic relation to Agriculture and Horticulture. Their researches having been principally in respect of birds found at or about Pusa there is presumably this handicap that the results of those researches could not be unreservedly held to be applicable to the birds of India. And, if this is so, any other investigation conducted in respect of birds of a limited area, say Poona, which the proposed scheme has in contemplation, will naturally suffer the same handicap. No two districts are alike each other, provinces vary from one another to a considerable degree. Conditions which in one district may tend to make a species destructive or even injurious do not obtain in another where the same species is highly beneficial. It will therefore be seen that the economic status of a species is often a highly complex problem whose solution is apt to be faulty if one attempts to base his judgment on local or provincial data only. Then there is such a thing as what is known as the "Balance of Nature". This we find when certain conditions operate to keep down the undue increase of any given species beyond a

certain point. The species is then beneficial no doubt, but, if the balance of Nature is disturbed, it is apt to be harmful by the inadequacy of its natural food leading it to direct its attention to other kinds of food and thus become injurious to agriculture.

Inasmuch as the scheme proposed to pursue the lines of Messrs. Mason and Lefroy, one may take it as a tacit acknowledgment (no words of compliment are found anywhere in the scheme) of the innate value of their work. Not only are their special studies and detailed investigations of Pusa birds embodied therein, a very valuable mass of notes and data from all existing and available sources has been compiled so as to justify the title of the monograph, "The food of birds in India". It may seem worth while to make some relevant quotations from this book so as to draw attention to different aspects of the problems of Economic Ornithology.

Wrote Mr. Mason over two decades ago—"The whole question of Economic Ornithology is at present a very doubtful one. It may be that in countries where no protection exists and where birds of all kinds are ruthlessly persecuted, we hear of no more insect plagues than in countries which afford protection to some of these birds."

Great strides no doubt have since been made in the progress of this study in European countries and in America.

Wrote Mr. Lefroy "We must inevitably come down to estimating the value of the bird by the actual value we place upon each insect, a matter very much of personal opinion but which must be based upon an intimate knowledge of the place, the insect habits and the local agricultural practice."

This shows how much one may have to depend on the Economic Entomologist for appraising any bird at its real worth.

In the proposed scheme it has been suggested that "there would be control aviaries where the preferences of birds of particular type of birds at different seasons will be studied and physiological experiments conducted to determine their reaction to different foods, and the significance of these".

From my long experience in Agriculture and intimate acquaintance with many Indian birds in captivity and most of these unknown as cage birds—I endorse every word that had been written by Mason and Lefroy on this point: "Of birds kept under these conditions (cage birds) little, if any, information of value can be obtained, as long as the food has to be provided for these birds. If we know what the food of certain species is in the wild state, we can then by caging some birds of this species form a vague idea of the proportion of, and preference shown for, certain kinds of foods; we can get little real idea as to the quantity."

For myself, I feel inclined to modify this observation a bit. For I have seen birds in confinement regularly and with avidity accept food which they cannot certainly find in their native haunts and reject food that is regularly taken under natural conditions. It cannot be denied that captive birds evince a marked adaptability to artificial environment and not infrequently show preferences which are amazingly contrary to what they evince in the wild state. Nothing else so changes their reaction

to stimuli as confinement.\* McAtee in a very able review of the literature of experiments upon the food of various animals including birds in America and other countries has shown how untrustworthy such experiments are. He says "I am betraying no secret in asserting that experimental Ornithology was abandoned by the United States Biological Survey because of a direct realisation from these trials of the futility of experiments as indications of the food preferences and, therefore, of the economic status of species under natural conditions". There is, however, one suggestion worthy of note in Mason and Lefroy's book, *viz.*, The only real application of this method of any value—and it is of great value when possible for furthering our knowledge of the food of nestlings—is to obtain and cage a clutch of young birds, so placing them that the old birds will come and feed the young. We can then identify accurately what food is fed to the young in definite proportion, and in fact get a full and accurate idea as to what the nestlings are brought upon until they can leave the nest or obtain food for themselves. This method is, however, only practicable occasionally, and with but few species of birds".

Needless to add, Mason and Lefroy's observations deserve serious attention. The fruition of their labours and achievement in the hitherto untrodden field of Economic Ornithology do no small credit to the Department of Agriculture and particularly to that of Economic Entomology. The question now naturally arises if there is any further possibility of research in a more intensive manner as contemplated in the scheme being taken in hand through the existing Government Departments of Economic Entomology and Economic Botany. With due allowance for some minor re-adjustment of the existing machinery and with an eye on economy may not the question deserve close examination. Mention may be made in this connection of Bulletin No. 81, Department of Agriculture, Madras, embodying a modest attempt to facilitate the recognition of "Bird Friends and Foes of the Farmer". This as well as Mason and Lefroy's work appear to indicate a natural interest on the part of the Department of Agriculture in an evidently congenial line of investigation, *viz.*, that of Economic Ornithology. Incidentally the good work done by the Nagpur Museum on "The Food of Birds in the Central Provinces" (Records of the Nagpur Museum, No. 2, 1928) based on examination of stomach contents of 600 species also deserves mention.

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## XVII

LETTER FROM THE ASSISTANT SECRETARY TO THE GOVERNMENT OF BENGAL,  
AGRICULTURE AND INDUSTRIES DEPARTMENT, No. 3712, DATED THE  
25TH JULY 1935.

In continuation of this Department letter No. 3350, dated the 8th July 1935, I am directed to forward for the information of the Council, herewith, copy of a note on the subject submitted by Professor H. K. Mookerjee. D.Sc. (Lond.), D.I.C., Head of the Department of Zoology, Calcutta University.

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\*Proc. Acad. Nat. Sa. Phila. LXN. 1912.

## XVIII

COPY OF A NOTE BY PROF. H. K. MOOKERJEE, D.Sc. (LOND.), D.I.C., HEAD-  
OF THE DEPARTMENT OF ZOOLOGY, CALCUTTA UNIVERSITY.

With reference to your letter No. Misc.-8849/25, dated 29th June 1935, regarding the scheme for research in Economic Ornithology, I am giving below my observations on the scheme and returning herewith the scheme sent to me.

As a Zoologist I cannot but have sympathy for expansion of Zoological investigations in different directions and would welcome any scheme of research, such as Ornithology. The results of the scientific enquiry of whatever kind, find their application with the progress of human knowledge and culture, in economic life and welfare of man. In introducing a scheme of economic importance, it is better, in view of economic considerations, to bear in mind the claims and relative values of other branches of Zoological studies which have direct bearing on agricultural and economic problems, particularly as considerable amount of work has been done on the lines suggested now by the proposer. Mr. Salim A. Ali in stating that the 'influence of birds is exerted in practically every branch of human activity' has drawn, in his enthusiasm, a far fetched conclusion, for all science subjects viewed in that sense have utilitarian value.

The author of the scheme admits that research "in Economic Ornithology in its early stages must necessarily be of an 'academical' rather than of a practical or remunerative character". In such a case it would be better if the suggested investigations be entrusted to Indian Universities. Larger amount of data on the gut-contents of birds can be had, if more number of persons are engaged in different localities than by appointing a single officer. This can be done by awarding research stipends to Post-Graduate students of different Universities for carrying on these investigations suggested in the scheme. Further, the principal reason given by the author of the scheme, is that the birds are destroyer of insect pests. Naturally therefore, identification and inquiry of biology of injurious insects would devolve more upon Entomologists than upon the Ornithologists whose main concern would be collection and identification of birds. The taxonomic work is being done by Ornithologists in India; duplication of work, therefore, is unnecessary. By the pooling of existing resources much useful data can be obtained at a nominal cost. If the results of a preliminary investigation are found to be of practical value, then the question of establishing a separate Ornithological department would arise. In the scheme formulated, I note with regret that there is no provision for recurring expenditure for running an Aviary or carrying on experimental work.

## XIX

LETTER FROM THE DEPUTY SECRETARY TO GOVERNMENT, UNITED PROVINCES  
No. 1495-A., DATED THE 10TH JULY 1935.

In continuation of my letter No. 1345-A., dated June 19, 1935, I am directed to say that, according to information at present available, no research work has hitherto been done or is in progress, on economy ornithology in this Province.

2. The need for research work on economic ornithology has not, so far, been brought to the notice of this Government. It is felt, however, that such a study might prove of some value to the agricultural and horticultural operations, by leading to the elimination of birds which severely damage the crop and through the protection of those which assist agriculture by killing the injurious insects; but the Local Government are doubtful as to the desirability of spending money on research work of this kind, at the present time when there are other questions of greater importance requiring attention.

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LETTER FROM THE JOINT SECRETARY TO GOVERNMENT, PUNJAB, DEVELOPMENT DEPARTMENT, No. 755-D. (S), DATED THE 27TH JUNE 1935.

In reply to your letter No. F. 99/35-Agril., dated the 11th May 1935, I am directed by the Punjab Government (Ministry of Agriculture) to forward herewith a copy of a note by Mr. Afzal Hussain, Principal, Punjab Agricultural College, Lyallpur and Entomologist to Government, Punjab, which gives details of the work done on economic ornithology by the Punjab Agricultural Department upto date, as well as the department's views on the future of such work.

2. The Registrar, University of the Punjab, Lahore, has drawn attention in particular to Mr. Afzal Hussain's opinion that for concentrated observations in restricted localities, the University of the Punjab in the Department of Zoology, if subsidized by the Imperial Council of Agricultural Research, can do excellent work at very low cost, and to his suggestion that the Imperial Council of Agricultural Research might consider the possibility of giving a grant to the Department of Agriculture for study of birds in relation to Agriculture and Horticulture as pests and as enemies of pests, and methods of their protection and control.

3. I am to add that the Director, Veterinary Services, Punjab, intimates that no information on the subject is available in the Punjab Veterinary Department.

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4.—*A brief account of research work on economic ornithology carried out and in progress in the Punjab.*

i. *Department of Agriculture, Punjab.*—Recognising the importance of birds in crop and fruit production, both as pests and beneficial animals—as predators on the insect pests, an Assistant of the Department of Agriculture, Punjab, had been detailed (part-time) for the study of birds. A preliminary survey of the birds of Lyallpur and certain other districts has been made with special reference to the food of birds. The following papers have been contributed:—

1. "Some bird enemies of the Desert Locust, *Schistocerca gregaria*," the Indian Journal of Agricultural Science, Volume I, Part V, October, 1931.
2. "Some birds of Lyallpur and their food", accepted for publication by the Bombay Natural History Society.

Detailed observations have been carried out and are in progress, regarding the food of the crow, parrot, house-sparrow, the Bengal Jungle babbler, the common babbler, common myna, pigeons, doves, bulbul, kites and the Punjab raven.

An investigation on the damage caused by birds in picking up seed sown and the sprouting crop is in progress.

Observations have also been made on the bird enemies of the cotton leaf roller.

ii. *University of the Punjab*.—A student of the Honours School obtained his M.Sc. degree in Zoology by presenting a thesis on the Birds of Lahore.

#### B.—*Applied Ornithology.*

i. *Importance*.—Birds, such as parrots, crows, sparrows, to mention only a few, cause enormous damage to fruit and crops, others such as starlings are useful as enemies of insects, whilst owls feed on rats and mice. A study of the life-histories, habits, control of the harmful species and protection of the beneficial is of very great importance to Agriculture and Horticulture in India.

With the enactment of legislation for the Protection of Wild Life, which is mostly applicable to birds, the importance of the bird problem has increased. It is likely that we may through the protection afforded by this Act unwittingly upset the balance of nature which may lead to the multiplication of certain birds which may prove serious enemies of the farmer and fruit grower. For instance, the pigeons, if they multiply and they are likely to do if protected, may cause havoc. The determination of the economic status of some of these birds, such as the starling, which are beneficial as enemies of locusts and harmful because they damage a number of crops such as bajri, jowar, mulberries, dates, etc., requires serious study. Thus, there is a great need for the organisation of Economic Ornithology.

ii. *Two aspects*. There are two aspects of the question:—

1. A survey of the bird fauna of India, including their migration.
2. Birds in relation to Agriculture and Horticulture.

i. *Survey and Migrations*.—Hume, Oats, Blandford, Douglas Dewar, Tiechurst Stuart-Baker, Whistler and others have provided us with splendid accounts of the bird fauna of India and in the words of the last mentioned "The day is now over in which it was necessary to collect huge series of skins and eggs in India. Enough general collecting has been done; concentration on filling in the gap in our knowledge is now needed.....But the greatest need of all is accurate observations on status and migration. In this all can help."

This work falls under the sphere of activities of the Zoological Survey of India and the Bombay Natural History Society. For concentrate observations in restricted localities the Universities can render most valuable help by carrying out local surveys. The University of the Punjab have in the Government College, Lahore, a very large collection of birds and some time ago a student worked out the bird fauna of Lahore. The Imperial Council of Agricultural Research can give financial aid some of the Universities, particularly the University of the Punjab the Department of Zoology, excellent work at very low cost would be possible.

Most of the valuable work of collection of birds has been done amateurs and there are a number of them working today. In so far



the Punjab is concerned we have in Mr. White, D. I. G., Police, a very enthusiastic bird collector. All such persons, who are interested in birds, can render help in survey and migration.

If the above mentioned resources are co-ordinated then it is possible to add to the information already available regarding the bird fauna of India and its movements. A central organisation affiliated to the Zoological Survey of India or the Bombay Natural History Society or the Agricultural Research Institute, Pusa, may be useful for purposes of compilation, co-ordination and supply of information. Thus, we need a new central organisation to act as a bureau but not essentially for making surveys and studying birds in detail which should be left to the provincial organisations.

This work on survey and migration is some times styled as 'of academic interest' but it is of the utmost value to the applied worker, because a proper identification of a bird and a knowledge of its habits, etc., is the foundation of applied ornithology.

2. *Ornithology in relation to Agriculture and Horticulture.*—In so far as Applied Ornithology, which includes a study of the birds in relation to Agriculture and Horticulture as pests and as enemies of pests and methods of their protection and control, is concerned, exceedingly little has been done. This work should be done in close association with the Departments of Agriculture. There is sufficient work for one or even two whole-time Assistants in each province. Crows and parrots mentioning only two of the harmful birds cause enormous damage to Agriculture and Horticulture and their control presents serious problems. To help in the work that we are doing in the Punjab it is suggested that the imperial Council of Agricultural Research may consider the possibility of giving a grant for such a study to the Department of Agriculture, Punjab, so that instead of a part-time worker one or two whole-time workers are available for this important and useful study.

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## XXI

LETTER FROM THE SECRETARY TO THE GOVERNMENT OF BURMA, FOREST DEPARTMENT, No. 159-O., DATED THE 3RD JULY 1935.

With reference to the correspondence resting with your Express letter No. F. 99/35-Agri., dated the 12th June 1935, I am directed to forward for your information, a copy of letter No. 5130/1-A.-82, dated the 25th June 1935, from the Director of Agriculture, Burma, and to say that the Senate of the Rangoon University considers that the scheme of research on economic ornithology is of no special interest so far as Burma is concerned. I am to add that the Government of Burma (Ministry of Forests) agree with the views expressed by the Director of Agriculture on the subject.

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## XXII

LETTER FROM THE DIRECTOR OF AGRICULTURE, BURMA, TO THE SECRETARY TO THE GOVERNMENT OF BURMA, FOREST DEPARTMENT, RANGOON, No. 5130/1-A.-82, DATED THE 25TH JUNE 1935.

There have not been to my knowledge, any systematic researches in economic ornithology conducted in this province although the occurrence

and distribution of birds in Burma have been noted and recorded by various observers officially and otherwise from time to time.

2. I would offer a few observations on the general merits of the proposed scheme of research in economic ornithology. There is a reference to work which has been done on the subject in America which is said to have produced results "of inestimable value". Unfortunately no concrete example of such result is given and in spite of the high superlative note of the author I am not convinced that any such scheme would be likely to produce useful results within any reasonable time. Even if a complete survey could be made of the feeding habits of all the Birds of India and Burma it is difficult to envisage any practical action being taken as a result of such a survey. Further, it is highly improbable that a centralised scheme with officers working at Poona would be able to include investigation over an area of such extent as the whole of India and Burma and my opinion is that if such work is to be undertaken at all it should be by officers working under the local heads of the Agriculture and Forest Departments. It is doubtful, however, if there is any great necessity for undertaking this work either centrally or provincially and the money proposed to be spent on it could be more profitably spent on other schemes likely to have a practical outcome within a reasonable time. I am, therefore, somewhat reluctantly compelled to report against the acceptance of the scheme.

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#### XXIII

LETTER FROM THE SECRETARY TO THE GOVERNMENT OF BIHAR AND ORISSA, EDUCATION AND DEVELOPMENT DEPARTMENT, No. 326-D.R., DATED THE 18TH JUNE 1935.

In reply to your letter No. F. 99/35-Agri., dated the 11th May 1935, regarding the scheme of research on economic ornithology, I am directed by the Government of Bihar and Orissa (Ministry of Education) to enclose copies of the letters noted below for the information of your Council and to say that the Local Government share the opinion expressed by the Director of Agriculture, Bihar and Orissa:—

- (1) A copy of letter No. 5936, dated the 27th May 1935, from the Director of Agriculture, Bihar and Orissa.
- (2) A copy of letter No. 2353-V.D., dated the 1st June 1935, from the Director of Veterinary Services, Bihar and Orissa.
- (3) A copy of letter No. 4151 dated the 6th June 1935, from the Registrar, Patna University.

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#### XXIV

COPY OF LETTER FROM THE DIRECTOR OF AGRICULTURE, BIHAR AND ORISSA, TO THE SECRETARY TO THE GOVERNMENT OF BIHAR AND ORISSA, EDUCATION AND DEVELOPMENT DEPARTMENT, No. 5936, DATED THE 27TH MAY 1935.

I have the honour to reply to your memorandum No. 198-99-D.R., dated the 19th May, 1935, and to say that I know nothing about ornithology. At the same time I cannot help feeling that the scheme forwarded with your letter will result in nothing further than enabling a

research officer and his assistant to ride a rather pleasant hobby at the expense of the Imperial Council of Agricultural Research.

2. The area of India is often compared to that of Europe without Russia. I wonder what farmers in Great Britain would think of a scheme on economic ornithology being carried out by two people in some corner of Czecho-Slovakia and held out to them as being of inestimable value to them in their farming. I think no British farmer would place any faith in the scheme. Similarly in my opinion, the study of bird life, by two men outside Poona, is going to have no effect whatever on the agriculture of this subcontinent.

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XXV

COPY OF LETTER FROM THE DIRECTOR OF VETERINARY SERVICES, BIHAR AND ORISSA, TO THE SECRETARY TO THE GOVERNMENT OF BIHAR AND ORISSA, EDUCATION AND DEVELOPMENT DEPARTMENT, No. 2353-V.D., DATED THE 1ST JUNE 1935.

I have the honour to state that the scheme as drawn up is not of much practical interest to this Department though it has a more direct bearing on Agriculture and the pure science of Zoology. The object of the scheme is apparently to determine the role of birds in helping cross-pollination, in the disposal of seeds and in the suppression and extermination of insect pests harmful to plants, though why their role in the suppression and extermination of insect and other pests harmful to animals such as lice, ticks and the insect vectors of Protozoan diseases has been left out from the purview of the scheme is not understood. It is well known that some birds such as egrets play a very important part in keeping down ticks. The scheme, if given effect to, may, however, incidentally yield results (though it is not the intention of the formulator) which may be of benefit to us. To this extent only the scheme is certainly of interest so far as this department is concerned.

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XXVI

COPY OF LETTER FROM THE REGISTRAR, PATNA UNIVERSITY, TO THE SECRETARY TO GOVERNMENT, BIHAR AND ORISSA (MINISTRY OF EDUCATION), No. 4151, DATED THE 6TH JUNE 1935.

With reference to your letter No. 200-D.R., dated the 19th May, 1935. I have the honour to inform you that this University teaches neither agriculture nor biology and so far no research work has been done in ornithology and therefore it can offer no suggestion as to the method of research in the subject.

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XXVII

LETTER FROM THE REVENUE SECRETARY TO THE GOVERNMENT OF THE CENTRAL PROVINCES, AGRICULTURAL DEPARTMENT, No. 737-660-XIV, DATED THE 6TH JULY 1935.

With reference to your letter No. F. 99/35-Agri., dated the 11th May 1935, I am directed by the Government of the Central Provinces (Ministry of Agriculture) to forward for information a copy of the

memorandum No. 8162, dated the 3rd July 1935, together with its enclosures, from the Director of Agriculture, Central Provinces, and to say that the local Government concurs in the views expressed therein.

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XXVIII

COPY OF MEMORANDUM FROM THE DIRECTOR OF AGRICULTURE, C. P., TO THE SECRETARY TO GOVERNMENT, AGRICULTURE DEPARTMENT, CENTRAL PROVINCES, NAGPUR. No. 8162, DATED THE 3RD JULY 1935.

I consulted the Head of the Studies in Botany and Zoology of the Nagpur University a copy of whose opinion is attached herewith. I also consulted the Curator of the Central Museum, Nagpur, who has done a considerable amount of work on the food of birds and a copy of his letter is herewith enclosed along with two reports which he furnished in this connection.

Personally I am of opinion that it is necessary that information on the subject should be obtained but if the work is to be carried out properly it should be done on an all-India basis. The information obtained at Poona will be of only slight benefit to us in the Central Provinces.

I think it would be much more profitable if this sort of work were to be taken up by the Universities of India who should, if necessary, obtain a small grant from the Imperial Council of Agricultural Research to enable them to carry out the work. The Imperial Council of Agricultural Research might lay down a definite programme which could be circulated to the Universities so that the work would be undertaken all over India on the same lines. Students in Science and Agriculture might undertake this work as a thesis and much more information would be available than is possible if the scheme were carried out at one place by one person.

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XXIX

REPORT OF THE HEAD OF THE DEPARTMENT OF STUDIES IN BOTANY AND ZOOLOGY OF THE NAGPUR UNIVERSITY.

We have not been doing any research work in this University on Economic Ornithology and none of us has so far considered the question. If the damage to drops from the source is great in this province, the question may be taken up. I am unable to state the nature and extent of damage. The Department of Agriculture may be able to give an opinion on this question with some degree of experience and authority.

I personally favour the scheme; but any research on this subject should naturally begin with a Survey of Bird life—such as visit on fields, and with a correct estimation of their habits. If such a survey is also taken up for C. P., the possibility of further research on the subject may then be examined. We may, at the most, recommend to the Department of Agriculture to press for the inclusion of this Province, if such a survey is to be undertaken.

COPY OF LETTER FROM THE CURATOR, CENTRAL MUSEUM, NAGPUR, TO THE DIRECTOR OF AGRICULTURE, CENTRAL PROVINCES, NAGPUR, THROUGH THE DIRECTOR OF INDUSTRIES, CENTRAL PROVINCES, No. 162-VII, DATED THE 16TH JUNE 1935.

The scheme drawn up by Mr. Salim A. Ali is on the whole approved of, but it becomes very necessary for a complete or almost complete survey of the Insect fauna of a locality to be first done before the birds' stomachs are examined in that locality. I did some work of this nature in 1918 in the Central Provinces, the material being the birds which were shot for the museum. I experienced great difficulty in identifying the insect material as no proper collection of local insects was available and I had to make a collection of local insects myself. I also had to take specimens to Pusa and to the Indian Museum, Calcutta, for identification and others were sent to experts in Europe. The result of this is published in the "Museum Record II". (A copy is attached). An extract will also be found in the Proceedings of the Third Entomological Meeting held at Pusa. Part 3, page 859 (copy is attached).

In my case the local Agricultural Entomologists were of little help in identifying half digested specimens and they asked me to refer to experts in the various groups who, in their turn, demanded complete specimens in most cases.

I am of opinion that the wholesale slaughter of birds must on no account be allowed and it would be well if the officer doing this work is both an Ornithologist and an Entomologist or a competent Entomologist should work conjointly with an Ornithologist.

LETTER FROM THE SECRETARY TO THE GOVERNMENT OF ASSAM, EDUCATION DEPARTMENT, AGRICULTURAL BRANCH, No. 1814-E., DATED THE 19TH JUNE 1935.

I am directed to refer to your letter No. F. 99/35-Agr., dated the 11th May 1935, and to say that no work on economic ornithology has been done, so far as is known, in this province. As regards the merits of the proposed scheme, the Forest Department advises that the enquiry would be interesting but that the conditions leading to upset of the economic balance in Europe—sharp frosts, game and fish rearing, organised campaigns against certain species, etc.—do not occur in Assam. The Director of Agriculture, Assam, considers that any such enquiry should be undertaken by a Central Institute, though provincial departments might co-operate. For the reasons given by the Forest Department the Government of Assam do not consider that expenditure on such a scheme would be justified, while schemes of practical necessity are held up for lack of funds. It is observed that the explanation of the scheme does not indicate any practical need for such work in any part of India.

## XXXII

LETTER FROM THE SECRETARY TO GOVERNMENT, NORTH-WEST FRONTIER PROVINCE, TRANSFERRED DEPARTMENTS, No. 3552-T.D.N./17/250, DATED THE 9TH JULY 1935.

I am directed to refer to your letter No. F-99/35-Agri., dated the 11th May 1935, and to state that no research in economic ornithology has so far been carried out in this Province. The Local Government however, consider that since this Province is mainly agricultural and since owing to its geographical position it is particularly favourably situated for the study of migratory birds as they enter and leave India, a research station in this Province should be of particular value.

2. It is suggested that the research station consist of:—

- (i) Research Officer,
- (ii) One field man; and possibly,
- (iii) a taxidermist.

The party would have the benefit of the use of instruments, books of reference, etc., at the Zoological Department of the Islamia College, Peshawar, and if it is decided to proceed with the proposal and when it is known what funds it will be possible for the I. C. A. R. to provide, a more detailed scheme will be forwarded to the I. C. A. R. for sanction in the light of the results achieved by the proposed Committee.

## XXXIII

LETTER FROM THE OFFG. SECRETARY TO GOVERNMENT, DEPARTMENT OF COMMERCE AND INDUSTRY, H. E. H. THE NIZAM'S GOVERNMENT, HYDERABAD-DECCAN, No. 7084, DATED THE 16TH JULY 1935.

With reference to your office letter No. F. 99/35/Agri., dated the 11th May 1935, I am directed to forward herewith a copy of the Director of Agriculture's letter No. 11342, dated the 31st Amerdad, 1344 Fasli, for information. The replies from the other concerned departments are still awaited and they will be sent to you as soon as they are received.

## XXXIV

COPY OF THE LETTER FROM THE DIRECTOR OF AGRICULTURE, ADDRESSED TO THE SECRETARY TO GOVERNMENT, DEPARTMENT OF COMMERCE AND INDUSTRY, H. E. H. THE NIZAM'S GOVERNMENT, HYDERABAD-DECCAN. No. 11342, DATED THE 31ST AMERDAD 1344-FASLI.

With reference to your letter No. 6416, dated 19th Amerdad 1344 Fasli, I have the honour to say that I am of the opinion that it is desirable to carry out research of the birds which are beneficial or harmful to agriculture and horticulture, though I am unable to supply any information as no work on the subject has as yet been carried out by this department.

## XXXV

LETTER FROM THE SECRETARY TO GOVERNMENT DEPARTMENT OF COMMERCE AND INDUSTRY, H. E. H. THE NIZAM'S GOVERNMENT, HYDERABAD-DECCAN, No. 7238, DATED THE 21ST JULY 1935.

In continuation of this office letter No. 7084, dated the 16th July 1935, I am directed to forward herewith a copy of the reply received from the Osmania University, for information.

## XXXVI

COPY OF A LETTER FROM THE SECRETARY TO THE GOVERNMENT, JUDICIAL, POLICE AND EDUCATIONAL DEPARTMENTS, TO THE SECRETARY, DEPARTMENT OF COMMERCE AND INDUSTRY, H. E. H. THE NIZAM'S GOVERNMENT.

I have the honour to state that as the Department of Zoology of the Osmania University has come into existence only lately, and the Final M.Sc. Examination of that subject will be held for the first time next year, it has not yet been possible to undertake researches in this subject.

The Department of Zoology has expressed the following opinion with regard to the proposed survey:—

- (a) There should be division or demarcation of areas or zones in each Province or State and the whole thing ought to be properly mapped out in charts, and a regular ornithological survey conducted on broad principles and on proper scientific methods based on local conditions, seasonal variations and various economic aspects.
- (b) All birds procured should be systematically arranged and their skins preserved with proper labels and they should be classified under expert guidance in order of their destructiveness or usefulness to agriculture.
- (c) The survey should not be narrowed down or restricted to one particular State or Province. It should be an All-India concern as India is a vast agricultural country, and it is necessary that the relation of our wild birds to crops should be better and more precisely understood.

The services of an expert Ornithologist, like Mr. Salim A. Ali, whose work and publications are well known should be requisitioned as soon as possible.

The University will be glad to co-operate in the proposed survey and will depute one of its Professors to attend the meetings of the committee proposed to consider this scheme.

Mr. Salim Ali undertook a preliminary Ornithological survey of the State and his work in this connection was appreciated.

## XXXVII

LETTER FROM THE GENERAL SECRETARY TO THE GOVERNMENT OF HIS HIGHNESS THE MAHARAJA OF MYSORE, No. D.-294/E./A.I.E.-268-14-6, DATED THE 13TH JULY 1935.

With reference to your letter No. F. 99/35/Agri., dated 11th May 1935, regarding scheme of research on Economic Ornithology, I am directed to forward herewith a copy of a note on the subject by the Superintendent, Government Gardens and to state as follows:—

The Chief Conservator of Forests and the Registrar, Mysore University are of opinion that the subject is an interesting one, that research on it is very desirable and the work is of immense economic importance for the Agricultural and Horticultural interests as well as for forestry.

The Director of Agriculture states that an intensive study of the life histories of the various birds, their migrations, seasonal appearance, the bulk of food they consume and other habits is of the utmost importance to the agriculturist in India and that investigations on these lines in various provinces in India will be very useful. He adds that the results of the Bombay Scheme will be of great benefit to other provinces for affording a basis for the lines of work to be started on this important subject.

The Government of Mysore are in general agreement with the views of the Director of Agriculture and the other officers.

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Note.

The proposal of Mr. A. Salim Ali of the Bombay Natural History Society to conduct researches on Economic Ornithology is a commendable one. As in other parts of India in this State also, agriculture is the main-stay of the people, the difference consisting in the peculiarly favourable climatic and soil conditions which have not a little tended to enhance the fruit, forest and other economic plantations on a large scale than in other parts of India. Due to naturally high elevation, climate, mild temperature in Mysore, several tropical and sub-tropical plants and trees easily grow both in the wild state and in the cultivated areas. The importance therefore of economic ornithology in relation to Mysore Flora is indeed great and a scheme of carrying on researches in this subject so as to throw light on the beneficial and harmful effects of birds in respect of Mysore Agriculture and allied pursuits is calculated to benefit the people. The Department of Horticulture was entrusted with the up-keep of the Museum, the Zoo and the Aviary. The Museum consists of a fairly representative collection of stuffed bird specimens and has been maintained as a part of the Natural History collection. The Aviary consists of a small number of birds of plumage and song. But systematic studies on the food habits of the beneficial and harmful birds have not been carried out by this Department as no technical staff has been provided therefor. With the co-operation of the Department of Zoology and Botany of the Mysore University, it would be possible for this Department to carry on researches on the lines contemplated, in the local Aviary Section and the Museum, to collate results with the Economic Ornithology section of the Imperial Council of Agricultural Research.



Owing to favourable climatic conditions quite a number of migratory and indigenous birds of India are found in Mysore and as the Mysore plateau consists of varying elevations of heavy rainfall and extensive forests, it would be desirable to open sub-stations in one or two typical places in the plains and in the maldnad of the Mysore State. The research work could even be conducted by Post Graduate Scholars such as Zoology and Botany under the guidance of technical experts. Such Scholars may be given stipends during the period of research and their work suitably recognised for Masters and Doctorate Degrees as is said to be done by the American Universities. The problems pertaining to the birds in Mysore in relation to local Agriculture, Forestry and Horticulture should be clearly dealt with by such research workers. From the data so obtained it is possible to classify the harmful and beneficial birds in Mysore and to protect them where necessary by including them under Game Law in Mysore. Natural preserves of Forest Sanctuaries for protection of birds could also be set apart as is being done in Colonies like South Africa. If accurate data is obtained, it is easy for the Department to carry on propaganda among the cultivators and others to preserve, encourage and foster the rearing of beneficial birds, as by providing inexpensive cages, water, etc., in the same way as bees are being systematically reared for honey and for pollinating orchards. The propaganda work could extend to the training of school-teachers in rudiments of Economic Ornithology so that young may be taught simple lessons of familiar birds and their importance to man. The Aviary section attached to the Lalbagh will also be made more representative of the local and migratory birds while the stuffed specimens could be maintained in the local Museum. In this way the importance of birds in relation to human and plant life could be brought home to the people.

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### XXXVIII

LETTER FROM THE DIRECTOR OF AGRICULTURE, BARODA STATE, No. 5496/1 OF 1934-35, DATED THE 7TH JUNE 1935.

With reference to your letter I have the honour to state that the research in ornithology is absolutely necessary from Agricultural point of view. The farmer must know his friends and foes amongst birds. In other countries like Holland, America special branches of the Agricultural Department are carrying on this study for a long time.

In my opinion it will be most convenient if this research is handed over to Bombay Natural History Society, Zoological Survey of India with a subsidy. As the work develops it may be extended to provinces by these Central bodies. Provincial Governments including States may also take an active part in helping this research.

Cultivators will be in want of books in popular languages and not on scientific basis. This will be the work of the Provincial Departments.

## XXXIX

LETTER FROM THE CHIEF SECRETARY TO GOVERNMENT, TRAVANCORE,  
No. 1135 OF 35/DEVPT., DATED THE 29TH MAY 1935.

With reference to your letter No. F. 99/35/Agri., dated the 11th May 1935, regarding the scheme of research on economic ornithology, I have the honour to inform you that there is no ornithologist in the State Agricultural Department, and that no work of any kind in Economic Ornithology is being done in Travancore. As birds are of immense help to the agriculturist and horticulturist as destroyers of injurious insect pests and other vermin, and as agents in the cross-pollination of flowers, there is necessity for taking up an investigation of the kind proposed by Mr. A. Salim Ali.

## XL

LETTER FROM THE DIWAN OF COCHIN, DEVELOPMENT DEPARTMENT, No. D.  
Dis. 14996/1110, DATED THE 4TH JULY 1935.

I have the honour to inform you that the Darbar had an Ornithological Survey conducted by Mr. Salim Ali in the year 1933. The report of that survey is being published in the Journal of the Bombay Natural History Society. The Darbar have at present no suggestions to offer on the present scheme. They agree that the work on the lines suggested in Mr. Salim Ali's report will be useful.

## XLI

LETTER FROM THE DIRECTOR OF AGRICULTURE AND STATE CHEMIST, GOVERNMENT OF BHOPAL, No. 261, DATED THE 18TH JUNE 1935.

With reference to your letter No. F. 99/35-Agri., dated the 11th May 1935, regarding scheme of research on economic ornithology, I have the honour to state that so far there are no arrangements for ornithology work but the matter is being put up before the Government for instructions.

## APPENDIX VIII.A.

Supplementary note by the Secretary, Imperial Council of Agricultural Research, dated the 26th November 1936, on Subject No. 5:—  
Scheme for Research in Economic Ornithology at a cost of Rs. 41,075 spread over a period of five years submitted by Mr. Salim A. Ali through the Government of Bombay.

In continuation of this Department note, dated the 17th September 1935, on the subject mentioned above, the attached further replies which have since been received from the Governments of Hyderabad and Bombay (Annexure) are circulated for the consideration of the Advisory Board.

## ENCLOSURE 1.

FROM THE SECRETARY TO GOVERNMENT, DEPARTMENT OF COMMERCE AND INDUSTRY, H. E. H. THE NIZAM'S GOVERNMENT, HYDERABAD, DECCAN, LETTER No. 699, DATED THE 3RD NOVEMBER 1935.

In continuation of this office letter No. 7238 dated the 14th Shahrevar 1344 Fashi, I am directed to forward herewith, copies of the replies received from the Revenue Secretariat and the Director of Veterinary Department for information.

COPY OF THE LETTER No. 2, DATED THE 10TH OCTOBER 1935, FROM THE DIRECTOR, CIVIL VETERINARY DEPARTMENT, ADDRESSED TO THE SECRETARY TO GOVERNMENT, DEPARTMENT OF COMMERCE AND INDUSTRY, H. E. H. THE NIZAM'S GOVERNMENT, HYDERABAD DECCAN.

With reference to your letter No. 9421, dated the 18/12/1344 Fashi, regarding Economic Ornithology, I have the honour to state that such a survey, as proposed, if carried out, would, in my opinion, be valuable. It is likely to give us valuable information as to how far the birds are responsible in carrying contagious diseases of livestock not only those that are domesticated but also from wild animals to the domesticated ones and *vice versa*. May I suggest a reference being made regarding any work that may be under enquiry on the subject by the University authorities as suggested by the Imperial Council of Agricultural Research, because I do not know of any other department of Government carrying on this work as a special subject.

COPY OF THE LETTER No. 1324, DATED THE 14TH SEPTEMBER 1935, FROM THE REVENUE SECRETARY, ADDRESSED TO THE SECRETARY TO GOVERNMENT, COMMERCE AND INDUSTRIES DEPARTMENT, H. E. H. THE NIZAM'S GOVERNMENT, HYDERABAD, DECCAN.

Please refer to your letter No. 5864 dated the 9th of June 1935 on the subject of a scheme for research in economic ornithology prepared by Mr. Salim Ali. The papers were sent to this office presumably because the

case was regarded as one concerning the Forest Department. It has been pending for a long time and I have now received a reply from the Inspector-General of Forests to the effect that so far as the Forest Department is concerned research in economic ornithology is not likely to be of any use at the present stage. From the letter of the Secretary, Imperial Council of Agricultural Research, I note that it is suggested that the scheme should be placed before a committee which would include representatives of Universities, Agricultural and Veterinary Departments, etc., and it was asked that the suggestions of the various departments of the Hyderabad State and of the Osmania University should be forwarded together with any observations which the Government of Hyderabad may have to make. It is assumed that the Commerce and Industries Department has separately taken action in so far as the opinions of the Agricultural and Veterinary Departments and of the University are concerned. If not, and as the reply has been long delayed I would suggest that the Secretary to the Imperial Council should be informed that the Hyderabad Government is interested in hearing of Mr. Salim Ali's scheme and notes that it is proposed to start work somewhere in the vicinity of Poona. Government has itself after consulting local officers no special suggestions to forward but requests that it may be kept informed of the progress made and of the results of the experiments proposed.

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FROM THE SECRETARY TO THE GOVERNMENT OF BOMBAY, LETTER NO. 3274-A./33, DATED THE 7TH NOVEMBER 1935.

I am directed by the Government of Bombay (Transferred Departments) to invite a reference to the concluding portion of their letter, No. 3274-A./33, dated 10th July 1935, and to state that the Registrar of the Bombay University has forwarded to the Research Council direct the views of its Board of Studies in Agriculture on the scheme of research in economic ornithology. I am now to offer the following observations on them. The Board of Studies has recommended that the scheme should be located at the Poona Agricultural College and the Local Government asked to provide suitable office and laboratory accommodation there. It is clear in the scheme that the work is to be located near Poona and not at the College. The College is already short of space for the needs of the existing staff and it will not be feasible to locate the scheme there. The Board has also suggested the provision of additional staff. If this recommendation is accepted and the scheme sanctioned by the Research Council, such staff will have to be provided from the funds of the Council as the Local Government will not be able to accept any liability on that account.

**APPENDIX IX**

**Note by the Secretary, Imperial Council of Agricultural Research, dated 1st February 1936, on Subject No. 3:—Recommendations of the Locust Committee at its seventh meeting held in January 1936. Proposals for continuance and future programme of work.**

At its meeting held in February 1935 the Advisory Board approved or the recommendations of the 6th meeting of the Locust Committee for the continuance of the Locust Research Scheme conducted with headquarters at Karachi during the year 1935-36 and work has been in progress as indicated by the Locust Committee.

2. The present sanction for the Locust Research Scheme expires on the 31st March 1936. The Locust Committee which met on the 20th and 21st January 1936 reviewed the progress of work made during the year 1935 and has recommended the continuance of the work for a further period of one year at a total estimated cost of Rs. 74,287. The lines on which work should proceed during the year 1936-37 and suggestion regarding the future of the scheme have also been indicated by the Locust Committee *vide* printed proceedings. (Enclosure I not printed). Attention is also invited to the report (not printed) of work done by the Locust Research staff during 1935 and to other relevant papers circulated to the Committee at its last meeting (Enclosure II). The total cost of the Locust Research Scheme up to the end of the year 1935-36 will come to about Rs. 4,56,654-0-8.

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**ENCLOSURE II**

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 16th January 1936 on Subject No. 1 (a) and (b), for the seventh meeting of the Locust Committee:—(a) Report on the work done by the Research staff under the Locust Research Entomologist to the Imperial Council of Agricultural Research during the year 1935. (b) Proposals for the continuance of the Locust Research Scheme.**

Attention is invited to the enclosed extract (Annexure I) of the proceedings of the 6th meeting of the Locust Committee held in January 1935 showing the Committee's recommendations for the continuance of the Locust Research Scheme for another year from the 1st April 1935.

2. The Council accepted all the recommendations of the Locust Committee and work has been in progress during 1935-36 on the lines recommended by the Committee. The progress report of the Locust Research Entomologist for the year 1935 (Annexure II not printed) has already been circulated to the members with this Department memorandum No. F. 1/36/L.B. dated the 14th January 1936.

3. The recommendations of the Locust Research Entomologist regarding the future of the Scheme will be found on pages 24 and 25 of his report. For detailed estimates of expenditure for the continuance of the Scheme during 1936-37 attention is invited to the statement in the annual report on pages 100-102. It will be seen that the estimated cost of the Scheme during 1936-37 as proposed by the Locust Research Entomologist will come to Rs. 86,471.

4. The Locust Research Scheme has been in progress since December 1930 at an estimated total cost upto 31st March 1936 of Rs. 4,56,654-0-8 (Annexure II)

#### ANNEXURE I.

EXTRACT OF THE PROCEEDINGS OF THE SIXTH MEETING OF THE LOCUST COMMITTEE HELD IN NEW DELHI ON THE 18TH JANUARY 1935.

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4. *Proposals for the continuance of the Locust Research Scheme [Subject No. 1 (c) of the Agenda].*—The conclusions and suggestions for future work made by the Locust Research Entomologist on pages 15 and 16 of his report on the work done by the staff under him during the year 1934 were then taken up.

(1) *Ecological Works.*—The Committee agreed that the work at Pasni and Ambagh should be continued, and that the survey Assistant already stationed at Karachi should be replaced by a biologically qualified man on Rs. 125 per mensem, his headquarters being fixed by Locust Research Entomologist and his work being supervised by him.

(2) *Survey Work.*—The Committee agreed that extensive survey work was now of less importance than the intensive survey and the work in Sind should be limited to the desert area in Thar-Parkar district. The intensive work should be carried out at 3 or 4 centres with two fieldmen at each. The Committee instructed the Locust Research Entomologist to draw up a scheme for the intensive survey work and submit it to the Council's secretariat for final orders.

(3) *Headquarters.*—Dr. Pruthi suggested that the headquarters of the Locust Research Entomologist should be at Pasni now that the work there was of such importance and needed the supervision of a senior officer. Mr. Burt explained the difficulties in supervising the work in Rajputana and Sind from Pasni and said that he considered Pasni an impossible Headquarters for the Locust Research Entomologist. After some discussions the Committee decided that the Locust Research Entomologist should be stationed at Karachi but that he should spend a fortnight at Pasni once every two months. The Committee were definitely of the view that the Locust Research Entomologist should in future be solely responsible for the work at Pasni and that he should frequently supervise the work of Dr. Karandikar who is his assistant. It was also agreed that the next report on the work at Pasni should be signed by the Locust Research Entomologist.

The proposal to establish a Central Laboratory at Karachi was withdrawn by Rao Sahib Ramachandra Rao in view of the intensive survey work now proposed and the revised arrangements for Pasni. He, however, put forward a proposal for a Laboratory Assistant to do some biometrical work. The Committee decided that a biometrical Assistant should be given to Mr. Ramachandra Rao for a period of six months in the first instance on a pay of Rs. 80 per mensem plus Karachi Allowance.

The Committee also agreed to the appointment of a Draftsman for mapping on a pay of Rs. 45 per mensem plus Karachi Allowance.

## (ANNEXURE II)

*Cost of the Locust Research Scheme.*

|   | Rs.             | A.       | P.       |
|---|-----------------|----------|----------|
| 1930-31 (Actuals) . . . . .   | 19,065          | 4        | 7        |
| 1931-32 ,, . . . . .  | 98,467          | 14       | 7        |
| 1932-33 ,, . . . . .  | 97,324          | 15       | 3        |
| 1933-34 ,, . . . . .  | 72,914          | 6        | 0        |
| 1934-35 ,, . . . . .  | 73,577          | 2        | 0        |
| 1935-36 probable (including a grant of Rs. 6,000 made to the Punjab Government) . . . . . | 95,304          | 6        | 3        |
|   | <u>4,56,654</u> | <u>0</u> | <u>8</u> |

**APPENDIX X**

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 30th September 1935 on Subject No. 26 (a):—Report on the tests of Indian Barley by the Institute of Brewing, London, for the year 1933-34.**

As the Advisory Board is aware the Imperial Council of Agricultural Research have sanctioned grants to the Governments of the Punjab, United Provinces and Bihar and Orissa, for investigations into the malting and brewing qualities of improved barley (Details of these schemes will be found at pages 12-13 and 59—68 of the printed proceedings of the Advisory Board, August 1933 and pages 7 and 54-55 of the printed proceedings of the Advisory Board, February 1934.)

2. The report (not printed) of the Institute of Brewing, London, on the samples of the improved barley sent from the Punjab, United Provinces and Bihar and Orissa during 1933-34, has now been received through the High Commissioner for India. The report is for the consideration of the Advisory Board.



## APPENDIX XI

**Note by the Secretary Imperial Council of Agricultural Research, dated the 11th October 1935 on Subject No. 26 (d):—Use of technical terms in progress reports on Agricultural Schemes financed by the Imperial Council of Agricultural Research.**

At its meeting held in February 1935, the Sub-Committee of the Advisory Board which examined progress reports on rice research schemes, made the following recommendation:—

“The sub-committee were also of opinion that there should be uniformity in the use of certain terms in the reports and it is provisionally suggested that the word ‘variety’ should be reserved for a commercial or agricultural variety and the term ‘strain’ reserved for strains multiplied at a plant-breeding station from single plant cultures. The term ‘pure line’ should be reserved for strains which have been demonstrated to be pure lines in the strict botanical sense and such should be fully described under type numbers. The term ‘single plant culture’ is a suitable description for such cultures whilst under study. Before prescribing the terms to be used in future reports, it is desirable that the Imperial Bureau of Plant Genetics should be consulted in order that the accepted international nomenclature may be followed.”

This was accepted by the Advisory Board.

2. The Imperial Bureau of Plant Genetics (for crops other than herbage) was accordingly addressed on the subject and a copy of their reply (Encl. I) together with a copy of a circular letter dated the 3rd October 1935 issued to Directors of Agriculture and other officers interested (Encl. II) is attached for the information of the Board.

## ENCLOSURE I.

COPY OF LETTER No. 611 (54), DATED THE 9TH AUGUST 1935, FROM THE DEPUTY DIRECTOR, IMPERIAL BUREAU OF PLANT GENETICS (FOR CROPS OTHER THAN HERBAGE) SCHOOL OF AGRICULTURE, CAMBRIDGE, ENGLAND TO B. C. BURT, ESQ., IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

I have the honour to acknowledge the receipt of your letter F. 229/34A of 11th July, and to state that the proposed definitions of the terms ‘variety’, ‘strain’, ‘pure line’ and ‘single plant culture’ are in every way appropriate as far as the Imperial Bureau of Plant Genetics is concerned. I have therefore no comments or further suggestions, and am convinced that much confusion can be avoided by use of these terms as defined.

## ENCLOSURE II

LETTER TO ALL DIRECTORS OF AGRICULTURE, INCLUDING HYDERABAD, MYSORE, BARODA, COCHIN, TRAVANCORE. BHOPAL, THE CHIEF AGRICULTURAL OFFICER, SIND, THE AGRICULTURAL OFFICER, BALUCHISTAN, No. F.-229/34-A., DATED THE 3RD OCTOBER, 1935.

I am directed to say that in the course of discussions on the annual reports on rice research schemes, the Advisory Board of the Council considered that greater uniformity was desirable in the use of the terms ‘pure

line', 'variety', and 'strain', in reports on plant breeding work. The provisional conclusion of the Board was that the word 'variety' should be used for a commercial or agricultural variety; that the term 'strain' should be reserved for strains multiplied at a plant breeding station from single-plant cultures; that the term 'pure line' should be restricted to strains which have been demonstrated to be pure lines in the strict botanical sense (these pure lines should be fully described under type numbers) and that the term 'Single plant culture' is a suitable description for such cultures whilst still under study. The Board, however, decided that before laying down that these terms should be used in future reports, the Imperial Bureau of Plant Genetics should be consulted in order that accepted international nomenclature may not be transgressed.

2. A reference was made by this Department to the Imperial Bureau of Plant Genetics, Cambridge and a reply has been received that the definitions provisionally prescribed by the Advisory Board are appropriate. A copy of letter from Dr. Hudson, No. 611 (54) dated the 9th August 1935 is enclosed (Encl. I) I am therefore to request that this nomenclature may kindly be used in all progress reports submitted to the Council and in all papers intended for publication in the Indian Journal of Agricultural Science, Agriculture and Livestock in India or as scientific monographs or bulletins.

**APPENDIX III**

**Note by the Secretary Imperial Council of Agricultural Research, dated the 6th February 1936 on Subject No. 26 (b):—Report on the Scheme of Agricultural Meteorology for the year ending 21st August 1935.**

The third annual report (not printed) on the Scheme of Agricultural Meteorology, for the year ending 21st August 1935, is submitted for the consideration of the Advisory Board. A reprint of the portion relating to the Agricultural Meteorology Branch, from the "Report on the Administration of the Meteorological Department of the Government of India during 1934-35", supplied by the Director General of Observatories, is also attached. (not printed.)

**APPENDIX XII-A**

**Supplementary note by the Secretary, Imperial Council of Agricultural Research dated the 6th February 1936 on Subject No. 26 (b):—Continuation of the scheme of Agricultural Meteorology.**

At its meeting held in February 1935 the Advisory Board recommended (i) that the scheme of Agricultural Meteorology sanctioned by the Council should be continued for the remaining period of two years from August 1935 for which the Council had originally sanctioned it, with the additional staff and equipment required by the Director General of Observatories, and (ii) that the question of further continuance should be considered in consultation with the other Departments of the Government of India concerned (pages 32, 187-188 and 285-300 of the printed proceedings).

2. The present staff of the Agricultural Meteorology Branch is as stated below:—

*Officers.*

Agricultural Meteorologist.

(Rs. 400-50-600—600-50-1,000 1,000-50-1,250. Efficiency Bar 800).  
Assistant Agricultural Meteorologist.

(Rs. 200-15-320-20-400. Efficiency Bar—20-600).

*Establishment.*

1 Meteorological Assistant. (Rs. 130-8-210-10-270).

2 Senior Observers (Rs. 70-4-150)

3 Junior Observers (Rs. 40-3-100).

1 Typist (Rs. 40-3-100)

1 Peon. (Rs. 18).

The Council has sanctioned a grant upto August 1937.

3. The matter has been discussed informally with the Director General of Observatories and with the Departments of Government concerned and probably the best course would be for the Advisory Board to record its views by a formal resolution in order that the Director General of Observatories may place specific proposals before Government.

4. The Vice-Chairman considers that the following statement correctly summarises the views expressed by the Advisory Board in recent discussions:—

“In the opinion of the Imperial Council of Agricultural Research it has now been established that agricultural meteorology should become one of the permanent activities of Government and it is desirable that the Agricultural Meteorology Section of the Meteorological Department should now be placed on a permanent basis. It is in accordance with general idea underlying the establishment of the Research Council that, when a research activity has been proved to be of permanent value, it should be taken over in whole or part by the appropriate Department of Government so releasing the Council's funds for new schemes. The Advisory Board, therefore, recommends to the Government of India that the agricultural branch should be made a permanent activity of the Indian Meteorological Department under the Director General of Observatories at Poona. It follows

that the two officers' posts, *viz.*, the Agricultural Meteorologist and the Assistant Agricultural Meteorologist, should be made permanent. This statement is for discussion.

5. The Director General of Observatories has expressed the opinion that it is of the highest importance that the Agricultural Meteorologist should maintain close touch with Agricultural Departments, as at present, and that for this purpose the consideration of an Annual Report by the Advisory Board of the Council is eminently desirable even if the whole expenditure on the scheme is borne by Government. The Advisory Board will doubtless confirm this view which is in accordance with its previous expressions of opinion. As the actual technical programme of work will, to a considerable extent, depend on the recommendations of the Advisory Board of the Council it would only be logical that the Council should contribute to the cost of carrying out these recommendations. The cost of establishment and contingencies in the year 1936-37 will be approximately Rs. 12,000 and it would not be inappropriate for the Council to make a grant of this order for a term of years after 1936-37 in the event of Government making the section permanent.

**APPENDIX XIII.**

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 2nd December 1935 on subject No. 40:—Application from the Government of Madras for a grant of Rs. 92,487 spread over a period of three years for a scheme for research for improving the fishing industry and developing the supply of fish manure.**

At its meeting held in September 1934, the Advisory Board considered the attached application (Annexure I) from the Government of Madras for a grant of Rs. 92,487 spread over a period of 3 years for a scheme for research for improving the fishing industry and developing the supply of fish manure. The Board recommended the scheme subject to the condition that the Madras Government renewed the measures previously adopted for the development of deep sea fishing *vide* Annexure II. The Governing Body at its meeting held in January 1935, decided to postpone consideration of the scheme till full facts on the continuation of the survey of deep sea fishing resources were received from the Government of Madras (Annexure III). The Governing Body's decision was communicated to the Government of Madras, who in reply have sent a short account (Annexure IV) of the action taken by them to develop deep sea fishing. They are also considering a proposal to employ a Yorkshire Coble to demonstrate the possibility of exploiting the fishing grounds discovered previously. The Madras Government have been asked for information as to whether this proposal has been approved.

2. The subject is now submitted for the consideration of the Board as to whether the action proposed by the Government of Madras is adequate.

**ANNEXURE I.****SUBJECT No. 14.**

*Application from the Government of Madras for a grant of Rs. 92,487 spread over a period of three years for a scheme of research for improving the Fishing Industry and Developing the supply of Fish Manure.*

Attention is invited to the attached letter from the Government of Madras, No. 3563-II/33-I., dated the 11th January 1933 (Annexure) regarding a scheme of research for improving the fishing industry and developing the supply of fish manure. The scheme which is fully explained in Mr. Slater's letter (Enclosure) involves, in so far as the Council is concerned, an expenditure of Rs. 92,487 spread over a period of three years.

The subject is now for the consideration of the Advisory Board.

**CHARAN DAS,**  
*Secretary.*

*The 19th January 1933.*

## ENCLOSURE.

LETTER FROM S. H. SLATER, Esq., C.M.G., C.I.E., I.C.S., SECRETARY TO THE GOVERNMENT OF MADRAS, DEVELOPMENT DEPARTMENT, TO THE SECRETARY TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI, No. 3563-II/33-I., DATED FORT ST. GEORGE, THE 11TH JANUARY 1933.

*Fish manure-Research.*

I am directed to forward a scheme of research for improving the fishing industry and developing the supply of fish manure for favourable consideration by the Imperial Council of Agricultural Research.

As the Council is aware, the Department of Fisheries in Madras has been engaged for some time in introducing improvements in the manufacture of fish guano, fish meal and fish manure. Prior to the investigations made by the department, the method of producing fish fertilizer was primitive in character and consisted in drying sardines in the sun on the sands of the open beach. This system had two drawbacks. Large quantities of valuable oil of no manurial value were lost and the manure became so highly impregnated with sand that analysis frequently showed the resultant mass to contain as much as 40 per cent. of this useless adulterant. Experiments were, therefore, undertaken at the Tanur station on the West Coast and had a speedy success. It was found that a simple and inexpensive plant could be devised to separate the oil and fertilizer effectively and profitably and the oil and the fertilizer so separated were of such good quality and fetched such high prices that numerous private factories came into existence on the Malabar and South Kanara coasts. Further experiments have shown that it is likely that a good proportion of the fish guano now used as a fertilizer will eventually be used more profitably as food for livestock, cattle pigs, dogs, poultry, etc. Success has already been obtained in producing fish meal on a small scale from all the common fish found on the West Coast. Samples of these were exhibited at the Wemby Exhibition and several enquiries followed for the supply of the meal in bulk. The conversion of 'scrap' (fish pressed for oil) into fish meal is more remunerative to the manufacturers and useful to the agriculturist than conversion into fish guano.

The processes now followed at Tanur for separating the oil and the fertilizer are, however, still empirical and crude. Much remains to be done by technological research to improve the quality of the oil and to develop the manufacture of guano and fish meal on approved scientific lines. The process of boiling and expressing the oil by hand presses which is now done at the Research station and in private factories is wasteful inasmuch as the proteins and other nitrogenous substances from the fish are lost in liquid form. The mechanical devices for manufacture of these products on a commercial scale have still to be improved so that production may be cheapened and quality standardized. Every step in the manufacture of oil and guano requires careful and detailed investigation and experiment. The degree of freshness of the fish required for high class manure and meal, the correct temperature for cooking, methods of cooking in closed or open vessels by steam or open fire, the period for which

cooking should be continued, methods of separation of oil without detriment to the quality of manure, the degree of dryage of scrap, etc.—all require detailed investigation and accurate experiment. Though general methods of manufacture are the same everywhere details of the process differ with each kind of fish. The process suitable for Indian fish has therefore to be specially ascertained before the fish guano industry can claim to have attained even a reasonable degree of success. The perfection of the methods of manufacture, of fish meal referred to above, which is a more remunerative industry and one of considerable importance to the agriculturist in feeding livestock requires also the services of an expert Fisheries Chemist and Technologist.

The Tanur station as at present equipped and staffed is not competent to deal with any of the problems enumerated above. The Director of Fisheries proposes, therefore, that a bio-chemical laboratory should be established at Tanur and the services of a competent and experienced Bio-Chemist should be engaged for a period of at least three years to begin with. As the research is of a highly technical nature the officer to be recruited should be a technologist of wide experience and it is not anticipated that such an officer could be obtained for less than Rs. 1,200 per mensem. One of the Assistants of the United States Bureau of Fisheries with considerable experience in the manufacture of oil and guano who has actually patented improved processes and machinery, was interviewed by the Director in 1929 when he agreed to come to India for a short term of years but considered that a salary of Rs. 1,200 per mensem was the minimum which he could accept. It is understood that this officer, though he has since left the Bureau will be available to undertake the proposed research at Tanur.

It will be convenient and economical to locate the laboratory at Tanur where there is ample accommodation for the Technologist, his staff and his laboratory. It is considered that if the experiments prove as is expected, a success, the laboratory will be required as a permanent measure and it will then be necessary to have a suitable Indian specially trained in charge of the work. To that end, it has been suggested that a Chemistry Honours Graduate of an Indian University of approved merit and high academic qualifications should be recruited at once on an initial salary of Rs. 200 a month. In order to enable him to acquaint himself with local conditions and specific problems relating to Indian fish oil and manure industry he will be deputed for a period of one year to visit the private oil and guano factories on the coast and to work under the immediate control and guidance of the expert at the Tanur station. After a preliminary study and training he should be deputed to America, for an advance course of bio-chemistry with special reference to fish oil, guano, and fish meal manufacture for a period of one year. The deputation to America is proposed as it undoubtedly offers the best facility for study and training to Indian students. In America, the student will visit the Atlantic and Pacific coasts, where two different kinds of fish are used in the industry. On his return at the end of the second year he will resume his work under the expert, the intention being that he should eventually succeed the expert. During the one year when the student will be away on training the expert will need the assistance of a suitable well-trained assistant of the department. An assistant on Rs. 70—250 will therefore be attached to the expert during the second year of the recruit's training abroad.



The total cost of the scheme is as shown below:—

*Non-recurring.*

|  | Rs.           |
|--|---------------|
| Apparatus, chemicals, etc., for the laboratory . . . . . | 10,000        |
| Furniture and fittings . . . . .                         | 1,500         |
| Site, buildings, plants, laboratory and office . . . . . | 39,120        |
| Total  | <u>50,620</u> |

*Recurring.*

|   | Rs.           |
|---|---------------|
| Pay of Bio-Chemist at Rs. 1,200 a month . . . . .         | 43,200        |
| Pay of Research Assistant at Rs. 150 (one year) . . . . . | 1,800         |
| Pay of laboratory assistant on Rs. 65—125 . . . . .       | 2,484         |
| Pay of clerk on Rs. 35—60 . . . . .                       | 1,278         |
| Pay of peon on Rs. 12—18 . . . . .                        | 432           |
| Contingencies . . . . .                                   | 3,000         |
| Apparatus and chemicals . . . . .                         | 3,000         |
| Travelling allowance . . . . .                            | 3,000         |
| Passage of the expert . . . . .                           | 3,500         |
| Total   | <u>61,694</u> |

To the above expenditure will be added the cost of training of an Indian candidate as shown below:

|  | Rs.           |
|--|---------------|
| Pay @ Rs. 200 (for 12 months) . . . . .  | 2,400         |
| Travelling allowance in India . . . . .  | 1,000         |
| Charges on account of the candidate going to America for a period of one year at 2,000 dollars . . . . . | 8,500         |
| Pay for the third year on return at Rs. 230 . . . . .  | 2,760         |
| Passage to and from America (£160) . . . . .   | 2,133         |
| Travelling allowance in America . . . . .  | 2,500         |
| Total  | <u>19,293</u> |

The scheme as explained above was placed before the Provincial Research Committee and has been approved by it. The contribution of Madras Government towards the cost of the scheme will be the cost of buildings, site, etc., estimated at Rs. 39,120 and included under non-recurring expenditure shown above. The continuance of the Tanur station has at present been sanctioned only up to 31st March 1934, and even if they decide to discontinue the work now done there after this date they would have no objection to allow the use of the buildings, laboratory, etc., for the conduct of the proposed investigation. The scheme is of importance not only to Madras but to all India. The Government of Madras attach great importance to the development of fish manure industry and I am to express the confident hope of His Excellency the Governor acting with his Ministers that the scheme will receive the sympathetic consideration of the Imperial Council of Agricultural Research.

## ANNEXURE II.

EXTRACT FROM THE PROCEEDINGS OF THE MEETING OF THE ADVISORY BOARD  
HELD ON THE 3RD SEPTEMBER 1934.

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5. *Application from the Government of Madras for a grant of Rs. 92,487 spread over a period of three years for a scheme of research for improving the fishing industry and developing the supply of fish manure (Subject No. 10 of the Agenda).*

Mr. Ramamurty in introducing the scheme said that in the West Coast of Madras there was a large surplus of fish which could not be consumed locally. He said that the supply of fish had varied from year to year for the last ten years and on an average he estimated that the value of the supply would be about Rs. 8 lakhs per annum. Some years ago the Madras Government had some research done in regard to the preparation of fish manure and fish meal. The East Coast of the Madras Presidency had also been surveyed by the trawler and it was found that there was five times as great a supply there as in the West Coast, and that if these fisheries were developed there would be plenty of material available for conversion into fish manure and fish meal. He therefore supported the recommendation of the Fertilisers' Committee regarding the bio-chemical work which was proposed by the Madras Government in order to make economic use of the material already available. The Madras Government, he thought would not be content with making use of the material available but would also exploit the new sources. In reply to a question put by Mr. Livingstone, Mr. Ramamurty said that they had a second-hand trawler bought in England some ten years ago but as it gave trouble it was recently sold. There were now a number of new fishing grounds which had been surveyed but not exploited. Dr. Burns, in opposing the scheme, said that the manufacture of fish manure and fish meal was only a subsidiary item of the main question and until it was known from the Madras Government whether they would again take up deep-sea fishing the scheme should not be passed. Mr. Livingstone agreed with Dr. Burns. He said that the development of the fishing industry was more important than the development of existing factories to produce fish manure and that the problems of proper marketing of fish meal and storage in refrigerating vans were more important than the question of production of fish manure. He was of the opinion that without holding up the Madras Scheme in any way a Committee should be appointed to expand the Madras Scheme so as to cover any enquiry into the production manufacture and utilisation of fish and fish products generally. It was also elicited in the course of discussion that except in Madras, Cochin and Travancore the Fisheries Department in maritime provinces had been closed. That being so, Mr. Livingstone was of the opinion that a central committee should be appointed by the Imperial Council of Agricultural Research to deal with work connected with fisheries. Dr. Hyder opposed the scheme on the ground that Sir Frederick Nicholson, a former Director of the Department of Fisheries, Madras, had expressed the view that the expenditure was unnecessary, and unwarranted and that the oil produced in Madras was first class. Rao Bahadur Viswanath supported the Scheme and said that subjects Nos. 9 and 10 were inter-connected and that the fishing industry should be developed firstly for the purpose of

producing fish for edible purposes, secondly to produce fish manure free from defects such as oil, sand, etc., and capable of readily undergoing decomposition in the soil and thirdly to produce oils to supplement cod liver oil and for the purpose of soaps, etc. He said that the Madras Government scheme should be accepted and sanctioned without undue delay. Mr. Ramamurty in replying to the criticisms said that he welcomed the suggestion of appointing a central fisheries committee but the Madras Government scheme should not be postponed as there were plenty of grounds to exploit. He was of the opinion that after the fields already discovered had been exploited the Madras Government would consider the question of purchasing a new trawler. After several members had spoken it was suggested by Mr. Burt that information should be obtained before the end of the present meeting of the Board as to what the Madras Government have done to exploit the new sources located by the trawler. Mr. Ramamurty promised to obtain information by telegram from the Madras Government. Further consideration of the Scheme was therefore postponed till Friday, the 7th September.

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EXTRACTS FROM THE PROCEEDINGS OF THE MEETING OF THE ADVISORY BOARD  
HELD ON THE 8TH SEPTEMBER 1934.

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19. *Application from the Government of Madras for a grant of Rs. 92,487 spread over a period of three years for a scheme of research for improving the fishing industry and developing the supply of fish manure. (Subject No. 10 of the Agenda).*

The Chairman explained that a decision on this subject had been postponed for want of information as to what the Madras Government had done to exploit the new sources located by the trawler. He then called on Mr. Ramamurty to acquaint the Board with the information he had received. Mr. Ramamurty read out the following telegram from the Madras Government:—

"Your telegram regarding fish manure scheme. Since disposal trawler nothing done by Government to exploit new fishing banks discovered though Yorkshire Coble was obtained as most suitable for use in Indian waters. Unfortunately trawler broke down immediately after arrival of Coble. As no expert available not even demonstration with Coble possible but possibilities Coble as fishing boat were demonstrated near Sethubasatram in September 1933. Trawlers discoveries have attracted private attention. Already two fishermen have applied for full particulars of trawlers survey as well as chart. One set up refrigerating plant and factory on East Coast and started freezing curing fish and experiments in manufacture fish meal and manures on Tanur methods. One on West Coast endeavouring to get big refrigerating plant in view success attained by him with small one worked with guidance and help of Department." The Chairman then informed the members of the Board that he had received a telegram from one Mr. Madhavan saying that the fishermen of the West Coast protested against purchasing a trawler and research expenditure. He said that the Board could not interfere in the matter which was for the Local Government. The protests should have been

made to the Government of Madras. Mr. Burt suggested that the recommendation of the Fertilizers' Committee be accepted and that the condition recommended by the Fertilizers' Committee be attached to any grant that might be made to this scheme. The Board accepted the suggestion and approved the recommendation of the Fertilizers' Committee.

### ANNEXURE III

EXTRACT FROM THE PROCEEDINGS OF THE MEETING OF THE GOVERNING BODY HELD ON THE 21ST JANUARY 1935.

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18. *Application from the Government of Madras for a grant of Rs. 92,487 spread over a period of three years for a scheme of research for improving the fishing industry and developing the supply of fish manure (Subject No. 29 of the Agenda).*

The Hon'ble Maulvi Abdul Hamid and Sir Joseph Kay did not favour the scheme on the ground that it was purely a provincial matter and should not be financed by the Council. Mr. Burt explained the various stages through which the scheme had passed and drew attention to the importance of developing the supply of fish for human food, fish meal for cattle food and fish manure. Colonel Olver also spoke in support of the scheme. In the end, it was decided to postpone the scheme till full facts on the continuance of the survey of deep-sea fishing resources were received from the Madras Government.

### ANNEXURE IV

COPY OF LETTER No. F. 67/34/Vet., DATED THE 13TH MARCH 1935, FROM THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, TO THE SECRETARY TO THE GOVERNMENT OF MADRAS, DEVELOPMENT DEPARTMENT, MADRAS.

*Scheme of research for improving the fishing industry and developing the supply of fish manure.*

I am directed to refer to the correspondence resting with your letter No. 2494-II/33-2, dated the 13th February 1934 and to enclose a copy of an extract from the proceedings of the meeting of the Governing Body of the Imperial Council of Agricultural Research relating to the scheme mentioned above. It will be seen therefrom the Governing Body has decided to postpone further consideration of the scheme till full facts on the continuance of the survey of deep-sea fishing resources were received from the Government of Madras. I am therefore to request the Government of Madras kindly to supply the information asked for by the Governing Body.

LETTER FROM THE SECRETARY TO THE GOVERNMENT OF MADRAS DEVELOPMENT DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. 1150-II/35-2, DATED THE 17TH SEPTEMBER 1935.

With reference to your letter No. F. 67/34/Vet., dated 13th March 1935, I am directed to state that, under the scheme placed before the

Imperial Council of Agricultural Research by the Government of Madras, it was proposed to conduct research in order to evolve improved methods of manufacturing fish oil, fish meal and fish manure. On account of the high feeding and manural value of fish meal and fish manure, the Fertilizers Committee of the Council recommended the scheme, subject to the condition that the Madras Government would revive the measures previously adopted for the development of deep-sea fishing. But the Governing Body of the Council deferred consideration of the scheme until full information about the continuance of the survey of deep-sea fishery resources was received from the Government of Madras.

2. A short account of the action taken by the Madras Government to develop deep-sea fishing will be found in the letter from the Director of Fisheries, a copy of which is enclosed. It will be observed that the Government purchased and employed a trawler to make a survey of deep-sea fishing grounds. The results of the survey have been recorded in bulletins of which two have been published and copies of them are enclosed; the third is in the Press. Unfortunately, however, the trawler soon became unserviceable and had to be sold. Expenditure on further research of this nature was obviously useless unless the discoveries already made could be exploited to an appreciable extent. The Director of Fisheries, therefore, proposes to employ a Yorkshire Coble, which was obtained in connection with the previous deep-sea fishing experiments, to demonstrate the possibility of exploiting the fishing grounds discovered by the trawler. His proposal is under consideration.

3. But, even without any intensive exploitation of deep-sea fisheries or any further investigation of them, there is, on an average, a sufficient surplus, over and above local food requirements, of certain classes of cheap shoaling fish suitable for conversion into fish guano and manure. The manufacture of fish oil is, admittedly, chiefly conditioned by the presence of the Sardine in sufficient quantities. The causes of the periodical absence of this fish from the inshore waters of the West Coast are a constant subject of study. The Government of Madras, therefore, fail to understand why their proposal to employ a bio-chemist for research into improved methods of manufacturing fish meal, fish oil and fish manure should depend on a revival of the measures previously adopted for the investigation of the possibilities of deep-sea fishing.

4. In the circumstances, the Government of Madras would urge a favourable consideration of their proposal.

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FROM THE DIRECTOR OF FISHERIES, MADRAS, REF. NO. 2804-E/31, DATED THE 9TH AUGUST 1935.

*Ref. Government Memorandum No. 1150-11/35-1 dated 28th March 1935*

The Governing Body of the Imperial Council Agricultural Research asks for full facts regarding the continuance of the survey of deep-sea fisheries before they sanction the scheme for research on fish manure at Tanur. From the Proceedings of the Governing Body it is clear that the Council are not aware of the contribution the Madras Government has made towards the development of deep-sea fisheries for the last two decades and more. A short account of the deep sea fishing investigations

conducted in Madras since 1909 seems necessary for a correct appreciation of the present position and future policy of the Madras Government with regard to the development of marine fisheries.

*Development of deep-sea fisheries.*

For the last three decades, ever since the inception of the Department of Fisheries the development of deep-sea fishing has been the main aim of the Government and considerable money, time and effort have been expended on it. The investigations made fall under two heads:—

- (1) Trials with various types of fishing boats, rig and gear; and
- (2) Scientific survey of deep-sea fisheries and fishing banks.

(1) *Trials with various types of fishing boats, rig and gear.*—In 1909 two fishing boats one a sailing vessel of 12 tons "Sutherland" designed by the Fishery Board of Scotland, and the other a 15 h.p. motor vessel "Turbinella" of 25 tons of Arklow design were constructed at a cost of Rs. 6,000 and Rs. 8,000 respectively. Fishing experiments beyond the usual range of the local boats were conducted with these boats till 1910-11. The experiments show that these boats were too big for small work but not big enough for large work. The "Sutherland", though it caught a larger quantity of fish than local vessels was found too slow for the light winds of the East coast. The motor boat "Turbinella" attracted the attention of the fishermen at Tuticorin by the unusual catching power of her nets. The main difficulty encountered was the impossibility of obtaining a crew, who, on their own initiative and without expert supervision would work and modify their methods as occasion required in unknown and hitherto untried conditions and purely experimental work.

In addition two of the largest fishing boats of local type (Ratnagiri sailing drifters) of 6 to 8 tons were chartered from the Kanara coast and drift net experiments beyond the usual range of local fishermen were conducted. They brought in large quantities of fish—1500 lbs. in weight for one night's work was the largest catch. Each of the two boats caught on an average at the rate of 10 tons for the two months. The catches however could not be landed fresh. A motor boat as carrier was therefore considered essential.

Proposals for the recruitment of a Master Fisherman from Scotland were next sanctioned by Government but the Great War prevented the recruitment.

Pending the recruitment of a Master Fisherman and experiment with western methods, two Ratnagiri boats were purchased in 1915-16 (cost Rs. 2,000) as they could not be chartered, for continuing the experiments with local Malabar crews. Trial fishing with these boats was done from 1916-22, when the experiments were finally abandoned for the reason (as in the case of "Sutherland" previously) that the crew did not work satisfactorily in the absence of expert guidance and in addition the boats could not land fish fresh without a motor carrier.

Mr. Hornell next recommended experiments with a Danish motor cutter and seine net in 1920-21. Instead of a cutter a powerful sea-going motor launch "Sea Scout" of 30 h.p. was purchased in 1922 on the advice of the Indian Stores Department at a cost of Rs. 37,000 and an Experienced Master Fisherman was also recruited to conduct experiments. The

vessel, however proved totally unsuitable in design and equipment and the experiments ceased in March 1924. The expenditure incurred on the experiment, apart from the cost of the launch, was Rs. 12,072.

(2) *Survey of deep-sea fisheries and fishing banks.*—In 1908 Mr. Hornell conducted a preliminary trawling cruise off the Malabar coast with the pearl fishery inspection vessel, a steam boat "Margaritta" purchased at a cost of about Rs. 90,000. His conclusions were (1) that steam trawling would not be remunerative within the 30 fathom line where the bottom consists of mud, but a zone roughly 25 miles of grey sand beyond this line which extends from Cochin to Coondapoor may prove profitable; (2) the "Margaritta" was too small and feeble a boat and otherwise quite unsuitable for experimental trawling and inspection and a survey with a larger better equipped boat was necessary. A new inspection schooner replacing the "Margaritta" was then built at a cost of Rs. 99,731 at Calcutta in 1913. She, however, did not prove a sea-worthy boat for trawling and deep-sea work, though suitable enough for the inspection of pearl banks and chank fisheries in the sheltered waters of the Gulf of Manaar.

In 1914 the Government examined the need for a larger vessel. A Committee consisting of Sir F. A. Nicholson, Mr. Hornell and Commander Huddleston met in conference at Coonoor and recommended the construction of a steam trawler at a cost of £85,000. As War had commenced, Government decided to postpone the proposal till after the War.

The scheme was revived in 1919 and another Committee was appointed to examine the question. The Committee recommended a larger trawler costing £80,000, among other purposes, for (1) a survey of trawling grounds from inshore to the 100 fathom line; and (2) a general off-shore fishing investigation other than trawling *i.e.*, the extension of fishing operations into off-shore waters for shoaling and surface fish. As the Naval architects estimated the cost of this trawler at the prohibitive sum of £109,000, the proposal had to be abandoned in 1920.

In 1924 the fish-curing yards of the Presidency were transferred to this Department. The main item of expenditure on yards was the purchase and transport of salt from Tuticorin to the West coast yards at a cost approximately of Rs. 2 lakhs per annum. Combining the three duties—salt transport (done till then by hired schooners), the survey of deep-sea fishing grounds, and the inspection of the Laccadives, it was found that a second-hand trawler at a cost of £2,000 (the market price in 1924) could be purchased and worked by the Government economically. Accordingly in 1926 a trawler 'Lady Goschen' was obtained at a cost of Rs. 75,986 and the services of Capt. Cribb as Master Fisherman were entertained. For the first time a systematic survey of deep-sea grounds, on two selected sections of the East and West Coasts, was conducted from 1927 to 31 at a total cost of Rs. 5,68,427. The results are embodied in three reports, two of which have been published so far (copies enclosed). The survey had to be suspended in 1931 on account of the unfortunate breakdown of the trawler's boiler and the urgent need for retrenchment on account of the unprecedented economic depression.

Though the survey was confined to two selected sections of the coast it has resulted in some remarkable discoveries of fishery resources wholly unsuspected before. Besides regularly recording the kinds and abundance

of the common food fish in off-shore waters and their seasons the following five new fisheries, all of which were previously unknown, were located:—

- (1) An extensive shark ground opposite Point Calimere.
- (2) A squat-nosed lobster fishery from Point Calimere to Cuddalore and beyond.
- (3) A perch fishing ground from Point Calimere to Pondicherry.
- (4) Horse Mackerel fisheries from Pondicherry to Madras.
- (5) A large cuttle fish fishery off Coondapoor in South Kanara.

An even more remarkable fact brought out by the survey was the striking contrast between the off-shore fisheries of the sections of the East and West coast surveyed. The off-shore fisheries of the East coast were found to be far superior in quality and value to those on the West coast. The existence of such a wealth of good class fish on the East coast had never been suspected before.

The earlier experiments in the survey of fishing grounds indicated the need for a larger boat of the trawler type. The survey by the trawler 'Lady Goschen' has now shown beyond doubt the existence of valuable fisheries in the off-shore waters on sections of the East and West coasts explored by her. For studying deep-sea conditions and the habits of fish, especially the richness or otherwise in fish generally of our deeper waters of which nothing was known before, and to indicate probable developments in capturing methods an expensive trawler with its equipment and staff were indispensable. While the trawler was a necessity to enable the Department to make the researches upon which future marine fishery developments may be founded, it was never contemplated that the Indian fishing industry would jump from the catamaran or canoe to the steam trawler all at once. The task, therefore, of ascertaining a suitable type of small but efficient modern power boat which would enable the fishermen to exploit the off-shore fisheries that may be discovered by the survey had engaged the attention of the Department from the start.

The experience gained with various types and sizes of sail, motor and steam fishing boats from 1909 has been valuable but in itself did not finally solve the problem. The most serious handicap, besides the heavy capital investment, to the introduction of large-sized modern craft and methods of sea-fishing is the absence of harbour facilities and shelter for sea-going boats. The existing fishing craft (canoes and catamarans) are beached when not in use or in stormy weather. Even if men and money are available for the development of fishing, the absence of shelter in the form of natural or artificial harbours in most places precludes the introduction of larger sail or power boats.

The heavy surf is another, perhaps, minor handicap for fishing craft and any modern boat which is not specially designed to withstand the heavy surfs not suited to the fishermen's requirements. What was needed was a cheap power boat built on approved modern lines, more roomy and better constructed than the existing canoe or catamaran and



capable of cruising longer distances than either, but one which, at the same time, could be beached securely like them and could be launched against a heavy surf. After an extensive study of sea-going fishing craft in other countries, and in consultation with Fishery experts, the introduction of the Yorkshire Coble, which closely resembles the "Sampan" of Japan and China and happily combines all the requisite qualities, was decided on as the most likely immediate improvement possible in Indian sea-going fishing craft. The remarkable feature of the coble is that the Yorkshire and Durham fishermen have embodied in her fifty years before the time, the main principles of design reached after much experimenting in the modern speed motorboat—the high hollow bow running away to the clean flat sections of the stern. No wonder that the coble has attained such a reputation for speed, especially when reaching with a good weight of wind.

The coble is one of the most distinctive types of craft to be found in Europe or Asia. She was primarily designed for launching off beaches against heavy seas and admirably has she met this principal requirement. With a high shouldered bow and a deep grip, she carries a flat floor aft to her low stern, beneath which two "skorvels" or shallow bilge keels, help to keep her upright and to launch her down the beach. Besides, the twin keels help to shield the propeller from coming into contact with the ground when the boat is beached or launched. The deep forefoot is useful in coming head first off the shore into a breaking sea, being a help in keeping the head of the boat up to windward, drawing as it does from two or three feet. It gives her a powerful grip which, added to the hold given by the deep rudder, enables a coble to be a very fine performer on a wind, especially in a sea-way. The coble will enable the fisherman to cruise much longer distances with the certainty of expeditious return to his home port. The boat being beachable, this innovation need not await the development of fishing harbours.

Accordingly a 23 feet square stern motor 'coble' equipped with 6-8 h.p. engine was ordered from Mr. W. H. Cambridge (a well known coble builder) at a cost of Rs. 2,920 and arrived in India on 29th November 1930. As her arrival almost coincided with the breakdown of the trawler's boiler and the termination of Cap. Cribb's services no experiments have been possible with the boat.

As the worst of the depression appears to have been tided over, proposals to recruit an experienced Yorkshire Coble Fisherman to experiment with the coble and demonstrate its fishing possibilities on the fishing grounds discovered by the trawler are under consideration.

Circumstances entirely beyond the control of the Madras Government led to the termination of the survey and there seems to be no immediate prospect of resuming the survey largely due to financial stringency. There is also the fact that the extensive off-shore fisheries discovered by the trawler have not yet been exploited by the local fishing industry. Under the present financial stringency, the question of giving practical advice and assistance to fishermen to extend their operations beyond present limits to the off-shore grounds surveyed by the trawler was naturally considered more important than continuing the survey itself. The proposed experiments with the coble, it is hoped, will make this possible.

The Madras Government have so far spent a sum of Rs. 7,21,419 as per details below, towards the development of deep-sea fisheries.

| Name of vessel.  | Capital Cost.<br>Rs. | Year.   |
|--|----------------------|---------|
| 1. Margaritta . . . . .                                      | 90,000               | 1908    |
| Running expenses not available.                              |                      |         |
| 2. Sutherland . . . . .                                      | 6,000                | 1909-11 |
| Running expenses not available.                              |                      |         |
| 3. Turbinella . . . . .                                      | 8,000                | 1910-11 |
| Running expenses not available.                              |                      |         |
| 4. Ratnagiri Machuwas . . . . .                              | 2,000                | 1916    |
| Running expenses not available.                              |                      |         |
| 5. Sea Scout . . . . .                                       | 37,000               | 1922    |
| Running expenses . . . . .                                   | 12,072               |         |
| 6. Trawler 'Lady Goschen' . . . . .                          | 75,986               | 1926-31 |
| Running expenses . . . . .                                   | 48,744               |         |
| 7. Yorkshire Coble . . . . .                                 | 2,920                | 1930    |
| No experiment has been conducted yet with the boat . . . . . | 7,21,419*            |         |

\* Excludes Rs. 99,731 being the cost of 'Lady Nicholson' built in 1913 as she is suitable only for the inspection of pearl banks and chank fisheries and the working expenses of the vessel (1) to (4) for which separate figures are not now available.

The keen interest of the Madras Government in developing the deep sea fishing industry in the Presidency will be evident from the brief history given above of the continuous experiments conducted so far and the large investment involved. Proposals to recruit a Yorkshire Coble Fisherman to demonstrate the use of the Coble, the motor boat decided on as the most suitable for conditions in India, are now receiving attention.

The oil sardine occurs in sufficient abundance along the West Coast of India upto Baluchistan and beyond and also in the Andamans and Mergui Archipelago, Burma and beyond, but the industry has been scientifically developed only in the two west coast districts of Malabar and South Kanara through the far-sighted initiative of the Madras Government. The research on manure proposed in Madras will, therefore, benefit not only Madras but all the other provinces concerned. The research can be carried out only in Madras as facilities for the work exist here and the Tanur station has been engaged in the work for over two decades.

The Council seems to be also under the misapprehension that without a large supply of fish which could be made available only through the development of deep-sea fishing there would be no scope for the development of the manure industry on the lines described in the scheme. Fairly accurate statistics of annual production and value are available only for the two districts of the Madras Presidency where the industry exists in an

organised form. The statement below furnishes the figure for the twelve years ending 1933-34.

| Year.             | Fish guano. |           | Fish manure. |           |
|-------------------|-------------|-----------|--------------|-----------|
|                   | Quantity.   | Value.    | Quantity.    | Value.    |
|                   | Tons.       | Rs.       | Tons.        | Rs.       |
| 1922-23 . . . . . | 32,000      | 24,00,000 | ..           | ..        |
| 1923-24 . . . . . | 22,500      | 13,50,000 | 17,000       | 6,80,000  |
| 1924-25 . . . . . | 4,000       | 4,25,000  | 1,000        | 1,00,000  |
| 1925-26 . . . . . | 9,850       | 7,50,000  | 1,000        | 70,000    |
| 1926-27 . . . . . | 2,100       | 2,52,000  | 2,100        | 2,10,000  |
| 1927-28 . . . . . | 850         | 95,000    | 10,000       | 10,00,000 |
| 1928-29 . . . . . | 1,100       | 1,10,000  | 15,000       | 7,50,000  |
| 1929-30 . . . . . | 223         | 24,530    | 730          | 73,000    |
| 1930-31 . . . . . | 65          | 4,550     | 110          | 4,500     |
| 1931-32 . . . . . | 71          | 5,325     | 840          | 50,400    |
| 1932-33 . . . . . | 20          | 2,400     | 18           | 1,800     |
| 1933-34 . . . . . | 10,000      | 2,50,000  | 13,600       | 3,26,400  |
| Total . . . . .   | 82,779      | 56,68,805 | 61,398       | 32,65,600 |

Fish guano plus Fish manure . . . . . Quantity 1,44,177 tons.  
Value Rs. 89,34,405.

Average per year . . . . . Quantity 12,015 tons.  
Value Rs. 7,44,534.

In my letter Ref. 2804-E/32 to Government, dated 15th October, 1933 statistics of the value and output of the West coast industry for 10 years ending 1931-32 were given. The average annual value for the 10 years of fish guano and manure amounted to about 8½ lakhs. Statistics for the 12 years ending 1933-34 now available (see statement) show that the average annual value of the industry has decreased to Rs. 7½ lakhs. That this is not due to any decrease in the quantity of fish converted into manure is evident from the average annual quantity of manure produced during the 12 years. While the quantity has remained more or less stationary, the average annual value has deteriorated by a lakh of rupees due to the prevailing economic depression and depreciation of the market value of commodities. If the cost of oil is added, the value of the industry is about half a crore of rupees in a good year and about 10 lakhs every year on an average for the two districts mentioned; this, in spite of the several unfavourable seasons, undeveloped state of the guano industry (only crude products are manufactured) and the limited extent of the

sea coast (Malabar and South Kanara). There is, on an average, therefore, a sufficient surplus of certain classes of cheap shoaling fish above local food requirements for conversion into manure even without the intensive exploitation of deep-sea fisheries. The average aggregate value of the industry amounts to the high figure of 10 lakhs over a limited coastline of 250 miles in Madras and is bound to be very much more if the entire West coast including Baluchistan, and Assam, Burma, the Andamans and the Mergui Archipelago in the East are taken into account. The oil and guano industry is, therefore, carried on from year to year and is of sufficient magnitude to justify the small expenditure of Rs. 30,829 per year on research, for a period of three years for improving and modernising the methods of production.

**APPENDIX XIV.**

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 3rd February 1936 on Subject No. 48:—Encouragement to the cultivation of Medicinal Plants and Herbs in India.**

The Drugs Enquiry Committee appointed by the Government of India in 1930 considered *inter alia* the question of the indigenous supply of genuine medicinal plants and herbs in India and recommended that every encouragement should be given to promote the cultivation of such plants and herbs *vide* extracts enclosed (Annexure I). This recommendation was brought to the notice of local Governments and Administrations by the Government of India in August 1932. Attention is now invited to the attached copy of a letter (Annexure II) from the Government of Madras to the Government of India, Department of Education, Health and Lands No. 3486-III/35-1, dated the 8th October 1935, in which they have raised the question of the line on which action should be taken by provinces in respect of this recommendation and have suggested that the whole question may be examined by the Council either on the basis of materials already available or after convening a small conference of experts.

2. The following is a statement of the action which has already been taken by the Council in this matter:—

- (i) Since the Government of India brought the Drug Enquiry Committee's recommendation to the notice of local Governments and Administrations, enquiries have been received by the Council (both direct and through the Government of India), from certain local Governments, as to what plants would be most suitable for the provinces to take up. The Council accordingly obtained information regarding the drugs which are at present consumed in India and imported in sufficient quantities to hold out reasonable prospects of a satisfactory market, from Lt. Col. R. N. Chopra, Professor of Pharmacology at the School of Tropical Medicine, Calcutta, and from Messrs Smith Stanistreet and Co. and the Bengal Chemical and Pharmaceutical Works, Calcutta. Copies of the list were supplied to all local Governments and Administrations in February 1935.
- (ii) The Council has sanctioned the following three schemes, the first two of which are already in progress.
  - (a) Research in systematic collection of medicinal plants and study of food poisons in India by Lt. Col. R. N. Chopra.
  - (b) Investigation of Indian fish poisons in Mysore.
  - (c) Research into the indigenous drugs of India with special reference to their toxicology.
- (iii) In August 1933, the Advisory Board considered two further applications, one from the Government of the Punjab and the other from the Government of the United Provinces for grants for investigations of medicinal plants. Reference

is invited to the attached extracts from a report of the Sub-Committee which examined the schemes in the first instance (Annexure III). As stated in paragraph 4 of the report two lists were kindly supplied by Lt.-Col. Chopra—[Same as that referred to in paragraph 2 (i) above] viz., (A) Important drugs for which there is a good market; and (B) Pharmacopoeial drugs or their substitutes, which grow in India. These have been published in the Indian Journal of Agricultural Science, Volume V, Part I, February 1935.

3. Reference is also invited to the attached extract (Annexure IV) from a letter No. P. 59-XI/34-H., dated the 27th November 1935 addressed by the Department of Education, Health and Lands to all local Governments relating to this recommendation.

4. The point raised by the Government of Madras is now for the consideration of the Advisory Board. A note by the Agricultural Expert to the Council on the subject is attached (Annexure V).

#### ANNEXURE I.

EXTRACTS FROM THE REPORT OF THE DRUGS ENQUIRY COMMITTEE, 1930-31.

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287. Many witnesses in different provinces have drawn the attention of the Committee to the difficulty of identifying, selecting and procuring medicinal herbs of good quality. There appears to be a large demand for such raw material, but the supply is not commensurate with it. If a regular supply of genuine raw materials is assured, a great obstacle will be removed from the path of the drug manufacturers in India. It will also confer incidentally a lasting benefit to a large section of the population, dependent on the indigenous practitioners, who now obtain their supply from *Pansaris* and *Attars* dealing in stocks usually old and inert and stored under very unsatisfactory conditions.

288. Cultivation of medicinal plants on a commercial scale under Government experts will, in the opinion of many witnesses, remove one of the serious obstacles to the development of drug manufacture in India. The Committee considers that the practicability of the suggestion should be further explored. India is a veritable emporium of medicinal plants. Nearly three-fourths of the drugs mentioned in the British and other Pharmacopœias grow here. India possesses climatic conditions varying from the torrid to the frigid. It embraces vast tracts of tropical plains, temperate hills and valleys, irrigated soil, and moist and dry climates. It has, in fact, been described as the epitome of climates, seasons and soils of the British Empire. It is, therefore, possible that the drugs which do not now grow within her bounds can be made to do so. Acclimatization is possible to a large extent with almost any plant, and there are many instances where plants, indigenous to one country and originally marketed from there only, have been successfully introduced into other countries.

289. In India, reliance has been, so far, almost entirely placed on the natural resources of the country and herbs growing wild have been chiefly collected and utilized. The great impediment in the development of forest drug resources has always been the question of transport. These forests in many instances, are situated hundreds of miles from the railway and consequently the transport of forest products is beset with difficulties and

expense. Moreover, the forest resources, even if utilized to the fullest extent, will not be found sufficient for the needs of the country as many important medicinal herbs and plants do not grow in India in a state of nature. The subject of cultivation of medicinal plants, therefore, should receive the special and careful attention of the Government.

290. Important medicinal plants, such as digitalis, ipecacuanha, cinchona, jalap, etc., have already been grown in India and there is no reason why the country should not grow almost every drug needed to supply her own wants and at the same time develop a large export business. A large export trade in some of the pharmacopœial drugs already exists. Little reliance can be placed on the nature and quality of the wild-grown drugs, and this presents a serious drawback to their employment for therapeutic purposes. It is for this reason that India imports not only prepared drugs, but also raw materials to the extent of many lakhs of rupees annually. Vast tracts of land are available in this country which, if utilized for systematic cultivation, will make genuine drugs available to the people at a reasonable price. In countries like Germany and Belgium, medicinal plant and essential oil gardens have proved a great success. The State authorities in France and America have displayed a great deal of interest in growing drugs on an extensive scale. In the United States of America, there is a Bureau of Plant Industry attached to the Botanical Survey Section of the Department of Agriculture where all questions relating to the development of drug cultivation are considered. This bureau sends its agricultural experts to various parts of the world to investigate the climate, soil and environments suitable for the growth of a particular plant with a view to introduce it into their own country. The idea of the progress made is evident from the publications of the department which appear from time to time. Even the Commonwealth of Soviet Russia has started a bureau for carrying on a drug trade. Those departments are doing splendid work in their respective countries.

291. The establishment of a drug emporium in India was suggested many years ago, but has not yet materialized. Experimental drug farms have been started on a small scale in places like Mungpoo and Sabaranpur but their spheres of activity are limited. Creation of greater interest in this direction will prove advantageous to the country in general and to the drug industry in particular. The Government of the United Provinces has already taken the right step by appointing a Committee of Experts to investigate this question—a lead which other Local Governments may, with advantage, follow. The co-operation of expert botanists, pharmaceutical chemists, and pharmacologists, is essential for the success of any scheme to further drug cultivation. Their advice will be valuable not only regarding the locality where particular drugs can be successfully cultivated, but also about the time suitable for cultivation, collection, etc., with a view to obtain the maximum activity and yield. They can devise methods for improving the content of active principles in cases where they are deficient. The establishment of the Imperial Council of Agriculture with the large funds at its disposal, ought to make this easy. The Committee would urge on the Government to impress on the Council the necessity for giving immediate attention to this important aspect. Without development in this direction, the drug industry in this country will take a long time to take root and flourish.

## ANNEXURE II.

COPY OF A LETTER No. 3486/III/35-1. DATED THE 8TH OCTOBER 1935, FROM THE SECRETARY TO THE GOVERNMENT OF MADRAS, DEVELOPMENT DEPARTMENT, TO THE SECRETARY TO THE GOVERNMENT OF INDIA, DEPARTMENT OF EDUCATION, HEALTH AND LANDS.

**SUBJECT:**—*Recommendation No. 79 of the Drugs Enquiry Committee—Encouragement of cultivation of medicinal plants and herbs.*

I am directed to invite attention to the Proceedings of this Government (Local Self-Government Department), No. 250-P. H., dated the 29th January 1934, dealing with several recommendations of the Drugs Enquiry Committee. It was stated therein that a separate communication will be sent regarding recommendation No. 79 of the Committee. I am now directed to address the Government of India on this recommendation.

2. The papers forwarded with Mr. Hutching's letter No. F.-59-XI/34-H., dated the 28th February 1935, were sent to the Surgeon-General, the Director of Agriculture and the Chief Conservator of Forests, Madras, for remarks. Copies of their replies together with enclosures as shown in the annexed list (Enclosure I) are forwarded herewith for the information of the Government of India. The Director of Agriculture has subsequently stated that the trials of medicinal plants so far made at the several Agricultural Research Stations have not given satisfactory results except in the case of Jalap and Tinnevely Senna. Further trials are being made and samples of the medicinal parts of such plants as do well will be sent for test to the Medical Stores, Madras, as they become ready, and a report on this will be forwarded to the Government early next year.

I am directed to state that it is not clear to the Local Government what line of action should be taken by it in order to give effect to the recommendation of the Committee, although the Local Government has been in communication with the Imperial Council of Agricultural Research on the subject. A copy of this Government's letter No. 4534-III/34-8, dated the 22nd April 1934 to that body is enclosed (Enclosure II). The Imperial Council of Agricultural Research has merely forwarded the information in the papers sent as enclosures to Mr. Hutching's letter No. F.-59-XI/34-H., dated the 28th February 1935, and has not indicated the direction in which this Government should take action. I am therefore directed to suggest that the whole question be examined by the Imperial Council of Agricultural Research either on the basis of materials already available or after convening a small conference of Select Experts with a view to laying down the lines of future action in the matter in each Province.

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*List of papers forwarded.*

Enclosure I.

- (1) Letter from the Surgeon-General with the Government of Madras, R. No. 211-Accts./35, dated 9th March 1935.
- (2) Letter from the Director of Agriculture, Madras, No. D.-613/35, dated 23rd May 1935 (with enclosure).
- (3) Letter from the Chief Conservator of Forests, Madras, Ref. No. 2509/35-E., dated the 21st July 1935.



## Enclosure II.

FROM THE SECRETARY TO GOVERNMENT, DEVELOPMENT DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, SIMLA, LETTER No. 4584-III/34-S. DATED THE 22ND APRIL 1934

SUBJECT:—*Cultivation of medicinal plants and herbs.*

I am to invite attention to paragraphs 287—291 of the Drugs Enquiry Committee Report, 1930-31 on the encouragement of the cultivation of medicinal plants and to the recommendation of the Committee that 'every encouragement should be given to promote the cultivation of medicinal plants and herbs' on page 170 of the Report. A copy of letter No. R. O. C. D.-2-1816/33, dated the 16th March 1934 from the Director of Agriculture, Madras, on the subject is enclosed for information. The encouragement which the Committee recommended is apparently intended for those who are prepared to grow these medicinal plants and herbs or who would grow them under certain guarantees and assistance. The Committee was also of the opinion that the cultivation of these plants on a commercial scale under Government experts would tend to the development of drug manufacture in India. As attempts on the part of the Madras Agricultural Department in the past to grow Jalap and other medicinal plants have not been commercially successful for want of an assured demand for the products, it is considered that the practicability of the suggestions of the Committee should be further explored.

2. I am accordingly to enquire what action the Council proposes to take in regard to the Committee's recommendation and to request that this Government may be informed, if possible, what the demand will be for plants which it will be possible to grow in this province.

FROM THE DIRECTOR OF AGRICULTURE, No. R. O. C. D.-2-1816/33, DATED 16TH MARCH 1934.

*Medicinal Plants and Herbs—Cultivation—Encouragement.*

To promote the cultivation of medicinal plants and herbs, they must be grown on a commercial scale by ryots. Before ryots or others are persuaded to do so, they should be provided with information such as the kind of plants and herbs that could be successfully cultivated on the plains, what sort of soils are suitable for their successful growth, whether they should be cultivated under irrigation or as dry crops, what is the cost of production and profit per acre, and whether there is a constant demand for such crops so that they may consider the advisability of growing them in preference to some crops grown at present. The department has, in former times, given such information to ryots whenever new crops were attempted to be introduced on a large scale.

2. On a perusal of information available on the introduction of medicinal plants in the Presidency, it is found that some experiments were made in the cultivation of Jalap, Ipecacuanha, Digitalis, Henbane, Senna, *Chenopodium anthelminticum*, etc., on the Nilgiris, Koilpatti and Coimbatore. It was soon found that climatic conditions on the Nilgiris were unfavourable for their cultivation, while even at Koilpatti their cultivation did not meet with an unqualified success. The cultivation of Henbane which alone was grown in the latter place for about 5 years indicated that ideal conditions were not always available and that it gave a profit of

Rs. 58 per acre in 1920-21. The broad facts that emerge from past trials are that (1) they were grown in small plots and were mainly experimental in nature, (2) these experiments did not give definite results, (3) and when grown the demand was indefinite, or prices were so low that they did not offer any encouragement to people to grow them on a commercial scale.

3. The drug enquiry committee in paragraph 288 seems to suggest that the crops should be grown on a commercial scale under Government experts, the co-operation of expert botanists, chemists and pharmacologists be enlisted and that investigation might be taken up with the financial aid of the Imperial Council of Agricultural Research (paragraph 291).

4. To my mind, of all the items of encouragement that ryots need in this matter, that of technical assistance is the most important. From what has been explained in paragraph 2 above, it will be seen what little information is available on this important point. Hence the suggestion of growing the most suitable plants on the plains; and Coimbatore was considered the best place offering the greatest facilities for growing under different methods of cultivation. The idea was to grow on a commercial scale those plants which on a preliminary investigation gave the most promise. The next item of encouragement is the assurance of a constant demand at a definite price. Unless this assurance is given, it is fatal to make a beginning. Thirdly, the supply of good seed, either free in the initial stages or at reasonably low prices, should be another form of encouragement, and fourthly, facilities for irrigation as in the case of green manures will be still another incentive, if it is found that such crops need irrigation.

5. I am of opinion that unless we have more information on the subject which can only be obtained by cultivating them on a large scale on our agricultural stations, it is premature to consider the ways and means of giving encouragement or assistance to ryots or others prepared to grow these plants and herbs.

FROM THE SURGEON-GENERAL WITH THE GOVERNMENT OF MADRAS, R. No.  
211-ACCOUNTS, 35, DATED THE 9TH MARCH 1935.

Reference.—Local Self-Government Memorandum No. 1911-2-D.-1-P.H.,  
dated 19th February 1935.

The lists of important indigenous drugs furnished by Lieutenant-Colonel R. N. Chopra and Messrs. Smith Stanistreet and Co., Calcutta, may be forwarded to the Director of Agriculture with a view to find out which of those drugs could with advantage be grown in this province both on the hills and in the plains. Some of them grow wild on the hills and others are grown by cultivators in the plains. The Forest Utilization Officer and the Marketing Officer to the Government of Madras (if there is one) will be able to find out the demand there is for the drugs. If the agricultural departments could promise to supply the Medical Stores Depot with some of these drugs of the quality the Depot requires, it is certain orders will be placed with them.

Before experiments are carried out in experimental forms about the yield per acre and before it is known whether it will be a profitable crop or not, it will be difficult to pass any opinion on the subject.

The Medical Stores Depot, Madras, may be consulted about the probable demand there will be from the Depot for indigenous herbs if grown in this province.

COPY OF LETTER FROM THE DIRECTOR OF AGRICULTURE, MADRAS, No. D.-2181/1935, DATED THE 23RD MAY 1935.

*Cultivation of medicinal plants and herbs—Surgeon-General's letter—Remarks offered.*

Reference.—Government Memorandum No. 1252-III/35-1, dated the 25th March 1935.

In my letter R. O. C. D.-2-1816/33, dated the 15th August 1934 I have furnished a statement showing the medicinal plants proposed for trial cultivation in the several Research Stations. The trials of the plants are being conducted and the results will be available in July next. The samples of the medicinal plants will be sent to the Medical Stores when ready for testing them with regard to their quality. The Medical Stores will be asked to say whether they would purchase them and if so at what cost. It is not possible for the Agricultural Department to undertake the manufacture or processing of drugs and plants in regard to grinding, extraction and distillation, etc., but medicinal parts, *i.e.*, roots, leaves, flowers or stems will be cleaned and dried before delivery to the Medical Stores. If there is demand for the medicinal plants from the Medical Stores, and if the price quoted is also satisfactory, the cost of production of such of the plants as are required in large quantities can then be worked out on a few selected farms to determine whether such cultivation is practicable.

FROM THE DIRECTOR OF AGRICULTURE, No. R. O. C. D.-2-1816/33, DATED THE 13TH AUGUST 1934.

*Agricultural stations—Medicinal plants and Herbs—Cultivation.*

Reference.—Government Memorandum No. 4534-III/34-10, dated the 2nd August 1934.

Government Memorandum No. 4534-III/34-10, dated the 2nd August 1934, as well as Government Memorandum No. 4534-III/33-9, dated the 11th July 1934 is based on the report of the Officiating Director of Agriculture, R. O. C. No. D.-2-1816/33, dated the 26th June 1934. Apparently it has not been clear to the Government from my letter R. O. C. No. D.-2-1816/33, dated the 19th July, 1934, that so far as present action is concerned, I do not agree with the view of the officiating Director of Agriculture. The subordinate officers consulted by the Officiating Director of Agriculture have proposed trials of medicinal plants mentioned in Enclosure A. I am directing them to carry out the trials. None of them reported that the cultivable area under any other crop required to be cut down, if the trial proposed by him was ordered. The Officiating Director's view related less to the present than to the possible needs of the future.

2. So far as present action is concerned, the answers to the three questions put in Government Memorandum No. 4534-III 33-9, dated 11th July 1934 are as follows on the basis of my view and the reports of the subordinate officers who have proposed trial cultivation of medicinal plants:

Question (2).—Nil.

Questions (1) and (3).—Do not arise.

## Enclosure A.

| Name of Research Station.                                    | Name of Medicinal plants or herbs to be tried.   |
|--|--|
| Research Stations under the control of the Curator.<br>Palur | <i>Barosma betulina</i> <i>Cephaelis ipecacuanha</i> <i>Ipomoea purga</i> (Jalap) <i>Lobelia inflata</i> <i>Digitalis purpurea</i> .<br><i>Acorus Calamus</i> (Sweet Flag) Bishop weed (Vamu) Cumin (Jeelakarra) Senna (Sunamukhi) Amseed (Sopu) Linseed (Avisi) Ginger (Allura) Garlic (Vellulli) Solam Nigrum (Kamanchi) <i>Acorus</i> (Vasa). |
| Koilpatti  | Manathakali (Salamum Nigrum) Parpadakan (Mollugo pentaphylla).   |
| Taliparamba  | The garden rue (Malayalam Arootha) <i>Ruta graveolens</i> Lin <i>Ruta Augustifolia</i> Pers.   |
|  | (2) Hedge aloe (Malayalam Kattavazha) Aloe—barbendensis Mill.  |
|  | (3) Rose—coloured Leadwort (Malayalam—Chekkikoduvelli) <i>Plumbago rosea</i> Liu.  |
|  | (4) Three leaved chaste tree (Malayalam karunochi) <i>Vitex trifolia</i> Lin.  |
| Samalkota, Anakapalle and Maruteru.                          | Long pepper—( <i>Piper longum</i> ) saraparilla ( <i>Hemidesmus indicus</i> ) Liquorice ( <i>Glycyrrhiza glabra</i> ) Chirata ( <i>Swertia Chirata</i> ) Myrobalam <i>Terminalia</i> —Cherula Jalap ( <i>Convolvulus</i> —turpethum).  |
|  | Cumin (Cuminum Cyminum) Ornum ( <i>Carum copticum</i> ) Senna ( <i>Cassia Augustifolia</i> ) Anise ( <i>Pimpinella Anisum</i> ) Vasa ( <i>Aconitum ferox</i> ) Penveru Peppermint— <i>Physsa flexuosa</i> .  |

FROM THE CHIEF CONSERVATOR OF FORESTS, REF. No. 2509/35-E., DATED THE 21ST JULY 1935.

Ref.—Government Memorandum No. 1252-III/35-A., dated 25th March 1935.

Particulars of the medical demand for the indigenous drugs recommended for cultivation by Lieut.-Col. Chopra and Messrs. Smith Stanistreet & Co., Calcutta, are not readily ascertainable by forest officers, but a list of enquiries received by the Forest Utilisation Officer for some of them and the quantities actually supplied where possible is attached.

2. Some of the species mentioned in Lieut.-Col. Chopra's list are common in the forests of this Presidency and the particulars of the divisions where they are grown are given below:—

1. *Alstonia scholaris* . . . Palghat Division.
2. *Acacia arabica* . . . Palghat, Guntur and other divisions.
3. *Bassia latifolia* . . . Kurnool East, Godavari Upper and other divisions.
4. *Butea frondosa* . . . Kollegal, Kurnool and other divisions.
5. *Holarrhena Antidysenterica* Salem Central and other divisions.
6. *Melia azadirachta* . . . Salem Central, Vellore West and other divisions.
7. *Terminalia arjuna* . . . Palghat and other divisions.
8. *Toddalia acleata* . . . Vellore East, and other divisions.
9. *Cassia fistula* . . . Vizagapatam, Nellore, Anantapur and other divisions.
10. *Eucalyptus globulus* . . . Nilgiris.
11. *Strychnos Nux vomica* . . . Nellore, and other divisions.
12. *Santalum Album* . . . Coimbatore North, Vellore West, Salem North, and other divisions.

In the case of these species it is probable that artificial cultivation would not be required to meet the demand.

3. Other drugs or herbs which might possibly be cultivated provided the demand for them is in excess of what natural growth can supply, would fall into the category of "plantation products", and would hardly be comprised amongst the activities of the Forest Department.

Statement showing details of enquiries received for indigenous and quantities supplied where possible.

| No.                            | Particulars of drugs.                                | From whom enquiry was received.                                | Date of enquiry.                            | Quantity supplied.           | Division for which supplies were made.   |
|--------------------------------|--|--|---|------------------------------|--|
| <i>(a) Drugs supplied.</i>     |  |  |   |                              |  |
| 1                              | Tylophora Asthmatica.<br>Do.                         | School of Tropical Medicines, Calcutta<br>Do.                  | September 1931<br>June 1932                 | Two gunny bags.<br>1 Maund   | } From private sources.  |
| 2                              | Holarthena Antidi-senterica bark.<br>Do.             | Andhra Ayurvedic Pharmacy.<br>Do.                              | July 1932<br>November 1932.                 | 17 Railway seers.<br>1½ lbs. |  |
| 3                              | Aegle Marmelos (dried bark).                         | Do.  | October 1932                                | 80 lbs.                      | Nellore.   |
| 4                              | Toddalia aculeata (roots).                           | Research Fellow, Presidency College, Madras.                   | November 1933.                              | 100 lbs.                     | Vellore East division.   |
| 5                              | Taraktogeno- kurzii (Hydnocarpus Wrightiana).<br>Do. | Stafford Allen & Sons, London.<br>Forest Economist, Dehra Dun. | March 1931.<br>May 1931.<br>December, 1931. | ...<br>50 tolas<br>2 lbs.    | Supply not made.<br>From Nilgiris.<br>From Tinnevely & Mangalore, S.   |
| 6                              | Strychnos Nux Vomica.                                | Forest Economist, Dehra Dun.                                   | January 1931.                               | 50 lbs.                      | From Nellore.  |
| <i>(b) Items not supplied.</i> |  |  |   |                              |  |
| 1                              | Butea Frondosa                                       | Mr. O. J. Sundaram, Washermanpet.                              | May 1934                                    | ...                          | Not available any where except in Kollegal in small quantities.  |
| 2                              | Saraca Indica (Asoka).                               | Andhra Ayurvedic Pharmacy, Madras.                             | November 1934.                              | ...                          | Available in Vijayanagaram Samastanam Estates.   |
| 3                              | Gum Acaciaarabica                                    | Shelat Bros., Calcutta.  | January, 1935                               | ...                          | District Forest Officers Kurnool East and Cuddapah North furnished the names of contractors who extract this from Reserve Forests. |
| 4                              | Andrographis paniculata                              | I. G. Gajjar & Co., Bombay.                                    | September, 1934.                            | ...                          | Available in Nellore Division—Supply not made.   |
| 5                              | Podophyllum emodi                                    | Stafford Allen & Sons, London.                                 | March 1931.                                 | ...                          | Not found.   |
| 6                              | Bassia latifolia                                     | District Forest Officer Kurnool, enquiry for marketing.        | June 1932                                   | ...                          | Available in Upper odavari.  |

#### ANNEXURE JII.

EXTRACTS FROM THE REPORT OF THE SUB-COMMITTEE APPOINTED TO CONSIDER THE SCHEME FOR INVESTIGATION INTO INDIGENOUS DRUGS PLANTS (SUBJECTS NOS. 39 AND 3 OF THE AGENDA).

The following were present:—

1. Mr. B. C. Burt, C.I.E., M.B.E., I.A.S., Chairman.
2. Mr. M. Carbery.

3. Mr. R. G. Allan.
4. Lieut.-Colonel R. N. Chopra.
5. Dr. S. P. Agharkar.
6. Professor P. Parija.
7. Dr. T. Ekambaram.

Mr. Carbery was appointed Secretary to the Committee.

2. The Committee met at Rock House, Simla, on the 8th August 1933, at 5-30 P.M., and made the following recommendations:—

- (1) The Committee consider that they can support neither scheme, *i.e.*, United Provinces and Punjab, because the number of drugs that are likely to be of agricultural importance is very small.
- (2) The minor forest product section, both chemical and botanical, are already doing a considerable amount of work on medicinal plants and their cultivation on an experimental scale.
- (3) The Council might consider proposals for experimental work on the production of certain specified drugs as agricultural crops if put forward.
- (4) Colonel Chopra has promised to give a note on the possibility of cultivable drugs and their possible areas which will be published in the Indian Journal of Agricultural Science.

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#### ANNEXURE IV.

EXTRACT FROM A LETTER NO. F.-59-NI/34-H., DATED THE 27TH NOVEMBER 1935, FROM THE DEPARTMENT OF EDUCATION, HEALTH AND LANDS, GOVERNMENT OF INDIA, TO ALL LOCAL GOVERNMENTS.

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6. The recommendation of the Committee for the encouragement of the cultivation of medicinal plants and herbs in India is one that has received a considerable amount of attention from the Imperial Council of Agricultural Research and apparently from some local Governments also. This is not a recommendation which lends itself to spectacular results but rather calls for persistent endeavour and experiment over a prolonged period. The Government of India would be glad to know whether the Agricultural Departments of local Governments are keeping this recommendation in view. The Government of India would suggest that a close touch be kept with the Imperial Council of Agricultural Research on this matter.

( ) They observe that the Government of the Punjab speak with particular approval of this recommendation which, they said, was being taken up "in right earnest". They would be glad to know of the progress of the enquiries pursued.

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( ) To Punjab only.

## ANNEXURE V.

A NOTE BY THE AGRICULTURAL EXPERT, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, DATED THE 10TH DECEMBER 1935.

The recommendation referred to is presumably paragraph 477 of the Report and reads "Every encouragement should be given to promote the cultivation of medicinal plants and herbs". The resources of the Local Governments for doing this lie in their Agricultural and Forest Departments and the question of what Madras should do has been dealt with in letter No. R. O. C.-2-1816/33, dated 16th March 1934 from the Director of Agriculture, Madras. The steps which Madras should take are—

- (1) Various medicinal plants should be tried on Government farms,
- (2) Those which are found to grow successfully should be grown on a relatively large scale on these farms at which soil and climate suit them.

The Madras Agricultural Department will then be in a position to advise ryots as to what crops can be grown and how to grow them.

- (3) The quality and yield of a drug from crops cultivated on Government farms should be estimated in order that a basis of the financial return per acre may be obtained.
- (4) Steps should be taken to ascertain from Medical Stores and private firms, the average yearly demand for a particular drug. This will enable the Madras Agricultural Departments to estimate the extent to which they are justified in introducing the cultivation of a particular plant.

These four steps are matters which the Madras Government can itself carry out through its Agricultural Department and Forest Department.

## APPENDIX XV.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 1st February 1936, on Subject No. 52:—Application from the Government of Bombay for a grant of Rs. 56,795 spread over a period of 5 years for Research on the study of the Deccan Wingless Grasshopper ("Colemania Sphenarioidis").**

The scheme (Annexure I to enclosure) mentioned above was forwarded by the Government of Bombay in January 1934. The Advisory Board which considered the scheme at its meeting held in February 1934 referred it to the Locust Committee of the Council for examination in the first instance.

2. The Locust Committee which accordingly considered the scheme at its meetings held in January 1935 and again in January 1936 have come to the conclusion that this scheme is of local importance and that it could not be recommended for a grant by the Imperial Council of Agricultural Research.

## ENCLOSURE.

IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, LOCUST COMMITTEE, 7TH MEETING, JANUARY 1936. SUBJECT NO. 52.—APPLICATION FROM THE GOVERNMENT OF BOMBAY FOR A GRANT OF RS. 56,795, SPREAD OVER A PERIOD OF 5 YEARS FOR RESEARCH ON THE STUDY OF THE DECCAN WINGLESS GRASSHOPPER ("COLEMANIA SPHENARIOIDIS").

At its meeting held in February 1934, the Advisory Board which considered this scheme (annexure I) recommended that it should first be examined by the Locust Committee of the Council. The Locust Committee at its meeting held in January 1935 considered the scheme and an extract from its proceedings is given below:—

"After some discussion it was decided that the Council's Secretariat should ask the Directors of Agriculture, Bombay, Madras and Mysore, for information as to the extent of damage done by this pest and such other information as may be available. The information thus received should be passed on to the Imperial Entomologist who should prepare a note for the consideration of the Committee at its next meeting. In the meantime the scheme should lie over".

2. The Directors of Agriculture, Bombay, Madras and Mysore were accordingly addressed and the information received from the first two was passed on to the Imperial Entomologist. The Director of Agriculture, Mysore, has not so far replied.

3. The attached summary of data about the Deccan grasshopper prepared by the Imperial Entomologist, Pusa (annexure II) which is based on information available on the subject at Pusa and that supplied by the Directors of Agriculture, Bombay and Madras, is now for the consideration of the Locust Committee

N. C. MEHTA.

Secretary.

NEW DELHI;

The 6th January 1936.



## (ANNEXURE I TO ENCLOSURE).

FROM T. N. JHAVERI, ESQ., L.A., ASSISTANT PROFESSOR OF ENTOMOLOGY,  
POONA, TO THE DIRECTOR OF AGRICULTURE, BOMBAY PRESIDENCY, POONA,  
No. 52/564 OF 1933, DATED POONA, 6TH NOVEMBER 1933.

As desired in the Bombay Provincial Agricultural Research Committee held in June last, I have the honour to resubmit my Scheme on the subject duly recast in light of the discussion that took place in the meeting after incorporating all the details as desired in your letter No. S. 116-L-12742, dated 26th October 1933.

2. The item of the control propaganda has been altogether deleted from the scheme as the funds for the propaganda work are not allotted by the Imperial Council.

3. The scheme has been proposed for a period of 5 years in the first instance. As regards the expenditure for the same, the non-recurring amount is Rs. 2,500 and the recurring is Rs. 54,295. I have provided just the necessary staff to work the scheme. The scale proposed for the Chief Investigator is special and comparatively high as we want a really qualified man to take up the work and as such he should be given a higher remuneration.

4. After going through the scheme it will be noticed that the pest is a serious one and I beg to emphasise that this is a problem of the most vital importance causing an aggregate loss of several lakhs of rupees and covering vast tracts of Karnatak and the Deccan right from Dharwar up to Nasik, and it is quite essential that researches on this pest should be undertaken as early as possible.

5. The Headquarters of the Research Officer with his staff and Laboratory should be kept at or near Dharwar Government Farm, as Dharwar District seems to be the origin and the starting of this pest also appears in a serious form there.

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A RESEARCH SCHEME FOR THE STUDY OF THE DECCAN  
WINGLESS GRASSHOPPER ("COLEMANIA SPHENARIOIDES").

INTRODUCTION.

The Deccan wingless grasshopper is a typically South Indian species known mainly from the Southern part of the Bombay Presidency, Mysore State and a part of the Madras Presidency. Its original home appears to be somewhere on the border between Bombay, Madras and Mysore. The earliest appearance of this pest in this Presidency dates so far back as 1907-08, and it was reported as a pest till the year 1915. Then there comes a period of gap for nearly 7 to 8 years during which time the activity of the insect was not reported. But again from the year 1924 it has come into prominence and is steadily spreading and seriously affecting the principal cereal crops of the tract specially *bajri* and *jowar*. For a time it remained as a pest of local importance, when further emigration took place it assumed a serious form. The migrating bands of hoppers, whenever the pest appears, have been invading new areas and

establishing themselves there and year after year the pest is gaining more and more ground and extending northwards. At present the area of occupation by the pest extends from Dharwar to Nasik during the span of 23 years (1907 to 1931).

#### ECONOMIC IMPORTANCE.

This grasshopper is a swarming species and its ability to breed in cultivated lands and in their immediate vicinity makes it a dangerous pest, although it shows much preference for grasses and cereals, crops of other orders are not exempt from the ravages of the pest. Since this grasshopper is a new genus of recent origin, it is in a decidedly adaptable stage in its evolution and it is therefore an open question whether it finally establishes itself as a specialised pest of graminaceous crops or embarks in a phytophagous career. The ravages done by this pest are often considerable, but sometimes they are so enormous that it makes it impossible to grow any particular crop in a locality. Leaving aside the damage in Madras and Mysore, the Bombay Presidency alone suffers a tremendous loss due to this pest. The area under *kharij*, *jowar* and *bajri* in the tract where this pest is prevalent is 10,00,000 and 20,00,000. Calculating the average damage at one rupee per acre of *jowar* and *bajri* each at its minimum the total loss in years of damage comes to several lakhs of rupees annually.

#### PAST WORK.

The work done on this pest so far is of two kinds: (1) Study of the Bionomics and seasonal history and (2) Control methods—Mechanical and Agricultural. The first has been done in a more or less detailed way in Mysore by Dr. Coleman, and the second has been done to some extent in Mysore and in the Bombay Presidency.

It gives some idea about the life, seasonal history of the pest under conditions obtained in Mysore (*vide* Bulletin No. 2 of the Mysore Department of Agriculture) and also about the possibility of the control of the pest in Mysore and in the Deccan and Karnatak.

#### OUR PROBLEM.

The study of this pest was done in 1910 under Mysore conditions. Since then, that is during the span of 23 years, the pest has changed its habits and habitat. Instead of being localised it has been generally spreading and so far as our Presidency is concerned, it has occupied an area from Dharwar up to Khandesh in a particular direction of soil and crops, but has not shown any such tendency in Mysore and Madras. Why this is so, as well as what are the ecological influences that keep this in check in certain years and how it reappears or in other words what are the phenomena that help the periodicity of its appearance all these things require to be investigated. In fact this is more a pest of the Deccan as can be seen from the map of the distribution of these grasshoppers given by Dr. Coleman in his Bulletin above referred to and attached herewith and as such, the pest has to be studied very thoroughly from all aspects under conditions obtained in the area where it is prevalent. After we have got complete knowledge about this pest, it is hoped that the pest could be combated in a more efficient way with a greater success.

The main points for research can be broadly given as under:—

1. Survey work.
2. Establishment of research centre for a detailed study of the pest with a view to evolve effective control measures.

### I. Survey Work.

Survey work is absolutely essential if we are to get any inspiration for evolving any suitable line of control. If the origin of the pest has been from a non-pest, the following investigations are likely to throw some useful light. How this happened to be a pest? Was it not due to a change or changes in agricultural system such as replacement of one crop with another or extension of cultivation of favourable food plants, or (2) change from intensive system to extensive, of certain crops or *vice versa*? Or was it due to (3) clearing of large forest or uncultivable area into cultivation? Or was it due to (4) eliminating certain factors which have acted adversely on these creatures such as destructions of specific parasites, predators, beneficial birds and other biotic or even meteorological factors; or (5) elimination of such crops which used to act deleteriously on insects, impairing their fertility or fecundity or keeping their multiplication down in some other way; or (6) was it due to abandoning any of the cultural or rotational methods which used to keep down the pest in check?

Now all these investigations are of pre-eminent importance if we want to trace the evolution of this insect from a non-pest to a pest, so that we may be able to retrace the stage of this insect in an opposite direction.

If this species or genus is of recent origin, it is possible to trace the route of variation by thorough survey of all the affected as well as non-affected adjacent areas, more especially the connecting lines—collecting and examining anatomically and physiologically all the variations of this pest and allied acrididae.

### II. Detailed study of the pest.

It deals with the following points:—

- A. Bionomics.
  - B. Behaviour.
  - C. Ecology.
  - D. Natural enemies.
  - E. Control experiments.
- A. *Bionomics*.—This will give all the information about the periods of the life history, life-cycles and seasonal history.
- B. *Behaviour*.—Under this heading are studied the habits of this pest—principal host plants, alternate hosts, solitary phases, swarming phases, etc.
- C. *Ecology*.—Study of the pest in relation to climate and soil.
- D. *Natural enemies*.—Study of parasites, predators and diseases keeping it under check.
- E. *Control Experiments*.—Trials of different control measures after having got the complete information about the pest.

The budget estimated for the scheme would be as under:—

*Non-recurring Expenditure.*

|   | Rs.          |
|---|--------------|
| 1. One dissecting Binocular Microscope . . . . .    | 500          |
| 2. One Compound Microscope . . . . .                | 500          |
| 3. Sprayers and Dusters and Jat Apparatus . . . . . | 300          |
| 4. Equipment of field cages, etc. . . . .           | 1,200        |
| Total . . . . .                                     | <u>2,500</u> |

*Recurring Expenditure.*

| Items.   | 1st year.     | 2nd year.     | 3rd year.     | 4th year.     | 5th year.     |
|--|---------------|---------------|---------------|---------------|---------------|
|  | Rs.           | Rs.           | Rs.           | Rs.           | Rs.           |
| I. Establishment--   |               |               |               |               |               |
| Special Entomologist of the grade of Class II Officer of Bombay Agricultural Service at Rs. 320 per mensem in the grade of Rs. 200—15—320—20—440—20—600. | 3,840         | 4,080         | 4,320         | 4,560         | 4,800         |
| Graduate Assistant (Rs. 110—8—150).  | 1,320         | 1,416         | 1,512         | 1,608         | 1,704         |
| Non-graduate Assistant (35—5½—60—4—100).   | 420           | 420           | 480           | 480           | 540           |
| One Setter (Rs. 20—1—40)   | 240           | 252           | 264           | 276           | 288           |
| Peon at Rs. 16 per mensem  | 192           | 192           | 192           | 192           | 192           |
| Clerk on Rs. 40 per mensem in the grade of Rs. 30—5½—80.   | 480           | 480           | 540           | 540           | 600           |
| II. Travelling allowance . . . . .   | 1,500         | 1,000         | 1,000         | 1,000         | 1,000         |
| III. Contingent charges . . . . .  | 1,500         | 1,000         | 1,000         | 1,000         | 1,000         |
| IV. Rent . . . . .   | 600           | 600           | 600           | 600           | 600           |
| V. Service stamps and Stationery . . . . .   | 75            | 75            | 75            | 75            | 75            |
| VI. Labour and cultivation charges . . . . .   | 700           | 700           | 700           | 700           | 700           |
|  | <u>10,867</u> | <u>10,215</u> | <u>10,683</u> | <u>11,031</u> | <u>11,499</u> |

*Total Expenditure.*

|                         | Rs.           |
|-------------------------|---------------|
| Non-recurring . . . . . | 2,500         |
| Recurring . . . . .     | 54,295        |
| Total . . . . .         | <u>56,795</u> |

(Signed) T. N. JHAVERI,  
Assistant Professor of Entomology,  
College of Agriculture, Poona.

## (ANNEXURE II.)

A summary of data about the Deccan Grasshopper (*Colemania sphenarioides* Bol.) prepared by the Imperial Entomologist.

1. *Distribution*.—The pest was originally reported in 1907-08, from the Belgaum, Bijapur and Dharwar tracts of the Bombay Presidency, from thence it apparently spread to the neighbouring districts of Mysore, Hyderabad and Madras (Bellary and Kurnool districts). At present its distribution in the Bombay Presidency extends from Dharwar to Nasik, but in the other provinces the pest has not apparently spread beyond its original zone of infestation 25-30 years ago.

2. *Food plants, Economic Status, etc.*—It appears that originally the food of this grasshopper was wild grasses. It came into prominence when about 1908 it began attacking cultivated crops like *juar*, *ragi*, *bajra* and several other dry-land cereals. It can also eat some leguminous crops like grams, etc., but grasses and cereals may be considered its normal favourite food plants.

The pest has so far appeared sporadically. It appeared in 1908-09, was serious for eight to nine years, became negligible for the next period of almost equal duration, became prominent again for a similar period and so on. The Entomologist to Bombay Government estimates the damage by this pest at Re. 1 per acre of the affected crops ('several lakhs' of rupees annually in the aggregate). The Madras Entomologist's estimate of loss for his province due to this pest is 1-15 per cent of the crop when the attack is slight.

3. *Life-history, etc.*—The life-history of *Colemania sphenarioides* was completely worked out in Mysore by Dr. Coleman in 1911. Presumably it is almost the same in broad outline in the neighbouring areas of Bombay and Madras Presidencies. Eggs are laid in soil in November and December; they do not hatch till the onset of the South-West monsoons in the following July and August. The hoppers are mature in 3 to 4 months. There is only one brood in the year.

The pest being wingless throughout its life generally spreads from one tract to another while carried in fodder by country carts.

4. *Methods of Control*.—(a) *Bagging*.—Dr. Coleman found this method very effective in Mysore. In the Madras Presidency, however, due to the prevailing high winds at the time when this method should be adopted bagging has proved unmanageable. The running of special hopper dozers has given better results in this area. The Bombay Entomologist also does not seem to be enthusiastic about this method of control.

(b) *Ploughing and hoeing*.—This agricultural method of control is adopted during January and February when the eggs of the pest lie buried in the soil. By this method the eggs either get too deeply buried or get exposed to the attack of birds or other natural enemies. This method whenever properly practised has yielded useful results.

(c) *Baiting*.—Several acridiid hoppers are known to have been controlled successfully by means of poisonous baits. But in the present case in view of the nature of food plants of the pest it is not economical to practise this method and moreover there is serious risk of poisoning domestic cattle if the

baiting is practised over a large area. For these reasons no large scale work has so far been done with a view to discovering the most effective poison which should be used in the baits.

5. *Lines on which further work seems to be needed.*—(a) The most important problem which requires thorough investigation is as to why the pest appears in cycles and what factors conduce to its becoming prominent or otherwise. This problem is both of pure scientific and practical value and in my opinion fully entitled to the support of the Imperial Council of Agricultural Research. The work on this problem will require a wholetime entomologist fully trained in the modern methods of ecological research. He should be attached to a properly equipped laboratory (both with regard to apparatus and literature) where he can work out the data collected in the field. It is for consideration whether the entomological laboratory at Poona can afford the facilities mentioned above. The fact that the scheme demands the provision of such ordinary apparatus as microscope, binocular, etc., makes one doubtful if this laboratory will be able to lend special apparatus like thermostats, etc., which are absolutely essential for such work.

(b) Unless the problem mentioned in the above para. (5a) is satisfactorily solved research work on control measures against this pest cannot very much go beyond the lines indicated in para. 4 above. It will be readily realized that the success with these methods greatly depends on local conditions. A method found effective in one province may not prove so in the adjacent area. Every affected province therefore has to solve its own problem in this connection and if the Imperial Council decides to initiate work on these lines, it should do so in all the chief areas affected by this pest, so that the results obtained may be more than of local interest only.

## APPENDIX XVI.

Note by the Secretary, Imperial Council of Agricultural Research, February, 1936 (Rice Research Sub-Committee). Subject No. 8:—Rice Research Schemes:—Progress Reports. (Supplementary.)

Comments on the Annual Reports of the Rice Research Schemes for the year 1934-35.

By THE STATISTICIAN, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

## (a) Madras Report.

Page 5.—The statistical method adopted here in making a selection out of an unreplicated series, is recommended to the other provinces.

Pages 8 and 9.—In view of very small differences in yields between 3" and 6" spacings, the experiment may be continued for another season, and the results analysed combining all the three seasons.

Page 10.—(1) The analysis of variance given in pages 11 and 12 is incorrect. (The correct analysis is given in the Appendix).

(2) The lay-out of the experiment is defective in that of 'double-seedling spaced 3" either way' has been omitted, which has affected a proper comparison of different spacings and different seedlings, and their interactions.

Pages 13-14.—In experiment iv (a), date of sowing is taken to be constant, while in experiment iv (b) date of transplantation is the same. It seems necessary to conduct 'a complex experiment' involving both the factors:—different dates of sowing and different ages of seedling. The officer may examine the possibility of having such an experiment.

Pages 19-20.—The experiment is defective in that  $P_5O_2$  alone as a separate treatment has not been included.

## APPENDIX.

## Madras Report.

Tables 8 and 9 (pages 11 and 12).

Analysis of Variance (Series 55).

|  | D. F. | S.S.     | M.S.     | Z      |
|--|-------|----------|----------|--------|
| Due to Blocks . . . . .                                | 5     | 10829.4  | 2165.9   | ..     |
| Manure vs. No Manure . . . . .                         | 1     | 108035.3 | 108035.3 | 2.3651 |
| Error (a) . . . . .                                    | 5     | 4765.3   | 953.1    | ..     |
| Treatments . . . . .                                   | 4     | 38245.3  | 9561.3   | 1.3734 |
| Interaction—   |       |          |          |        |
| Treatment $\times$ Manure and No Ma-<br>nure . . . . . | 4     | 2892.7   | 723.2    | 0.0825 |
| Error (b) . . . . .                                    | 40    | 24527.6  | 613.2    | ..     |
| Total . . . . .  | 59    | 189295.6 | ..       | ..     |

For  $n_1 = 1$   $n_2 = 5$  and  $P = 0.01$   $Z = 1.3943$

For  $n_1 = 4$   $n_2 = 40$  and  $P = 0.01$   $Z =$  between 0.6472 and 0.6954.

The effects of manure and treatments are significant.

(b) *United Provinces Report.*

*Pages 14-15.*—(1) The analysis of variance table should be given, to know the effect of interaction between n and p.

(2) The conclusions of this season differ widely from last year's. The experiment should be continued for at least one more season, and the data analysed combining the results of several seasons.

*Pages 16-17.*—The results differ from last year's. The experiment should be continued for at least one more season.

*Pages 17-18.*—(1) As treatments 1, 5, 9 are identical, the number of treatments is only 10, and there is no need for repeating 'no-manure' in each block.

(2) As the 'analysis of variance' is not given, it is not clear whether several interactions have been considered.

*Pages 19-21.*—(a) The interspace between plot and plot and is not stated, which is important in all irrigation experiments.

(b) In view of accidental disturbances such as 'over flow of water' noted in the report, the design for the next year may be changed. The split plot design is recommended with 'irrigation' as main treatments, and 'manures' as sub-treatments.

*Pages 24-25.*—The analysis does not give the interaction between varieties and manures.

(c) *Bengal Report, 1934-35.*

This is a good report from the point of view of statistics.

(d) *Burma Report, 1934-35.*

*Page 13.*—It seems necessary to analyse the results separating the different 'variances'.

*Page 31.*—It seems necessary to indicate the conclusions in the form  $A=B < C$ .....; and also the corresponding results, if any, during the previous seasons.

*Page 34.*—'Passed both tests' is incorrect, as '01 test' includes '05 test'.

(e) *Bihar and Orissa Report, 1934-35.*

*Page 22.*—In the table, and in the column 'critical difference for significance', '.8443 and .5907' seem to be 'Z' values at 1 per cent. and 5 per cent. level, and are not critical differences. The critical difference is calculated from the expression:

$$S. E. \text{ of mean } X \sqrt{2} \times \text{value of } t \text{ (for D. F. for error).}$$

*Page 26.*—Same remarks as above with reference to the table.

*Page 27.*—Same remarks as above with reference to the table.

*Page 28.*—Same remarks as above with reference to the table.

*Page 30.*—The conclusions as stated at the end of the page are not borne out from the table.



*Page 31.*—The critical differences have not been correctly calculated; the correct values are the values given multiplied by  $\sqrt{2}$ .

*Pages 31 (a) and 32.*—A better planning of the lay-out seems necessary.

*Page 35 (table).*—Same remarks as in page 22.

(f) *Assam Report*, 1934-35.

The report does not contain the data of field experiments.

**APPENDIX XVII.****Report of the Rice Research Committee held on 10th February 1936.**

Present:—

Sir BRYCE BURT (*Chairman*).  
 Mr. M. ALAM.  
 Mr. R. G. ALLAN.  
 Mr. J. N. CHAKRAVARTY.  
 Mr. J. CHARLTON.  
 Mr. J. W. GRANT.  
 Dr. HEDAYATULLAH.  
 Mr. B. S. KADAM.  
 Mr. B. K. MUKERJEE.  
 Mr. NIZAMUDDIN HYDER.  
 Mr. K. RAMIAH.  
 Dr. F. J. F. SHAW.  
 Mr. R. L. SETHI.  
 Mr. A. M. THOMSON.  
 Rao Bahadur M. VAIDYANATHAN.  
 Mr. M. SARDAR KHAN attended as a visitor.

*Annual reports [items 8 (a), (b), (c), (d), (e), (f), (g) of the Agenda].*

(a) *Annual report on the Rice Research Scheme in the Madras Presidency for 1934-35.*

The Committee approved of the Madras (Berhampore) rice research scheme report and considered that the spacing experiment described on pages 8-9 of the report should be continued for another season and the results analysed, combining the results of all three seasons. The Committee noted that the analysis of variance given on pages 11-12 of the report was incorrect and called attention to the correct analysis given in the note by the Statistician to the Imperial Council of Agricultural Research.

(b) *Annual report for 1934-35 of the Rice Research Scheme at Bankura and Chinsurah (Bengal).*

The Committee approved generally of the annual report of the rice research schemes at Bankura and Chinsurah and made the following criticisms:—

- (1) The use of local terms which are not understood in other countries or even in other parts of India, should be avoided as far as possible or such terms should be explained in an appendix.
- (2) Yields should always be recorded in lbs. and ounces and acreage yields should only be stated when based on the results of final yield trials. They should not be based on the measurement of the yield of a 100 plants as in this report.

- (3) The use of technical terms such as "type", "strain", "pure line" and "single plant culture" should be in the manner approved by the Board as laid down by the Imperial Bureau of Plant Genetics.
- (4) Yield trial experiments should be set out so as to include the data in the prescribed form but, except in the case of complex experiments, the details of the analysis of variance need not be given. In describing experiments which have been repeated in successive years, a reference should be made to the results of previous years's work.

The Committee discussed the difficulty in the classification of varieties of rice by the colour character of the glumes. Stress was laid on the wide variation shown by this character and the different descriptive terms used, by different authors, for the same thing. It was agreed that Mr. Ramiah should write a note endeavouring to establish some degree of uniformity in the descriptive terms to be used for this character and that this note should be circulated to other workers on paddy schemes for their opinion.

*(c) Annual report on the rice research scheme in the United Provinces for 1934-35.*

The Committee considered the report of the United Provinces (Naginn) rice research scheme and suggested that in all hulling trials with the 'Maung' device, a standard variety of paddy should be included in every trial to allow of effective comparison between types. The Committee considered that the Maung device was the simplest and best machine for carrying out these trials.

The Committee drew attention to the fact that in all cases the level of significance in experimental results should be stated and that in investigations on sterility in rice particular attention should be paid to the incidence of the insect pests which some times causes sterility and may seriously affect conclusions as to the inheritance of this character.

*(d) Annual report on the rice research scheme in Burma for 1934-35.*

The Committee approved of the report of the Rice Research Officer, Burma, and noted that two Ngasein hybrids had reached a stage at which it would be possible to carry out experiments in export on a small scale.

*(e) Annual report on the rice research scheme in Bihar and Orissa for 1934-35.*

The Committee considered the report of the Rice Research Station, Sabour (Bihar and Orissa) and generally noted that there was a tendency in this scheme to base conclusions on inadequate experimental data. The committee considered that on the Botanical side the work should be concentrated on the main lines and that several lines of investigation which had been tried and were not leading to results might now be discontinued to avoid the energies of the staff.

The Committee did not intend this as a criticism against the taking up of different lines of work but merely as a suggestion that a watch should be kept for the stage at which subsidiary investigations could profitably be dropped. In particular, with reference to the data correlating the quality of fineness of rice with the fat content of grain the Committee

considered that the somewhat sweeping claim made in the report required support by more detailed observations and could not be regarded as substantiated unless definite correlation between the quality of fineness, as determined by the length and breadth ratio of the grain, and fat percentages had been established on a statistical basis. The Committee criticised the lay-out of the field experiments designed to investigate the best ratios of nitrogenous and phosphatic manures for paddy (page 31A) of the report and suggested that where the area of land available imposed any restriction on the scheme of experiment, the lay-out of the experiment must be such as not to be beyond the capacity of the land available. In particular, lay-outs which involve the use of blocks of different shapes should be avoided.

(f) *Annual report of the deep water paddy research farm, Habiganj, (Assam), for 1934-35.*

The Committee considered the report of the deep water paddy research farm Habiganj, (Assam) and made the following changes in the programme of work which should be rigidly restricted to investigation of deep water paddies. Items 3 (a) (2), 7, 14 and 16 were deleted from the programme of work. The following amendments were made:—

Item 6 should read "Root and Stem studies in relation to flood resistance".

Item 8 (b) (2) to read "Study of strength of stem".

The Committee emphasised the importance of the observations at page 7 of the report regarding the attack of borers and desired that observations on the influence time of transplanting to avoid the attack of borers should be continued.

(g) *Progress report on the scheme of research on quality in crops for the year ending 30th November 1935.*

The Committee approved of the progress report on the scheme of research on quality in crops with special reference to rice.

*Scheme for the investigation of the fungal diseases of the rice crop in the Punjab (item 9 of the agenda). (Appendix XVIII).*

The Committee examined an application from the Government of the Punjab and concluded that with the establishment of the Imperial Agricultural Research Institute at Delhi the investigation of diseases of rice in Northern India could be carried out by the Mycological Section of that Institute. The Committee noted that the Agricultural Research Institute possessed a large farm at Karnal in which a special area had been developed for the study of paddy and where there are ample resources at its disposal for investigating this subject.

F. J. F. SHAW,

The 11th February 1936.

## APPENDIX XVIII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 15th January 1936, on Subject No. 9:—Application from the Government of the Punjab for a grant of Rs. 38,380, spread over a period of five years for a scheme for the Investigation of the Fungal Diseases of the Rice Crop.**

Attention is invited to the attached note dated the 19th June 1935 (Enclosure I) on the subject mentioned above which was circulated to the Advisory Board for consideration at its meeting held in July 1935. The Rice Research Sub-Committee of the Board recommended (*vide* extracts at Enclosure II) that the question of work on the fungal diseases of the rice crop should be further examined in consultation with the Imperial Mycologist with a view to formulating a co-ordinated scheme of work. The Imperial Mycologist's note will be found at Enclosure III. The Directors of Agriculture of the various rice growing provinces were also invited to furnish any comments or suggestions which they desired to offer. The replies received have been printed as Enclosure IV.

2. The scheme will in the first instance be examined by the Rice Research Sub-Committee of the Council whose report (Appendix XVII) will be circulated to the Advisory Board in due course.

## ENCLOSURE I.

NOTE BY THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, DATED THE 19TH JUNE 1935, ON SUBJECT NO. 40:—APPLICATION FROM THE GOVERNMENT OF THE PUNJAB FOR A GRANT OF RS. 38,380 SPREAD OVER A PERIOD OF FIVE YEARS FOR A SCHEME FOR THE INVESTIGATION OF FUNGAL DISEASES OF THE RICE CROP.

Attention is invited to the attached copy of a scheme (Annexure) received from the Punjab Government for the investigation of fungal diseases of the rice crop, involving, so far as the Council is concerned, a grant of Rs. 38,380 (including non-recurring expenditure of Rs. 2,500) spread over a period of five years. The scheme has been approved by the Provincial Research Committee and recommended by the Local Government.

2. The Vice-Chairman considers that this scheme should first be examined by the Research Sub-Committee of the Standing Rice Committee, *viz.* :—

The Vice-Chairman, Imperial Council of Agricultural Research,  
*Chairman, ex-officio.*

The Agricultural Expert, Imperial Council of Agricultural Research.

The Directors of Agriculture, Hyderabad, Mysore, Baroda, Cochin and Travancore.

- The Paddy Specialist, Madras (Subject to the approval of the Local Government).
- The Crop Botanist, Bombay (Subject to the approval of the Local Government).
- The Economic Botanist, Bengal (Subject to the approval of the Local Government.)
- The Economic Botanist (Rice), United Provinces (Subject to the approval of the Local Government).
- The Rice Research Officer, Burma (Subject to the approval of the Local Government).
- The Paddy Specialist, Bihar and Orissa (Subject to the approval of the Local Government).
- The Officer in charge, Central Provinces Rice Research Scheme (Subject to the approval of the Local Government).
- The Economic Botanist, Assam (Subject to the approval of the Local Government).
- The Senior Marketing Officer (Rice).
- The Statistician, Imperial Council of Agricultural Research.
- The Secretary, Imperial Council of Agricultural Research, Secretary-*ex-officio*.

Or the Directors of Agriculture concerned if the specialist mentioned is unable to attend.

This Sub-Committee will meet on the afternoon of the 15th July 1935 and its report will be circulated to the Advisory Board in due course.

#### ANNEXURE.

##### SCHEME FOR INVESTIGATION OF FUNGAL DISEASES OF THE RICE CROP.

As a short season crop and one involving a smaller cost of cultivation than many other crops, as well as one restricted to peculiar conditions of soil and water supply, rice growing is greatly favoured by cultivators. In the hilly tracts in many places it is a crop of the poor peasantry and is the mainstay of the population both for income and sustenance. In the Punjab the area under it exceeds one million acres annually, whilst in other provinces it is of even greater importance.

At present the rice crop is subject to the attack of a number of fungal diseases of which some are very serious and take a heavy toll putting the growers to a considerable loss. Amongst these diseases the following may be noted:—

- (1) *Stem rot, caused by Sclerotium Oryzae*.—This is a very serious disease in the Punjab and is said to be also found in Burma, Bihar, Orissa, Madras, Bengal, Central Provinces and Kashmir. Damage to the extent of 40 to 50 per cent. has been reported from various places. At Kala Shab Kaku in the Punjab it has been a great hindrance in breeding work.

- (2) *Wilt*.—This is caused by *Cephalosporium* sp. and is present in certain districts in the Punjab. A similar disease is also reported from Madras and other Provinces. The percentage of attack has been as high as 80 to 40 per cent. in some places.
- (3) *Helminthosporium disease*.—This is also a very common disease of rice all over India. Although its life-history has been worked out partially, little has been done to find out measures of control. The damage done by it is said to be 15 to 20 per cent.
- (4) *Bunt*.—This disease is found in the Punjab, Bihar, Burma and Madras.
- (5) *Leaf blight, Piricularia, Oryzae* and *Stem spot* are three new diseases which have recently been observed in the Punjab, but the casual fungi have not been isolated. Damage done by these three diseases is not fully known yet.

At a moderate estimate the average damage caused by disease may be put at 10 per cent. of the total crop in the Punjab and it is probably not less in other parts of India where these diseases are found. In most cases the life-cycles of the casual fungi have either not been worked out at all or are not completely known, whilst in practically all cases control measures have not yet been determined.

Much work is being done in the Punjab and elsewhere on the production of improved strains of rice, but full advantage of these new strains cannot be reaped by the cultivator unless the diseases which effect them are also controlled. Research on the life histories and means of controlling these various diseases is a matter of urgent necessity and the present scheme proposes that work in this connection be undertaken by special staff and facilities to be made available jointly by the Imperial Council of Agricultural Research and the Punjab Government.

It is proposed that the Botanical Section of the Punjab Agricultural College and Research Institute, Lyallpur, should be used for all cultural and other laboratory studies and that the Rice Farm, Kala Shah Kaku, should be used for the purpose of field experiment connected with these investigations. The Punjab Government will provide laboratory accommodation, land, and such facilities as exist in the way of equipment. Government will also provide the necessary additional bullocks and implements; maintain these bullocks and provide labour, the expenses of cultivation, such as seed, manure, etc.

It is requested that the Imperial Council of Agricultural Research should provide an Assistant Mycologist, with the necessary staff to help him and certain other recurring expenditure for labour, travelling allowance, contingencies, apparatus and chemicals. At the instance of the Punjab Council of Research an additional Assistant on Rs. 100 per mensem (less 15 per cent.) has been provided for a period of two years only to continue an investigation of Stem Rot under Dr. H. Chaudhri, Reader in Botany, Punjab University, who has already worked on the problem for two years.

The cost of the scheme thus amounts to Rs. 43,410 as shown in the attached statement. It has been drawn up for a period of five years. The work to be done in this period will be the isolation and identification of the various causal fungi which attack the rice crop; a study of their

life-histories and the modes of carry over and the working out of the control measures for each of them. Of the non-recurring expenditure of Rs. 2,800, Rs. 300 will be met by the Punjab Government. The total recurring expenditure amounts to Rs. 40,610 of which the Punjab Government will contribute Rs. 4,730.

### Schedule of Expenditure for five years.

#### Non-recurring.

|   |           |
|---|-----------|
| Aparatus (to be met by the Imperial Council of Agricultural Research) | Rs. 2,500 |
| Bullocks (to be met by the Punjab Government)                         | 250       |
| Implements (to be met by the Punjab Government)                       | 50        |
| Total   | 2,800     |

#### Recurring.

|  | 1st year.    | 2nd year.    | 3rd year.    | 4th year.    | 5th year.    | Total.        |
|--|--------------|--------------|--------------|--------------|--------------|---------------|
|  | Rs.          | Rs.          | Rs.          | Rs.          | Rs.          | Rs.           |
| 1. One Assistant Mycologist on Rs. 200 (for two years) 250—25—550/25—750 less 15 per cent. | 2,040        | 2,040        | 2,610        | 2,940        | 3,240        | 12,900        |
| 2. One Agricultural Assistant on Rs. 100—10—200/10—300 less 15 per cent.                   | 1,020        | 1,140        | 1,260        | 1,380        | 1,500        | 6,300         |
| 3. One Agricultural Assistant on Rs. 100 per mensem (less 15 per cent)                     | 1,020        | 1,020        | ..           | ..           | ..           | 2,040         |
| 4. One laboratory attendant on Rs. 20—1—30   | 240          | 252          | 264          | 276          | 288          | 1,320         |
| 5. Two Fieldmen on Rs. 20—1—30 each.   | 480          | 504          | 528          | 552          | 576          | 2,640         |
| 6. One peon on Rs. 14 per mensem   | 168          | 168          | 168          | 168          | 168          | 840           |
| 7. Leave salary  | 255          | 265          | 325          | 360          | 395          | 1,600         |
| 8. Two beldars at Rs. 14 per mensem each   | 336          | 336          | 336          | 336          | 336          | 1,680         |
| 9. Seeds, manure, etc.   | 250          | 250          | 250          | 250          | 250          | 1,250         |
| 10. Feeding charges of bullocks  | 360          | 360          | 360          | 360          | 360          | 1,800         |
| 11. Casual labour  | 500          | 500          | 500          | 500          | 500          | 2,500         |
| 12. Travelling allowance   | 500          | 500          | 500          | 500          | 500          | 2,500         |
| 13. Contingencies  | 600          | 600          | 600          | 600          | 600          | 3,000         |
| 14. Compensatory allowances for laboratory attendant, peon and fieldmen                    | 48           | 48           | 48           | 48           | 48           | 240           |
| <b>Total recurring</b>   | <b>7,817</b> | <b>7,983</b> | <b>7,779</b> | <b>8,270</b> | <b>8,761</b> | <b>40,610</b> |

The cost of items 8, 9 and 10 above will be met by the Punjab Government.

|            |                | To be met by Imperial Council of Agricultural Research. |   | Total.        |
|------------|----------------|---|---|---------------|
|            |                | To be met by Government.                                | To be met by Imperial Council of Agricultural Research. |               |
|            |                | Rs.   | Rs.   | Rs.           |
| Total cost | Non-recurring. | 300   | 2,500   | 2,800         |
|            | Recurring      | 4,730   | 35,880  | 40,610        |
|            |                | <b>5,030</b>  | <b>38,380</b>   | <b>43,410</b> |



## ENCLOSURE II.

EXTRACT FROM THE PROCEEDINGS OF THE MEETING OF THE RICE RESEARCH SUB-COMMITTEE OF THE ADVISORY BOARD HELD ON THE 15TH JULY 1935.

*Scheme for investigation of fungal diseases of the rice crop in the Punjab.*  
(Subject No. 40).

The Sub-Committee observed that the Punjab is not one of the major rice growing provinces. It is understood that the principal object of the author of the scheme was to draw attention to the need for work on these diseases of rice crop with special reference to the designing of methods of control. A good deal of work has been done on several of these diseases at Pusa. All of this has not been published and some appears to be still in progress. Successful work on the Blast disease of paddy has also been carried out at Coimbatore for some twelve years. Some work on Rice diseases has also been done in other provinces. Work has also been done recently in other parts of the world on two of these diseases notably in Japan. The Sub-Committee therefore recommends that the question of work on these diseases be further examined in consultation with the Imperial Mycologist, with a view to formulating a scheme of work in different parts of India, where the best facilities exist, and for co-operation between the Imperial Institute of Agricultural Research and those provinces which are particularly concerned with one or more of the diseases indicated. The Sub-Committee therefore recommends that the scheme be referred back for the present.

## ENCLOSURE III.

SCHEME SUBMITTED BY THE PUNJAB GOVERNMENT FOR INVESTIGATION OF FUNGAL DISEASES OF RICE.

The position appears to be as follows:—

(1) The Punjab is not one of the major rice-growing provinces; far more is grown in Bengal, Madras, United Provinces, Bombay and Sind, Bihar and Orissa, C. P. and Assam. In addition all these provinces have a rice specialist, whereas Punjab has not.

(2) On the other hand, consideration must be given to the Punjab's willingness to take up the work, and its ability to provide suitable laboratory accommodation and skilled control. Also to the fact that rice breeding work is in progress there.

(3) The statement that fungal diseases of rice cause a ten per cent. loss in the Punjab is undoubtedly a considerable overestimate. This is a high figure for any crop and rice seems comparatively free from serious fungal diseases.

*Fusarium* foot-rot has been worked on in Madras and can now be controlled by seed treatment.

*Piricularia* "blast" causes some loss but disease resistant varieties are available.

*Helminthosporium* is not serious in most areas but is said to cause loss in Sind.

*Sclerotium* has been the subject of a recently published Pusa investigation, and its importance in this country is shown to have been greatly exaggerated.

*Ustilaginoidea* and *Ephelis* cause little damage.

(4) The scheme as submitted could be very much cut down, and facilities for field labour supplied by the Punjab Director of Agriculture. Three years at about half the annual grant requested would be sufficient to test the value of the proposal.

(5) The Mycological Section of the Imperial Institute of Agricultural Research will willingly co-operate with any scheme sanctioned.

If it is desired that an independent scheme controlled by the Imperial Institute of Agricultural Research should be put up, this will involve the provision of a special assistant with travelling allowance, and also an arrangement with the various rice specialists to give all facilities required.

L. D. GALLOWAY,  
*Imperial Mycologist.*

September, 24, 1935.

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ENCLOSURE IV.

MADRAS.

COPY OF A LETTER NO. D. DIS. NO. D.-1815/35, DATED THE 15TH NOVEMBER 1935, FROM THE DIRECTOR OF AGRICULTURE, MADRAS, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.

Reference your letter No. F. 45-XVIII/35-A, dated the 18th October 1935. I enclose a copy of the remarks and suggestions (Enclosure) of the Government Mycologist, Madras.

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(Enclosure.)

COPY OF LETTER NO. R. O. C. 535/35, DATED THE 11TH NOVEMBER 1935, FROM THE GOVERNMENT MYCOLOGIST, COIMBATORE, TO THE DIRECTOR OF AGRICULTURE, MADRAS.

Your letter No. D.-1-1815-35, dated the 5th November 1935.

It is not clear from the draft scheme which, among the five diseases mentioned in it, are more important than others in the Punjab requiring immediate investigation. If it is to be understood that all of them are equally important it is doubtful whether within the proposed period of five years investigation, any tangible result would be achieved.

2. In Madras Presidency, two of the major diseases of paddy (*vis.* 'Blast' caused by *Piricularia oryzae* and 'Foot-rot' by *Fusarium moniliforme*) have been studied in great detail and work has been done on othe

diseases also. It has been noticed that, with regard to their occurrence, the diseases are sporadic in nature depending mostly on the seasonal factor. The loss of crop caused by the disease would also appear to be determined chiefly by this factor. The diseases assume serious proportions only in certain years and long periods of comparative absence of the disease intervene before any disease appears once again in the same tract. This fact renders it impossible to pursue the investigation of the diseases with regard to methods of control within a certain specified period.

3. *Work done in Madras.*—The Wilt is probably the same as the 'foot-rot' disease of Madras. This disease has been effectively controlled by seed treatment with fungicides like Ceresan and the same treatment will prove effective in the Punjab also.

*Piricularia* (Blast disease).—Work has been pursued on the lines of finding out disease resistant varieties. A few varieties have been proved to be resistant and these are being used as parents in breeding *Piricularia*-resistant varieties.

*Helminthosporium disease.*—The disease though common does not cause any serious damage being sporadic in its incidence.

'Bunt'.—*Tilletia oryzae* has not been known to occur in Madras.

*Sclerotium oryzae.*—This disease has been recorded in Madras but has not been observed so far to cause damage sufficiently serious to warrant remedial measures.

4. I am, therefore, of opinion that the scheme should be confined to one or two diseases which are known definitely to occur every year in the paddy crop in the Punjab and an intensive study of these particular diseases with reference to local conditions would, I believe, be more useful than a study of the diseases all at a time as proposed in the scheme. I agree with Mr. Galloway, Imperial Mycologist, that the scheme submitted should be very much cut down and confined to the study of one or at the most, two, major problems.

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#### BOMBAY.

COPY OF A LETTER No. 493-G./13759 of 1935, DATED THE 29TH NOVEMBER 1935, FROM THE DIRECTOR OF AGRICULTURE, BOMBAY PRESIDENCY, POONA, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.

With reference to your letter No. F-45-XVIII/35-A. of October 18th, 1935, I have the honour to offer the following remarks on the scheme submitted by the Punjab Government for investigating the fungal diseases of the rice crop. I support the scheme. Though the Punjab is not one of the main rice growing provinces still the diseases are such that an organized attack on any one of them will justify the scheme. *Helminthosporium oryzae* is a very serious disease of rice in Sind, and as the damage in the Punjab is 15 to 20 per cent. as recorded in the printed note, then research on this disease will be very helpful to both provinces. The offer of the laboratory accommodation and the farm and also the offer of additional bullocks and implements and labour are inducements for this scheme to be taken up in the Punjab. I, therefore, consider that the scheme should be accepted.

## BENGAL.

COPY OF LETTER No. 20100, DATED THE 6TH DECEMBER 1935, FROM THE DIRECTOR OF AGRICULTURE, BENGAL, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.

With reference to your letter No. F-45-XVIII/35-A, dated 18th October, 1935, regarding fungal diseases of the rice crop, I have the honour to say as follows:—

Rice occupies the largest area in Bengal than in any other province. The damage caused by various Fungal pests as compared to other crops is practically negligible. On the other hand a considerable damage is done by Insects and Eelworms.

The following Fungal diseases have occasionally been noticed on rice in this province:—

1. Stem-rot, caused by *Sclerotium oryzae*. This disease though a very serious one, generally develops profusely on the dead stubbles left in the field after the crop is harvested. It is very seldom observed on the green plants and in cases only when they are previously attacked by "borers".

The life history has not been worked out.

2. "Foot-rot", caused by a species of *Fusarium*.—This disease has recently been observed on a few plants in the field and the fungus has been brought into culture.

Arrangement is being made to establish its parasitism by inoculation experiments.

3. *Helminthosporium*.—This disease is very common and has been observed both on the leaf and glumes of the plants.

Seed treatment with copper sulphate is said to be effective and is recommended when found necessary.

4. *Piricularia Oryzae*.—This disease is very seldom observed on paddy plants and the cause seems to be due to inadequate aeration and drainage of the fields.

5. False smut of paddy (*Ustilagimoidea virens*), Instances of false smut of paddy have been noticed on paddy grains in years of bumper harvest, but it is of rare occurrence.

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 UNITED PROVINCES.

COPY OF LETTER No. 10275/I.-373-A. (27)-12, DATED THE 10TH DECEMBER 1935, FROM THE DIRECTOR OF AGRICULTURE, UNITED PROVINCES, LUCKNOW, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.

With reference to your letter No. F-45-XVIII/35-A., dated October 18 1935, regarding the scheme submitted by the Punjab Government for investigating the fungal diseases of the rice crop, I have the honour to say that I consider that the investigation of fungal diseases in rice should be carried out by the staff of the Imperial Department of Agriculture who should be provided with extra staff for the purpose.

## BURMA.

LETTER No. 652-C./1A-12, II, DATED THE 14TH DECEMBER 1935, FROM THE DIRECTOR OF AGRICULTURE, BURMA, RANGOON, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.

In reply to your letter No. F-45-XVIII/35-A., dated the 18th October 1935, I have the honour to forward herewith a copy of a note (Enclosure) on the Scheme submitted by the Punjab Government for investigating the fungal diseases of the rice crop, which has been prepared by the Mycologist, Burma, Mandalay. The scheme outlined would appear to have considerable advantages over that proposed by the Punjab Government.

(Enclosure.)

NOTE RELATING TO THE SCHEME SUBMITTED BY THE PUNJAB GOVERNMENT FOR INVESTIGATING THE FUNGAL DISEASES OF THE RICE CROP.

Although it is true that rice is comparatively free from serious fungal diseases, the number of diseases to which it is subject is not small and as the area covered by the crop in India is very extensive the total loss caused to the country must be considerable. Provincial departments have investigated some of these diseases, but so far control measures have not been devised for most of them and in some cases the life-history of the causal fungi have not been worked out while in others even the causes have not been determined. I therefore consider that an intensive investigation of all diseases of rice which occur in India should be undertaken. But since the diseases vary in intensity in different localities and can be studied properly only in localities where they occur with appreciable intensity, the centre of investigation of the diseases should not be placed in one tract or province only. Investigations should be made in various parts of India.

For an all-India scheme, the most suitable arrangement would be for the Imperial Council of Agricultural Research to appoint about four trained investigators of the graduate assistants grade who should work under the Official Mycologists of suitable provinces and co-operate with the rice-specialist of those provinces. They should be given generous travelling allowances. It should not be difficult then for provincial governments to provide other facilities for their work.

The Imperial Council of Agricultural Research should at first call from the Mycologists of all provinces for a report dealing with the diseases of rice in order of severity with which they occur in their respective provinces, along with a statement of previous work done on them. The Imperial Council of Agricultural Research could then allot in consultation with the Imperial Mycologist, subjects for investigation to each officer, having due regard to the severity of the diseases in each province and the possibility of continuing previous work. Not more than two diseases should be allotted to each investigator at one time. The Imperial Mycologist should review the work of the investigators every year and make necessary adjustments in the allotment of work.

If such co-ordinated and concentrated effort be made, it is possible that the main problems relating to the diseases of rice in India will be solved within a period of five years.

In the light of the suggestion put forth above, the scheme submitted by the Punjab Government is, in my opinion much in excess of the requirements of that province.

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BIHAR AND ORISSA.

COPY OF A LETTER No. 12668/I-88-35, DATED THE 5TH NOVEMBER 1935, FROM THE OFFICIATING DIRECTOR OF AGRICULTURE, BIHAR AND ORISSA, DEPARTMENT OF AGRICULTURE, PATNA, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.

I have the honour to refer to your letter No. F. 45-XVIII/35-A., dated the 18th October 1935.

2. A scheme of this kind subdivides itself, as a rule, into four parts—Introductory, purpose, plan and expense and in this case the scheme is open to criticism on all parts except the plan, against which I have no comments to make.

3. As regards criticism of the introductory part, this has already been fully done by the Imperial Mycologist who points out that the Punjab is not a typical rice-growing area, and hints that if such work is to be done, it should be carried out in a province in which a Paddy Specialist has already been appointed by the Imperial Council of Agricultural Research.

The purposes of the work are:—

- (i) The isolation and identification of the various casual fungi which attack the rice crop;
- (ii) A study of their life-histories and the modes of carry over, and
- (iii) The working out of control measure of each of them.

Dr. Butler, formerly of the Imperial Institute of Agricultural Research Pusa, has described at least some of the diseases referred to in the scheme and doubtlessly a good deal of indigenous literature already exists in India on this matter in addition to that issued by Dr. Butler. It would, therefore, seem unnecessary to do all the work over again from the beginning.

The cost of the scheme is excessive. It is said that the laborator work will be done at Lyallpur, and the field work at the Rice Farm Kai Shah Kaku. Presumably this farm already exists, and if so it is understood why the recurring expenditure in the scheme is saddled with the pay of two Agricultural Assistants and of a heavy item of expenditure for casual labour.

4. Before this scheme is embarked on, I would suggest that the first necessity is to collate what has already been done in the matter of diseases of the rice crop in India, and from the knowledge thus made available it should then be possible to draw up a scheme for filling in missing details. It is quite an unnecessary extravagance to do the work all over again *ab initio*.

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CENTRAL PROVINCES.

COPY OF LETTER No. 10568, DATED THE 2ND DECEMBER 1935, FROM THE OFFG. DIRECTOR OF AGRICULTURE, C. P., TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.

*Reference*.—Your letter No. F. 45-XVIII/35-A., dated the 29th October 1935, regarding the scheme submitted by the Punjab Government for investigating the fungal diseases of the rice crop. It is suggested that the scheme should be put into operation in those provinces in which,

- (a) rice is a major crop,
- (b) there is an experienced Mycologist or Plant Pathologist on the provincial staff, and
- (c) rice research stations have been established by the Imperial Council.

2. *Recurring expenditure*.—Each province would require an Assistant Mycologist who would work under the direction of the provincial officer. It is doubtful, however, whether the Agricultural Assistants proposed under recurring expenditure items 2 and 3 of the Punjab Scheme would be necessary. The same remark applies with even greater force in respect of items 8, 9 and 10. All these are presumably already provided in the current rice research schemes. As regards item 11, all that would seem to be necessary for the Imperial Council to provide is the additional labour on account of disease investigation.

3. *Non-recurring expenditure*.—The laboratory equipment of the provincial Mycologist or Plant Pathologist should ordinarily suffice, and the research stations are already equipped with bullocks and implements. All the items under this heading might therefore be omitted.

4. The Imperial Mycologist suggests that the damage caused by fungal diseases has been overestimated, but in the case of a crop which occupies such a vast area as rice it may safely be assumed that the problem is of sufficient importance to warrant investigation. Even one per cent. loss represents the produce of  $\frac{4}{5}$ ths of a million acres in India and Burma.

5. As regards the duration of the investigations it is suggested that climatic conditions may be predisposing factors affecting the incidence in an epidemic form of many of these diseases, and that the scheme should therefore run for five years.

## ASSAM.

COPY OF LETTER No. IIB-33/4272-AG., DATED THE 6TH DECEMBER 1935, FROM THE DIRECTOR OF AGRICULTURE, ASSAM, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI

With reference to your letter No. F. 45-XVIII/35-A., dated the 18th October 1935, I have the honour to forward herewith a note (Enclosure) by the Economic Botanist, Assam, on the Punjab Scheme for investigating the fungal diseases of the rice crop to which I have nothing to add.

(Enclosure.)

A NOTE ON RICE DISEASES IN ASSAM.

The present state of Assam so far as rice cultivation is concerned may be stated as follows:—

Rice is the main staple crop of Assam. It is grown universally all over the province including the hill tracts and the present area under rice in Assam is about 5 million acres. It has a great commercial importance and is used as the main crop for sustenance. Though no definite study has yet been carried out as regards the exact amount of damage caused by fungus diseases, it would not be too much to say that this crop suffers in Assam no less than in the other provinces in India. The observations of the Mycological assistant has shown that the damage due to diseases in rice can be estimated to be about 7 per cent.

The diseases observed in Assam from time to time are (1) *Cephalosporium*, (2) *Helminthosporium*, (3) *Piricularia*, (4) *Ustilagoidea* and (5) *Sclerotium*. Of these the former two take a heavy toll every year and the damage caused by them cannot be ignored. *Helminthosporium* and *piricularia* in seed bed occasionally destroy the whole seed bed. The incidence of *Cephalosporium* is gradually increasing.

In connection with the Punjab scheme, I am glad to see that they have come forward to start research work on this particular line. The Imperial Council of Agricultural Research may be good enough to finance the scheme partly as stated by the Imperial Mycologist although the Punjab is not commercially so important in rice. But at the same time I would be glad to see similar work being taken up in the major rice-growing provinces—Bengal, Madras, Bihar and Orissa and Assam. The problem of diseases in rice has not been taken up in Assam owing to financial stringency. This is all the reason why an adequate staff may well be provided by the Imperial Council of Agricultural Research for research on fungus diseases on rice in Assam. For this, a Mycological assistant, one field assistant, a fieldman and a laboratory servant will serve the purpose. If this staff is provided in Assam some real good work will be done.



SIND.

COPY OF LETTER No. 417, DATED THE 10TH DECEMBER 1935, FROM THE CHIEF AGRICULTURAL OFFICER IN SIND, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.

With reference to your letter No. F-45-XVIII/35-A, dated 18th October 1935, I have the honour to forward herewith a copy of letter No. CP-1, dated 30th November 1935, (Enclosure) received from the Rice Mycologist, Larkana.

(Enclosure.)

LETTER No. CP-1, DATED THE 30TH NOVEMBER 1935, FROM THE RICE MYCOLOGIST, LARKANA, TO THE CHIEF AGRICULTURAL OFFICER IN SIND, KARACHI.

With reference to your letter No. 417, dated 31st October 1935, I have the honour to report as under:—

1. Rice is one of the major crops in Sind. For the past five years Rice Mycologist has carried on investigations in the diseases on rice under the grants from Sir Sassoon David Trust Fund, Bombay.

2. *Helminthosporium Oryzae* causes as much as 15 to 20 per cent. loss. Work on breeding and selecting of disease resistant strains is in progress and the results so far are very encouraging.

3. Benet (*Tilletia Horrida*) occurs throughout Sind but causes hardly any loss.

4. Sclerotial disease due to *Sclerotium Oryzae* has been noted in some places but is of no economic importance.

5. The pest which is causing considerable anxiety to zamindars in Lower Sind is 'ruro' disease in rice caused by small white insect belonging to the family *Jassidae*. Preliminary work has been carried out but requires a special man with a well equipped laboratory to investigate it thoroughly and devise control measures. So far spraying with 'Malir oil' has proved both effective and economical.

MYSORE

COPY OF LETTER No. ROC. 1125-Hc.-352/35-36, DATED THE 9TH DECEMBER 1935, FROM THE DIRECTOR OF AGRICULTURE IN MYSORE, BANGALORE, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.

With reference to your letter No. F-45-XVIII-35-A, dated 18th October 1935 on the subject, I have the honour to forward herewith a note (Enclosure) on the investigations that are being carried on, on Paddy Diseases in this State.

(Enclosure.)

The need for carrying on investigations on paddy diseases has long been felt by this Department, as paddy is an important major crop in the Mysore State. Investigations on the following diseases are under way:—

- (a) *Blast disease*.—*Piricularia oryzae*, which is very serious all over the State.
- (b) *Helminthosporium oryzae*, which is common, but not virulent.
- (c) *Ephelis oryzae*, which was only sporadic some years ago, but which has, during recent years, been noticeably on the increase.
- (d) *Fusarium foot-rot*, which occurs occasionally.

Two methods of control of these diseases are being tried at present, one by seed disinfection, the other by manuring. On our Paddy Breeding Station, attempts are being made to evolve disease resistant varieties.

In addition a serious pest of paddy fields, *viz.*, *Chara* has been noticed in many parts of the State, and is being successfully combated by using copper sulphate solution.

## APPENDIX XIX.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 31st December 1935, on Subject No. 6:—Application from the Government of Mysore for a grant of Rs. 1,39,145, spread over a period of ten years for a scheme of sheep breeding in the Mysore State.**

Attention is invited to the following extract of the Proceedings of a meeting of the Cattle Breeding Sub-Committee of the Council held in July 1935 which considered a scheme of Sheep Breeding in the Mysore State:—

“Dr. Narasimha Ayyangar explained the scheme. After discussion the Committee decided that the Scheme be returned to the Mysore Government for revision on the ground that the Scheme as put forward was not of all-India importance and that the experiments should be confined to the breeding of Deccani sheep as far as the Council was concerned. This would be in accordance with the co-ordinated plan of sheep breeding which had been decided on by the Special Sheep Breeding Committee. They also recommended that the Live-stock Officer of the State should attend the Cattle Breeding Committee when the Scheme came up again for discussion”.

2. The Advisory Board adopted the recommendation of the Committee and the Mysore representative withdrew the Scheme for purposes of revision.

3. The Mysore Government have accordingly submitted a revised scheme (Annexure) which involves a total expenditure of Rs. 1,39,145, (Rs. 39,875 non-recurring and Rs. 1,05,770 recurring) spread over a period of ten years as against Rs. 2,09,000 provided in the original scheme for a period of 5 years. The total estimated income for ten years from the sale of livestock and wool is Rs. 20,000.

4. The Scheme will be examined in the first instance by the Cattle Breeding Sub-Committee of the Council as before and its report (Appendix XX) will be circulated to the Board in due course.

## ANNEXURE.

SHEEP BREEDING SCHEME REVISED AS REQUIRED BY THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

As the sheep in Mysore are either black or brown or white both pure and in mixture, with different types of fleece, work in the direction of producing suitable type of ewes with definite characteristics, which is a matter of fundamental importance was started on the Government Sheep Farm, Yelchihalli, where attempts are being made to maintain pure bred homozygous type of local sheep to serve as foundation stock for the cross-breeding experiments that are also being carried on. The following are the remarks of the Technical Adviser on Woollen Industries to the Government of India, who inspected the sheep in November 1935.

“The improvement in the quality of the fleece of pure Indian Sheep from that of a coarse, kempy, and irregular wool such as is usually produced in Madras and Mysore was remarkable and clearly proves what can be done by careful breeding and proper feeding.

Apart from the question of improving the breed by the introduction of Merino rams, it was clear to me how by careful breeding and feeding, wool of a pure Indian sheep can be improved in quality as well as quantity.

When the improvements attained on these farms can be extended to the farmers in general—and I fail to see why this should not be done under proper organisation—Mysore will have rendered a great service to its own State in particular and to India in general."

The suggestion made by the Imperial Council of Agricultural Research reduces itself to intensive work on one phase of sheep improvement based upon the results that have already been achieved, viz. (1) By careful culling and classing over a number of years, a pure white flock is maintained. (2) The staple length on an average is about an inch more than the average length of unimproved sheep. (3) Almost 70 per cent. of the fleece of these sheep consists of wool fibres as against 30 to 40 per cent. among unimproved sheep. (4) That October-December season is a better season for lambing than an all round the year lambing. (5) That it is possible to have two breeding seasons in a year. (6) That the lambs born in October-December season develop better than those born in March-April. (7) That improved nutrition renders the sheep more resistant to infestation with parasites. (8) That the average birth weight of lambs born in October-December season is slightly more than that of those born in March-April. (9) That the active productive period ranges from the 3rd to the 6th year. (10) That the maximum yield of wool can be expected in the third year of life of the sheep. (11) That the average yield does not exceed 12 ozs. per annual clip. (12) That semi annual clippings yield about 1½ ozs. more per year. (13) That December is the best season for clipping. (14) That May-June is the best season for castration.

If the same work has to be done intensively, it has to be done in a more suitable place than Yelachihalli to achieve similar results by stocking not less than 500 ewes in two different places on an extensive pasture ground. As it is very difficult to procure 500 white ewes in the very first year, purchases will have to be made in the succeeding years to make up the full strength.

*Estimate for the scheme as proposed by the Director of Agriculture.  
Capital Expenditure.*

| Live Stock.  | First year. |           | Second year. |
|--|-------------|-----------|--------------|
|  | Rs.         | Rs.       | Rs.          |
| Two hundred and fifty local white ewes at Rs. 10 each including transporting charges to the Farm . . . . . | 2,500       | 2,500     |              |
| Ten rams at Rs. 15 . . . . .   | 150         | 5 rams 75 |              |
| Two pairs of bullocks . . . . .  | 400         |           |              |
| <i>Buildings and water-supply.</i>   |             |           |              |
| Sheep pens . . . . .   | 3,000       | 3,000     |              |
| Two segregation sheds . . . . .  | 500         |           |              |
| Shearing shed and go-down . . . . .  | 2,000       |           |              |
| Sheep dip . . . . .  | 400         |           |              |
| Feed and water troughs . . . . .   | 800         | 800       |              |
| Fencing . . . . .  | 4,000       |           |              |
| Two wells . . . . .  | 1,500       |           |              |
| Two pumping out-fits . . . . .   | 1,000       |           |              |
| Storage tank and pipes . . . . .   | 1,500       | 500       |              |
| Quarters for Manager . . . . .   | 2,500       |           |              |
| Quarters for Shepherds . . . . .   | 1,300       | 1,300     |              |
| Office and Stores combined . . . . .   | 2,000       |           |              |
| Quarters for Fieldman . . . . .  | 800         |           |              |

| <i>Equipment.</i>                           | <i>First year.</i> | <i>Second year.</i> |        |
|---|--------------------|---------------------|--------|
|   | Rs.                | Rs.                 | Rs.    |
| Three shearing machines . . . . .           | 450                | ..                  | ..     |
| Two bullock carts . . . . .                 | 200                | ..                  | ..     |
| Tools and agricultural implements . . . . . | 300                | 100                 | ..     |
| Furniture . . . . .                         | 200                | ..                  | ..     |
| Total . . . . .                             | 25,300             | 8,075               | 33,375 |

*Recurring Expenditure.*

|  | Rs.        | Rs.                    | Rs.                  |
|--|------------|------------------------|----------------------|
|  |            |                        | <i>For 10 years.</i> |
| (1) Establishment—                                 |            |                        |                      |
| Manager . . . . .                                  | 100—10—150 | ..                     | 16,200               |
| Fieldman . . . . .                                 | 20—5—30    | ..                     | 3,420                |
| One maistry . . . . .                              | 15—1—20    | one maistry<br>15—1—20 | 4,200                |
| (2) Labour charges . . . . .                       | 2,500      | 4,500                  | 43,000               |
| (3) Veterinary medicines and instruments . . . . . | 200        | 50                     | 650                  |
| (4) Feeding charges . . . . .                      | 1,500      | 3,000                  | 28,500               |
| (5) Contingencies . . . . .                        | 800        | 1,000                  | 9,800                |
|  |            |                        | 1,05,770             |
| Grand Total . . . . .                              |            |                        | 1,39,145             |

The total capital expenditure of the scheme would therefore be Rs. 33,375 spread over two years and the annual average recurring expenditure would be Rs. 10,577. The full cost of the scheme would be Rs. 1,39,145. The total income for ten years by sale of live-stock and wool will be approximately Rs. 20,000.

A. A. MONTEIRO,  
*Live-Stock Expert.*

## APPENDIX XX.

Report of the Cattle Breeding Committee which met at New Delhi on the  
10th February 1936.

## PRESENT:

1. Col. A. OLVER. (Chairman).
2. Mr. E. J. BRUEN.
3. S. DATAR SINGH.
4. Mr. DOST MOHAMMAD KEAN.
5. Mr. T. J. EGAN.
6. Mr. K. P. R. KARTHA.
7. Sir CHUNILAL V. MEHTA.
8. Mr. A. A. MONTEIRO.
9. Dr. S. S. NEHRU.
10. Mr. C. H. PARR.
11. Mr. T. F. QUIRRE.
12. Major P. B. RILEY.
13. Mr. C. B. SAMUEL.
14. Mr. WYNNE SAYER.
15. Mr. A. E. SLATER.
16. Mr. F. WARE.
17. Rao Bahadur M. VAIDYANATHAN.

1. Application from the Government of Mysore for a grant of Rs. 1,39,145 spread over a period of 10 years for a scheme of research on Sheep Breeding (Subject No. 6 on the agenda of the Advisory Board). Appendix XIX.

In discussing the scheme Mr. Monteiro stated that he considered that better value would be obtained if money were granted for extending the existing cross-breeding work with Merino sheep which was already in progress in Mysore State. It was agreed that this work should be continued but it was pointed out that to finance a further scheme on cross-breeding with Merino sheep would not be in accordance with the decision of the Advisory Board or the recommendations of the special Sheep-breeding Committee which had recommended that in Mysore the improvement of Deccani Sheep should be taken up. Mr. Monteiro stated that considerable progress had been made with Merino cross-breeding during the ten years the work has been in progress but he considered that the sheep of Mysore were generally so poor and of such an irregular type that large numbers and a long time would be needed to produce an indigenous flock of good quality. He had put up this scheme on the recommendations of the Advisory Board but he personally was not in favour of it and he considered that in any case in order to obtain results of value it would be necessary to purchase at least 500 sheep. It was pointed out in the course of the discussion that in any case funds for this number were unlikely to be available at an early date, and it was

decided that further consideration of a scheme of sheep-breeding from Mysore State should be postponed until the matter of co-ordinated sheep-breeding had been again discussed at the next Animal Husbandry Wing Meeting of the Board of Agriculture.

2. *Extension for a period of 5 years of the Scheme for breeding experiments in connection with the improvement of goats in the United Provinces, conducted by Mr. A. E. Slater. (Subject No. 10 on the agenda of the Advisory Board). (Appendix XXI).*

Col. Olver, before opening the discussion, drew attention to a statement which had been made in the Punjab Goat Breeding Scheme, which appeared to show that the cost of producing a lb. of milk at Etah was very much higher than at Hissar. He pointed out that the basis of calculation in the two cases was not the same and that according to figures worked out in his office, there was little difference when the basis of calculation was the same. Moreover, the system of daily milking and recording, carried out at Etah, involved regular stall-feeding which was not the case at Hissar. He also drew attention to the improvement which had been effected in reducing the kidding interval in the Etah flock in accordance with the recommendations of the Cattle Breeding Committee. The average duration of lactations for the whole flock during the past four years had been as follows:—

| Year.   |    |    |    |    | Days in milk. |
|---------|----|----|----|----|---------------|
| 1932-33 | .. | .. | .. | .. | 269           |
| 1933-34 | .. | .. | .. | .. | 261           |
| 1934-35 | .. | .. | .. | .. | 202           |
| 1935-36 | .. | .. | .. | .. | 161           |

Attention was drawn to the necessity, if possible, to reduce rather than increase the total expenditure under the scheme and Mr. Egan was asked if the provincial Government would be prepared to make a larger contribution to its cost. He stated that an arrangement had been come to by which money would be provided for the rearing of male kids which had hitherto been sold at about Re. 1 for slaughter, and that the United Provinces Government had agreed to bear the cost of the cheese-making room, but he did not know if it would be prepared to make any further contribution. The necessity for making provision for cottage cheese-making was discussed and it was generally agreed that this was necessary.

In dealing with the details of recurring expenditure it was agreed that the Assistant's salary was sufficient and that he should continue on his present scale of pay, with yearly increments of Rs. 5. It was agreed also that a clerk was essential. The possibility of reducing expenditure on menial staff, grain, fodder and cultivation charges was considered but it was decided that any small savings that could be made from these items would be detrimental to the work. If the Assistant's salary continued on his present scale, a saving of Rs. 2,205 would be made over the 5 year period, and it was anticipated that receipts might exceed the Rs. 6,200 estimated in the scheme. Allowing for receipts at the estimated amount of Rs. 6,200 the total cost of the scheme for the 5 year extension would amount to Rs. 27,235, and it was recommended that this amount should be approved.

8. *Application from the Government of Punjab for investigation and research of indigenous goat breeding at Government Cattle Farm, Hissar, at a cost of Rs. 38,000. (Subject on the supplementary agenda of the Advisory Board). (Appendix XXII).*

It was pointed out that this scheme would be in addition to the original comprehensive scheme of goat improvement and could be regarded as an extension of the work already in progress at Etah on Jumna Pari goats. In view of the small size of the flock at Etah and the wide area over which Jumna Pari goats are in demand this was considered desirable and it was felt that the opportunity should not be lost of making use of the facilities and flock available at Hissar and of the selection work already done there for the benefit of all India. In any case, the flock at Etah was a small one and it would be necessary, as time went on, to arrange for the periodical introduction of new blood.

In discussing the details of the scheme, it was proposed and agreed to by Mr. Quirke that the returns from the scheme should be divided between the Punjab Government and the Imperial Council of Agricultural Research on a 50: 50 basis and that the same basis should apply as regards the disposal of male goats available from the scheme for distribution. With these modifications the scheme was recommended for approval.

The meeting then adjourned till 2-45 p.m. on the 12th February 1936.

A. OLVER,  
Col.

The 10th February 1936.



PROCEEDINGS OF STANDING CATTLE BREEDING COMMITTEE  
HELD ON WEDNESDAY, THE 12TH FEBRUARY 1936.

The following members were present:—

1. Col. A. OLVER, *Chairman*.
2. Mr. E. J. BRUEN.
3. Sardar DATAR SINGH.
4. Khan Sahib DOST MOHAMMAD KHAN.
5. Mr. T. J. EGAN.
6. Mr. E. S. FARBROTHER.
7. Mr. K. P. R. KARTHA.
8. Mr. P. J. KERR.
9. Mr. Z. R. KOTHAVALA.
10. Mr. A. A. MONTEIRO.
11. Mr. C. H. PARR.
12. Mr. T. F. QUIRKE.
13. Major P. B. RILEY.
14. Mr. WYNNE SAYER.
15. Mr. S. M. A. SHAH.
16. Mr. F. WARE.

*Establishment of Pedigree Herd Books in India. (Item No. 6 of the Committee, No. 45 of the agenda of Board.)*

Col. Olver introduced the subject and explained that the matter had been on the tapis for a very long time. He was anxious to get a definite start made with the formation of herd books for a few of the most important Indian breeds. After discussion it was decided that characteristics should be defined in respect of the following which included the best known dairy breeds of India, viz.:—Sahiwal, Scindi, Gir, Tharparkar, Haryana, Ongole, Kankrej and Murrah Buffaloes.

It was agreed that for purposes of carrying out the definitions of breed characteristics a convener should be appointed for each breed who should get in touch with the most important breeders and after obtaining their views should arrange a meeting at a suitable place and draw up a schedule of breed-points including careful measurements and descriptions of the head, neck, body, udder, size, general appearance, colour and any other special point of each breed. Photographs of typical animals should also be obtained and when complete each convener should submit his report to the Cattle Breeding Committee of the Council for consideration. After these reports had been approved by the Committee and accepted by the Advisory Board they should be compiled and published by the Council in the form of a brochure for general guidance. The Committee selected Mr. Wynne Sayer for the Sahiwal and Tharparkar breeds, Mr. Kothawala for Scindi and Gir, Mr. Santokh Singh for Haryana cattle and Murrah buffaloes, Mr. Bruen for Kan'rej and Mr. Littlewood for Ongoles.

As regards expenses it was decided that each convener should submit an estimate for the Vice-Chairman's sanction as was done in the case of the sub-committees of the Dairy Legislation Committee.

The question of arranging for the periodical checking of milk records was left over for decision after breed characteristics had been defined.

7. *Application from Khan Sahib Dost Mohammad Khan for a grant of Rs. 720 spread over a period of two years for the appointment of a Milk Tester. (Subject No. 50 on the agenda of Advisory Board).*

Col. Olver explained that the scheme could be considered only if the Punjab Government accepted the responsibility for its proper working and it was agreed that as the scheme had not been submitted through the Punjab Government it should be referred back for consideration by the Punjab Provincial Research Committee.

4. *Application from the Government of the Punjab for a lump sum grant of Rs. 29,000 for sending an officer of the Punjab Veterinary Department on deputation to South Africa to study Angora Goat Breeding Industry. (Subject No. 42 on the agenda of the Board.)*

After discussion the Committee recommended that the Imperial Council of Agricultural Research should select an officer and send him on deputation to South Africa for a period of six months (including travelling) to study Angora Goat Breeding in South Africa with a view to developing it in suitable areas in India. As this was a modification of the proposal submitted by the Punjab Research Council, it was agreed that the scheme should be sent back with a view to its reconsideration, at the summer meeting of the Advisory Board.

3. *Application from the Government of Travancore for a grant for a scheme for improving cattle on the West Coast of India at a cost of Rs. 2,89,136, spread over a period of 2 years. (Subject No. 23 of Board.)*

Consideration of this scheme was postponed as desired by the Travancore Government owing to the inability of their representative to attend the meeting.

## APPENDIX XXI.

Note by the Secretary, Imperial Council of Agricultural Research, dated the 2nd January 1936, on Subject No. 10:—Application from Mr. A. E. Slater, Mission Poultry Farm, Etah, United Provinces, for a grant of Rs. 29,440 spread over a period of 5 years for the continuance of Breeding Experiments in connection with the Improvement of Goats in the United Provinces.

This scheme has been in operation since June 1931 and is to expire in June 1936.

2. An application for further extension of five years at a cost of Rs. 29,440 has been submitted by Mr. Slater (annexure). This has the approval of the Provincial Agricultural Research Committee and has been recommended by the United Provinces Government.

3. The application will be considered by the Cattle Breeding Committee whose report will be, as usual, circulated to the Advisory Board in due course.

## ANNEXURE.

AN APPLICATION FROM MR. A. E. SLATER, MISSION POULTRY FARM, ETAH, UNITED PROVINCES, TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH FOR A GRANT OF Rs. 29,440 (NON-RECURRING Rs. 1,200 AND RECURRING Rs. 28,240.) SPREAD OVER A PERIOD OF FIVE YEARS FOR THE CONTINUANCE OF BREEDING EXPERIMENTS IN CONNEXION WITH THE IMPROVEMENT OF GOATS IN THE UNITED PROVINCES (AS AMENDED AFTER DISCUSSION, VIDE RESOLUTION NO. 3, DATED THE 30TH OCTOBER, 1935.)

*Extension for a period of 5 years of the scheme for Breeding Experiments in connexion with the Improvement of Goats in the United Provinces.*

## INTRODUCTION.

The scheme which was commenced in June 1931-32 was sanctioned for a period of 5 years. The term therefore expires in May, 1936.

The Imperial Council of Agricultural Research have recently ruled that schemes dealing with experiments in regard to breeding of animals may be sanctioned for a period of 10 years, calling for a revision at the end of the 5 year period, as it is acknowledged that a 5 year period is too short a period in which to arrive at conclusive results.

The revised scheme has been drawn up on the lines sanctioned in the original schemes, with an addition of further lines of research, not in the original scheme, but which have been carried on the recommendations of the Animals Husbandry Expert to the Imperial Council of Agricultural Research, and of the Cattle Breeding Committee.

The original lines of research were as follows :

- (a) Selective breeding of the best Jumna Paris by means of recorded milk yields and progeny tests.
- (b) Selective breeding of the best Bar-Baris by means of recorded milk yields and progeny tests.
- (c) Experimentation with Swiss Toggenberg goats to test their suitability for Indian conditions, and to determine whether they will reproduce themselves pure in India without serious loss of vigour.
- (d) Cross-breeding of Swiss Toggenbergs on Desi goats.
- (e) Determination of the factors for milk production through transmission of the sire.

It is proposed that these lines except (c) and (d) be continued. It is also proposed that the following lines of research be carried on.

- (1) Experiments in the manufacture of soft cottage cheese from Goat's milk.
- (2) Annual testing of the herd by Muktesar for Brucella infection, in accordance with instructions received from the Advisory Board "that further tests at short intervals be carried out to make sure that the herd is free from infection of contagious abortion."
- (3) The rearing of pedigreed male kids to maturity for sale and distribution, rather than their sale to the butcher shortly after birth at Re. 1 each. This will entail some extra expenditure under this head, which was not estimated for in the original scheme. The Cattle Breeding Committee at its fourth meeting in Simla, on 15th July, 1935, expressed the opinion, in which we heartily concur, that these kids, coming as they do from a pedigreed herd, should be used for distribution in the province, and be available for other Provinces also.

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#### ANNEXURE

#### PROPOSALS FOR EXTENSION OF THE BREEDING EXPERIMENTS IN CONNEXION WITH THE IMPROVEMENT OF GOATS IN THE UNITED PROVINCES.

##### WORK DONE SO FAR AND RESULTS ACHIEVED.

##### *Brief resumé of work done.*

1. Purifying the blood lines and fixing the type of Jumna Paris and Bar-Baris.

2. Cross-breeding of Desi goats with Toggenbergs. Desi goats on the farm have given on an average 464.5 pounds of milk in 238 days, average per day being 1.15 lbs., whereas Crossbred goats have given 785.2 lbs. of

milk in 296 days, average milk yield per day being 2.11 lbs. The following are the performances of two best crossbred goats:

| Number of goat             | Total milk yield | Maximum milk a day | Average milk a day | Number of days in milk |
|----------------------------|------------------|--------------------|--------------------|------------------------|
|                            | lbs. oz.         | lbs. oz.           | lbs. oz.           |                        |
| 97 (i) Lactation . . . . . | 1,015 8          | 5 8                | 2 9                | 352                    |
| (ii) do. . . . .           | 585 10           | 7 0                | 3 7                | 158                    |
| 101 (i) do. . . . .        | 1,713 2          | 5 0                | 3 1                | 544                    |
| (ii) do. . . . .           | 887 10           | 7 4                | 3 10               | 244                    |

### 3. Improvement in milk yields of daughters over their dams.

| Total number of goats  | Total milk yield | Average milk a day | Maximum milk a day | Number of days in milk |
|------------------------|------------------|--------------------|--------------------|------------------------|
|                        | lbs. oz.         | lbs. oz.           | lbs. oz.           |                        |
| 30 Dams . . . . .      | 336 13           | 1 7                | 3 0                | 223                    |
| 30 Daughters . . . . . | 371 8            | 2 1                | 3 13               | 183                    |

4. Increased average milk of herd per day from 3.3 to 4.1 lbs.

5. Increased milk yield of the herd from year to year from 1.9 to 2.2 lbs.

6. Cost of production of milk per lb. is 7.3 pies, whereas in military dairies roughly the cost of cows' milk is 9 pies and for buffaloes' milk is 11 pies.

7. Determining the percentage of butter fat. The average percentage of butter fat for goats' milk is 4.8. One of the Jumna Pari goats No. 24 has tested 7.8 per cent. of butter fat.

8. Services of bucks on village goats. So far 122 village goats have been bred by the farm bucks.

9. Investigation of internal parasites and remedies.

10. Brucella Infection. Three tests of the herd have been made by Muktesar, through the Veterinary Investigation Officer, United Provinces. The result is as follows:

*First test.*—4 positive reactors out of 80 goats tested.

*Second test.*—2 positive reactors out of 51 goats tested.

*Third test.*—2 positive reactors out of 151 goats tested.

All the positive reactors have been destroyed.

11. Feeding and determination of a suitable grain ration.

12. Stall feeding versus free range.

13. Cheese making, on a small experimental scale.

One gratifying result has been the demand for our goats from various provinces. The following table will show that 43 goats have been supplied to 7 different provinces. This clearly indicates the all India importance of

our experiment. As the yield of milk is increased the demand should also be greater:

*Summary of the goats distributed in different provinces during the last four years—*

|                             |    | Adult             | Kid | Total             |    |
|-----------------------------|----|-------------------|-----|-------------------|----|
| <b>1. United Provinces—</b> |    |                   |     |                   |    |
| Male                        |    | 4                 | 4   | 8                 |    |
| Female                      |    | 4                 | ..  | 4                 |    |
| <b>Total</b>                |    | 8                 | 4   | 12                |    |
| <b>2. Bihar and Orissa—</b> |    |                   |     |                   |    |
| Male                        |    | 1                 | ..  | 1                 |    |
| Female                      |    | 2                 | ..  | 2                 |    |
| <b>Total</b>                |    | 3                 | ..  | 3                 |    |
| <b>3. Bengal—</b>           |    |                   |     |                   |    |
| Male                        |    | 1                 | ..  | 1                 |    |
| Female                      |    | 3                 | ..  | 3                 |    |
| <b>Total</b>                |    | 4                 | ..  | 4                 |    |
| <b>4. Madras—</b>           |    |                   |     |                   |    |
| Male                        |    | 2                 | ..  | 2                 |    |
| Female                      |    | 1                 | ..  | 1                 |    |
| <b>Total</b>                |    | 3                 | ..  | 3                 |    |
| <b>5. Bombay—</b>           |    |                   |     |                   |    |
| Male                        |    | 1                 | 2   | 3                 |    |
| Female                      |    | 7                 | 1   | 8                 |    |
| <b>Total</b>                |    | 8                 | 3   | 11                |    |
| <b>6. Assam—</b>            |    |                   |     |                   |    |
| Male                        |    | 1                 | ..  | 1                 |    |
| Female                      |    | 2                 | ..  | 2                 |    |
| <b>Total</b>                |    | 3                 | ..  | 3                 |    |
| <b>7. Baroda—</b>           |    |                   |     |                   |    |
| Male                        |    | ..                | 5   | 5                 |    |
| Female                      |    | ..                | 2   | 2                 |    |
| <b>Total</b>                |    | ..                | 7   | 7                 |    |
| <b>GRAND TOTAL</b>          |    | 29                | 14  | 43                |    |
| <hr/>                       |    |                   |     |                   |    |
| <b>Adults—</b>              |    | <b>Kids—</b>      |     | <b>Total—</b>     |    |
| Male                        | 10 | Male              | 11  | Male              | 21 |
| Female                      | 19 | Female            | 3   | Female            | 22 |
| <b>Total . 29</b>           |    | <b>Total . 14</b> |     | <b>Total . 43</b> |    |

Besides the goats given in the table, a pair of Jumna Pari goats (1 male and 1 female) has been supplied to Sir David Ezra through us. He will present this pair to the Zoological Society of Australia.

*Determination of the factors of high milk production through transmission of the sire.*

The period has been too short to determine whether the same law in regard to this matter, which holds true of cows, is true of goats also. This is a most important line of research and one which has not as yet been undertaken in any country. We have at present several young males from our heaviest milking females, four of which we are breeding from, and the progeny should show a marked increase in yield.

*Proposal for slight expansion.*

At the fourth meeting of the Advisory Board it was suggested that the method of making soft cheese from goat's milk should be standardized. A small non-recurring item of Rs. 1,500, therefore, is asked for (see appendices I and II), in order that this may be done.

It might be stated that soft cheese of good quality has already been made on a laboratory scale, and it seems well worth while going forward with this matter.

*Conclusion.*

In conclusion, we would point out that the goat is an economic producer of milk. The cost of production of milk per lb. for goats compares very favourably with that of cows or buffaloes. Further that goats' milk for the poor labouring classes has no equal, because the capital expenditure on goats, and their cost of maintenance in the village is much less than that required for either cows or buffaloes.

It should also be remembered that goats' milk is free of T. B. germs, an important point, when we note the rapid increase of this dread in India.

For all these reasons it would seem as if experiments in improving the indigenous breeds we are working with should be continued, and further investigation is essential, as clearly the whole matter is one of all-India importance.

Therefore, we would ask the Imperial Council of Agricultural Research to make us a total grant of Rs. 29,440 for a period of five years.

|   | Re-<br>curring<br>Rs. | Non-re-<br>curring<br>Rs. | Total<br>Rs. |
|---|-----------------------|---------------------------|--------------|
| Gross Total   | 36,440                | 2,150                     | 38,590       |
| Deduct—   |                       |                           |              |
| (a) Local Government's contribution                       | 2,000                 | 950                       | 2,950        |
| (b) Receipts  | 6,200                 | ..                        | 6,200        |
|   | 8,200                 | 950                       | 9,150        |
| Net cost to the Imperial Council of Agricultural Research | 28,240                | 1,200                     | 29,440       |

A. E. SLATER.

DATED ETAAH :  
The August , 1935.

(1) *Recurring expenditure from June 1936 to May 1941.*

| Items.   | Sixth year   | Seventh year | Eighth year  | Ninth year   | Tenth year   | Total         | Remarks.  |
|--|--------------|--------------|--------------|--------------|--------------|---------------|---|
|  | Rs.          | Rs.          | Rs.          | Rs.          | Rs.          | Rs.           |   |
| 1. Assistant's salary (at Rs. 150-10-2000).          | 1,800        | 1,920        | 2,040        | 2,160        | 2,280        | 10,200        |   |
| 2. Clerk (at Rs. 40-2-50).                           | 480          | 504          | 528          | 552          | 576          | 2,640         |   |
| 2. Menial—   |              |              |              |              |              |               |   |
| (i) 4 adults at Rs. 15 per mensem.                   | 720          | 720          | 720          | 720          | 720          | 5,100         |   |
| (ii) 1 chaukidar at Rs. 15 per mensem.               | 180          | 180          | 180          | 180          | 180          |               |   |
| (iii) 2 boys at Rs. 5 per mensem.                    | 120          | 120          | 120          | 120          | 120          |               |   |
| 4. Grain   | 1,800        | 1,800        | 1,800        | 1,800        | 1,800        | 9,000         | 100 adults at Rs. 12 and 100 young stock at Rs. 6 per year. Rs. 30 per mensem.                |
| 5. Fodder  | 360          | 360          | 360          | 360          | 360          | 1,800         |   |
| 6. Cultivation—                                      |              |              |              |              |              |               |   |
| (i) Labour   | 240          | 240          | 240          | 240          | 240          | 1,200         | Rs. 20 per mensem.  |
| (ii) Irrigation                                      | 60           | 60           | 60           | 60           | 60           | 300           | Rs. 5 per mensem.   |
| 7. Medicine  | 75           | 75           | 75           | 75           | 75           | 375           |   |
| 8. Veterinary Doctor's allowance.                    | 120          | 120          | 120          | 120          | 120          | 600           | Rs. 10 per mensem.  |
| 9. Office  | 125          | 125          | 125          | 125          | 125          | 625           |   |
| 10. Miscellaneous—<br>Dairy and farm contingencies.  | 520          | 520          | 520          | 520          | 520          | 2,600         |   |
| 11. Raising 20 male kids for distribution at Rs. 20. | 400          | 400          | 400          | 400          | 400          | 2,000         | This amount will be provided by the Local Government through the Civil Veterinary Department. |
| <b>GRAND TOTAL</b>                                   | <b>7,000</b> | <b>7,144</b> | <b>7,288</b> | <b>7,432</b> | <b>7,576</b> | <b>36,440</b> |   |

(2) *Non-recurring expenditure.*

|                                |  |
|--------------------------------|--|
| 1. 26 goats at 25 each         | Rs. 650  |
| 2. For cheese-making room      | 950 (See appendix no. I) U. P. Govt. contribution. |
| 3. For cheese-making equipment | 550 (See appendix no. II)                          |
| <b>Total</b>                   | <b>2,150</b>                                       |

*Summary of (approximate) receipts for the next five years.*

| Items                                  | Sixth year   | Seventh year | Eighth year  | Ninth year   | Tenth year   | Total        | Remarks. |
|--|--------------|--------------|--------------|--------------|--------------|--------------|----------|
|  | Rs.          | Rs.          | Rs.          | Rs.          | Rs.          | Rs.          |          |
| 1. Sale of milk and its products.      | 720          | 803          | 886          | 969          | 1,052        | 4,430        |          |
| 2. Sale of Audit stock                 | 150          | 175          | 200          | 225          | 250          | 1,000        |          |
| 3. Sale of male kids                   | 100          | 110          | 120          | 130          | 140          | 600          |          |
| 4. Services of bucks on Village goats. | 10           | 12           | 14           | 16           | 18           | 70           |          |
| 5. Sale of hides                       | 10           | 10           | 10           | 10           | 10           | 50           |          |
| 6. Sale of manure                      | 10           | 10           | 10           | 10           | 10           | 50           |          |
| <b>GRAND TOTAL</b>                     | <b>1,000</b> | <b>1,120</b> | <b>1,240</b> | <b>1,360</b> | <b>1,480</b> | <b>6,200</b> |          |



## ENCLOSURE No. I.

*Estimate for cheese-making room 14' x 20'.*

|   | Rs. |
|---|-----|
| 1. 4 doors at Rs. 20 each . . . . .   | 80  |
| 2. 6 windows at Rs. 10 each . . . . .   | 60  |
| 3. 8 ventilators at Rs. 5 each . . . . .                                      | 40  |
| 4. 8 girders 16 ft. long . . . . .  | 60  |
| 5. 30,000 bricks at Rs. 9 per 1,000 . . . . .                                 | 270 |
| 6. 6 chaukhats complete with doors for wall alambhas at Rs. 10 each . . . . . | 60  |
| 7. 8 tie rods . . . . .   | 20  |
| 8. 16 cement bags . . . . .   | 80  |
| 9. Chuna 200 c.ft. . . . .  | 40  |
| 10. Sand 100 c.ft. . . . .  | 10  |
| 11. Labour . . . . .  | 200 |
| 12. Miscellaneous . . . . .   | 60  |
| Total   | 950 |

## ENCLOSURE No. II.

*Cheese-making equipment.*

|   | Rs.   |
|---|-------|
| 1. Double jacketed cheese vat 100 lb. . . . .     | 150   |
| 2. Pair of cheese knives . . . . .                | 55    |
| 3. Weighing scale complete with weights . . . . . | 40    |
| 4. Milk receiving drum . . . . .                  | 20    |
| 5. Equipment for cooling milk . . . . .           | 150   |
| 6. Dairy acidimeter complete . . . . .            | 15    |
| 7. Chemicals, etc. . . . .                        | 30    |
| 8. <i>Angithi</i> for heating water . . . . .     | 50    |
| 9. Miscellaneous . . . . .                        | 40    |
| Total   | 550   |
| <b>GRAND TOTAL</b>                                | 1,500 |

COPY OF LETTER NO. 609, DATED NOVEMBER 3, 1935, FROM MR. A. E. SLATER, MISSION POULTRY FARM, ETAH, TO J. H. RITCHIE, ESQ., M.A., I.A.S., DIRECTOR OF AGRICULTURE, UNITED PROVINCES, LUCKNOW.

SUBJECT:—*Explaining reasons for the increased pay of the assistant and the provision of a clerk in the scheme of breeding experiments in connection with the improvement of goats in the United Provinces.*

I am in receipt of your telegram, reading as follows:—

“Your Scheme. Reasons for higher pay of assistant and clerk awaited.”.

As per your wire I am putting my notes on these two items, and request you to kindly insert in the scheme. The notes are as follows:—

“(a) *Assistant*.—The reasons for the higher pay of the Assistant, Sardar Singh Bhatia, I.D.D., are as follows:—Mr. S. S. Bhatia was started in the original scheme on too low a scale of pay, *i.e.*, Rs. 100. His qualifications, *i.e.*, I.D.D., and Gold Medalist (he stood first in his class), together with his experience—he had been in charge for some time, of the Dairy at the Agricultural Institute, Allahabad—entitled him to start on a salary of Rs. 150. His increment should also have been on the scale of Rs. 7 instead of Rs. 5 (*vide* original scheme).

It is for these reasons together with the fact that Mr. S. S. Bhatia has for the last four years shown great industry and initiative in his work, and is proving himself capable in every way, that in the revised scheme I have entered his salary at Rs. 150 rising by Rs. 10 to Rs. 200.

When the present scheme expires in June, 1936, he will be receiving Rs. 120.

I would strongly recommend that the Imperial Council of Agricultural Research be asked to approve of this item as submitted by me.

(b) *Clerk*.—Unfortunately through an error, no estimate for a clerk was entered by me in the original scheme. We have been under great difficulties owing to three things; (a) the large amount of clerical work involved in the keeping and filing of all milk and pedigree records; (b) the keeping of accounts in such a way as to be accepted by the audit office (Accountant-General's); (c) our growing correspondence due to many enquiries received on goat breeding, etc.

A clerk is absolutely necessary. We have for the last two years been engaging a part-time clerk, and meeting his salary with great difficulty from our sales.

I would strongly urge that this item for a clerk, *i.e.*, Rs. 40—2—50, be sanctioned.”.

I would be obliged if you would kindly send me a copy of our scheme revised and passed when it is printed.

## APPENDIX XXII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 14th January 1936, on Subject No. 43:—Scheme from the Punjab Government for Investigation and Research of Indigenous Goat-breeding at Government Cattle Farm, Hissar, at a cost of Rs. 38,000 spread over a period of five years.**

Attention is invited to the enclosed letter No. 44-D., dated the 6th January 1936, from the Punjab Government forwarding a scheme for investigation and research of indigenous goat-breeding at Government Cattle Farm, Hissar. The scheme is estimated to involve an expenditure of Rs. 38,000. The Council has been asked to sanction a grant of Rs. 19,000, the balance to be met by the Punjab Government.

2. The Scheme will be examined by the Cattle Breeding Committee and its report will be circulated in due course.

COPY OF A LETTER No. 44-D., DATED THE 6TH JANUARY 1936, FROM THE JOINT SECRETARY TO GOVERNMENT, PUNJAB, DEVELOPMENT DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.

I am directed by the Punjab Government (Ministry of Agriculture) to forward herewith a scheme (Enclosure I) for investigation and research of indigenous goat-breeding at the Government Cattle Farm, Hissar, for consideration and provision of requisite funds.

2. The total cost of the scheme is Rs. 38,000 to be divided between the Punjab Government and the Imperial Council of Agricultural Research as shown below:—

| Imperial Council of Agricultural Research. |  |                                  | Punjab Government. |            |        |
|--|--|----------------------------------|--------------------|------------|--------|
| Non-recurring.                             | Recurring.   | Total.                           | Non-recurring.     | Recurring. | Total. |
| Rs.  | Rs.  | Rs.                              | Rs.                | Rs.        | Rs.    |
| 5,200                                      | 13,520<br>(Spread over a<br>period of<br>5 years). | 18,720<br>or<br>19,000<br>round. | 3,500              | 15,500     | 19,000 |

It will be seen from the details attached to the scheme that the Punjab Government is not committed to any additional expenditure beyond what it is already incurring. But the herd of Jumna Pari goats at the Hissar Cattle Farm valued at Rs. 3,500 will be placed at the disposal of the Imperial Council of Agricultural Research for the purpose of this scheme and the Punjab Government will assume responsibility for their food, keep, veterinary treatment, medicines, supervision, etc.

3. The proposed scheme is of great importance and was approved by the Punjab Council of Research at its meeting held on the 16th November 1935. I am accordingly to request that it be considered by the Imperial Council of Agricultural Research and financed by them to the extent indicated above.

## ENCLOSURE I.

**A SCHEME FOR INVESTIGATION AND RESEARCH AT THE GOVERNMENT CATTLE FARM, HISSAR, PUNJAB, WITH REGARD TO INDIGENOUS GOAT-BREEDING, TO BE FINANCED BY A GRANT-IN-AID, FROM THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.**

**FUNDS REQUIRED.**—A NON-RECURRING GRANT OF RS. 5,200 IN THE FIRST YEAR, AND A GRANT OF RS. 13,520 SPREAD OVER A PERIOD OF FIVE YEARS, TO COVER RECURRING EXPENDITURE.

One of the recommendations of the Royal Commission on Agriculture in India related to the improvement of the indigenous goat of India, and in Northern India, two very promising schemes have now been in operation for several years.

These two operations are as follows:—

- (a) Work by Mr. A. E. Slater, at the Mission Farm at Etah in the United Provinces, in improving the milk-yield of several breeds of goats, cheese-making from goats milk, experiments in stall-feeding milch goats, and comparisons of various breeds and crosses.
- (b) The maintenance of a herd of Jumna Pari goats at the Government Cattle Farm, Hissar, Punjab, for the breeding of pedigree goats by selection and grading, for issue to approved breeders to improve the indigenous herds of goats.

The chief differences between these two schemes are as follows:—

“(a)” is being financed by the Imperial Council of Agricultural Research, who in June 1931 voted a non-recurring grant of Rs. 7,000 and a recurring grant of Rs. 5,000 per annum for a period of five years. This recurring grant has since been extended for a further period. The Government of the United Provinces have also given contributions to the work.

Rs. a. p.

|   |              |           |          |
|---|--------------|-----------|----------|
| “(b)” is being financed entirely by the Punjab Government from Provincial revenues. The operation was commenced in 1928-29, by the purchase of foundation stock, at a cost of . . . . . | 2,328        | 4         | 0        |
| In 1929-30 further stock was purchased at a cost of . . . . .   | 998          | 8         | 0        |
| <b>Total</b>  | <b>3,326</b> | <b>12</b> | <b>0</b> |

The total recurring expenditure incurred up to the present by the Punjab Government, is as follows:—

|                   | Rs.   | A. | P. |
|-------------------|-------|----|----|
| 1928-29 . . . . . | 1,803 | 5  | 2  |
| 1929-30 . . . . . | 2,428 | 10 | 5  |
| 1930-31 . . . . . | 2,736 | 6  | 8  |
| 1931-32 . . . . . | 1,055 | 13 | 1  |
| 1932-33 . . . . . | 982   | 8  | 0  |
| 1933-34 . . . . . | 1,056 | 14 | 0  |
| 1934-35 . . . . . | 1,540 | 15 | 9  |

From this it will be seen that the scheme has been operated on very economical lines, for whilst the expenditure has been considerably less

than that of the United Provinces scheme, the number of animals maintained has been much the same. This should assure the Imperial Council that the money they are now being asked to invest in the scheme will be spent to the best advantage.

The Profit or Loss in each year of the scheme has been as follows:—

|         | Profit. |    |    | Loss. |    |    |
|---------|---------|----|----|-------|----|----|
|         | Rs.     | A. | P. | Rs.   | A. | P. |
| 1928-29 | ..      | .. | .. | 1,397 | 1  | 11 |
| 1929-30 | ..      | .. | .. | 1,152 | 12 | 11 |
| 1930-31 | ..      | .. | .. | 1,937 | 12 | 11 |
| 1931-32 | ..      | .. | .. | 281   | 14 | 1  |
| 1932-33 | 914     | 12 | 0  | ..    | .. | .. |
| 1933-34 | 174     | 4  | 0  | ..    | .. | .. |
| 1934-35 | ..      | .. | .. | 290   | 15 | 3  |

The heavy losses in the early part of the scheme were due to rigorous control measures for Contagious Abortion, and also to scarcity conditions. The loss in 1934-35 was due to famine conditions prevailing.

Further differences between these two operations are that—

“a” includes work on several Indian breeds, exotic breeds, and cross-breeds, whilst—

“b” is confined to the Jumna Pari breed alone, and aims at improving that breed entirely by scientific selection, grading and culling.

A comparison of the work, and the results so far achieved by these two operations, is as follows:—

|  | Etah.        |            | Hissar.          |            |
|--|--------------|------------|------------------|------------|
| Strength of the herd on 1st April, 1935. | Jamna Pari   | 45         | Jamna Pari Bucks | 5          |
|  | Bar Bari     | 30         | does             | 106        |
|  | Cross-breeds | 23         | Kids, male       | 78         |
|  | Desi         | 11         | Kids, female     | 64         |
|  | Toggenburg   | 3          |                  |            |
|  | Kids, male   | 30         |                  |            |
|  | Kids, female | 107        |                  |            |
|  | <b>Total</b> | <b>249</b> |                  | <b>253</b> |

Weekly milk records . . . . . Yes.  
Daily milk records . . . . . Yes, from about 20 goats only.

Yes.  
No. The primary object is to rear good kids for distribution.

| Average annual milk yields of Jamna Pari does. | Lbs. Oz. | Lbs. Oz. |
|--|----------|----------|
| 1932-33  | 1 3      | 0 12     |
| 1933-34  | 1 4      | 1 6      |
| 1934-35  | 1 3      | 1 8      |

Highest yield performance 1934-35:—

Goat No. Etah 29, Hissar 133.

|                                      |           |           |
|--------------------------------------|-----------|-----------|
| Milk yield, total                    | Lbs. Oz.  | Lbs. Oz.  |
| .. .. .                              | 891 4     | 1,093 0   |
| .. .. . maximum                      | 6 4       | 8 0       |
| .. .. . average during lactation     | 3 3       | 5 3       |
| .. .. . overall average              | 2 6       | 3 14      |
| Number of days in milk               | Days.     | Days.     |
| .. .. .                              | 277       | 211       |
| .. .. . dry                          | 99        | 70        |
| Maximum yield per diem from any goat | Lbs. Oz.  | Lbs. Oz.  |
| .. .. .                              | 8 0       | 10 0      |
| Age to maturity, days                | Days.     | Days.     |
| .. .. .                              | 747       | 643       |
| Cost of feed for 1 lb. of milk       | 4-3 pias. | 1-4 pias. |

The above comparison is made purely in the interests of investigation, and is not intended in any way to be a disparagement on the extremely useful work being done at Etah. It is recognised that difference in climate, grazing facilities, and similar items must cause a considerable difference in results, between two places so widely separated. This comparison is necessary, however, to show the Imperial Council the value of the work being done at Hissar, and so obtain their support for this scheme also.

The progress so far made at Hissar has brought the Hissar strain of the Jumna Pari breed of goat into very great favour, as the following table of breeding stock already issued shows:—

|   | Bucks. | Does. | Kids. |         | Total. |
|---|--------|-------|-------|---------|--------|
|   |        |       | Male. | Female. |        |
| To approved breeders in the Punjab  | 198    | ..    | ..    | 1       | 199    |
| To the North-West Frontier Province, Delhi Province, Indian States and other Provinces. | 13     | 14    | 1     | ..      | 28     |
| Total   | 211    | 14    | 1     | 1       | 227    |

The Hissar strain is now so popular that the Farm is totally unable to meet the annual indent from the Punjab, and the demand from places outside the Punjab is so rapidly increasing that it now cannot be met. In fact, it has now become necessary to refuse all indents from outside the Province. The work will, therefore, have to be expanded.

This goat-breeding operation at Hissar has, therefore, now assumed an aspect of "All-India" importance, and in view of the valuable work already done, and the progress that has been made, I have no hesitation in submitting this scheme for the work on indigenous goat-breeding at Hissar to be continued, with the assistance of a grant-in-aid from the Imperial Council of Agricultural Research.

#### THE SCHEME.

I propose that the Punjab Government should place the existing herd of Jumna Pari goats, now maintained on the Government Cattle Farm, Hissar, at the disposal of the Imperial Council of Agricultural Research, and that that body should provide funds for the acquisition of a further herd of 100 Jumna Pari does, and make a contribution towards recurring expenditure.

The terms should be that the Punjab Government should have the right to issue 60 per cent. of the surplus young stock, from the whole herd, to meet the annual Provincial indent from approved breeders. The remaining 40 per cent. to be at the disposal of the Imperial Council of Agricultural Research, for distribution to approved breeders outside the Punjab. Any progeny not absorbed outside the Punjab to revert to that Province for distribution.

Any profits which may accrue from the scheme to be credited to the Punjab Government, in return for placing its herds at the disposal of the

Imperial Council, and for providing accommodation, maintenance, supervision and grazing.

Any mortality which occurs in the herds to be borne by the Punjab Government.

Should the life of the scheme not be extended beyond the initial period, the whole herd to revert to the Punjab Government, who will, however, undertake to continue to supply pedigree breeding stock outside the Punjab, when available.

#### OBJECTS.

1. Research and investigation for the systematic improvement of a herd of Jumna Pari goats, by selected breeding, grading, culling, milk-recording and progeny tests.
2. To provide the nuclei for herds of pedigree, Jumna Pari goats, when required, for commencing goat-breeding schemes with good stock, in other Provinces.
3. To provide young pedigree goats for issue to:—
  - (a) breeders in the Punjab as approved by the Director, Veterinary Services, Punjab,
  - (b) breeders outside the Punjab as approved by the Animal Husbandry Expert to the Imperial Council of Agricultural Research.
4. To investigate the diseases of goats, through the agency of the Civil Veterinary Department, Punjab.
5. To investigate and improve the methods of branding, tattooing, clipping, mating, castration, etc.
6. Investigate the relationship between various rations and milk-yield.
7. Undertake any other investigations in relation to indigenous goat breeding, as may be suggested from time to time, by the Animal Husbandry Expert to the Imperial Council of Agricultural Research.

#### FINANCIAL ASPECT.

The financial aspect of this scheme is given in the Tables at the end of this note, and is extremely modest. The contribution of the Punjab Government is a valuable one, in which the value of experience gained by the work already done, is not included.

Expenditure to be incurred by the Imperial Council of Agricultural Research has been shown separately. This will cover the non-recurring costs incurred in the purchase of livestock, and recurring expenditure to cover the clerical establishment and equipment for keeping records, and the pay of the menial establishment.

The Punjab Government will place its herd of approximately 250 goats, valued at Rs 3,500, at the disposal of the Imperial Council of Agricultural Research for the purposes of this scheme, and will assume responsibility for—

- (a) Casualties.
- (b) The observance of the objects of the scheme.
- (c) The purchase of 100 does of high quality from funds provided for the purpose by the Imperial Council of Agricultural Research.

- (d) Providing the necessary bucks for the above, free of cost, from the existing herd.
- (e) Provide accommodation for the herds and menial establishment.
- (f) Provide rations and grazing for the herd, and all necessary veterinary treatment and medicine.

## RETURN FOR EXPENDITURE.

It is estimated that when the operation is in full swing, a minimum of 75 males and 20 females per annum, will be available for issue.

## ESTIMATES.

## PART I.

*Imperial Council of Agricultural Research.*  
*Expenditure (non-recurring).*

|  | Rs.   |
|--|-------|
| (a) Purchase of 100 female goats at Rs. 35 . . . . .             | 3,500 |
| (b) Travelling allowances and road expenses of animals . . . . . | 500   |
| (c) Purchase of animal weighing machine . . . . .                | 800   |
| (d) Record room equipment . . . . .                              | 400   |
| Total . . . . .  | 5,200 |

*(Expenditure recurring).*

|   | 1st year. | 2nd year. | 3rd year. | 4th year. | 5th year. |
|---|-----------|-----------|-----------|-----------|-----------|
|   | Rs.       | Rs.       | Rs.       | Rs.       | Rs.       |
| (a) One Record-keeper at Rs. 40—2—90 less 15%                                     | 408       | 432       | 456       | 480       | 504       |
| (b) One Jemadar at Rs. 20—1—25.   | 240       | 252       | 264       | 276       | 288       |
| (c) Ten Goat-herds at Rs. 12 p. m. each.  | 1,440     | 1,440     | 1,440     | 1,440     | 1,440     |
| (d) One Bhishti at Rs. 12 p. m.   | 144       | 144       | 144       | 144       | 144       |
| (a) Miscellaneous charges for stationery, books, tattooing instruments, ink, etc. | 400       | 400       | 400       | 400       | 400       |
| Total . . . . .   | 2,632     | 2,668     | 2,704     | 2,740     | 2,776     |



*Summary.*

|                        |                    | Rs.    |
|------------------------|--------------------|--------|
| Expenditure, recurring | 1st year . . . . . | 2,632  |
| " "                    | 2nd " . . . . .    | 2,668  |
| " "                    | 3rd " . . . . .    | 2,704  |
| " "                    | 4th " . . . . .    | 2,740  |
| " "                    | 5th " . . . . .    | 2,776  |
|                        | Total . . . . .    | 13,520 |
| " non-recurring        | . . . . .          | 5,200  |
|                        |                    | 18,720 |

or say Rs. 19,000 (Rupees Nineteen thousand only).

## ESTIMATES.

## PART II.

*Contribution by the Punjab Government.**Non-recurring—*

|  | Rs.   |
|--|-------|
| (a) Value of the herd of Jumna Pari goats placed at the disposal of the Imperial Council of Agricultural Research. | 3,500 |

*Recurring, per annum.—*

|  |                       |
|--|-----------------------|
| (a) Supervision . . . . .                      | 1,000                 |
| (b) Value of livestock accommodation . . . . . | 500                   |
| (c) Feed and Keep of animals . . . . .         | 1,200                 |
| (d) Veterinary instruments, etc. . . . .       | 200                   |
| (e) Value of menial's quarters . . . . .       | 200                   |
|  | Total . . . . . 3,100 |

(f) To this the value of the grazing which cannot be accurately estimated should be added.

*Summary.—*

|                                       |                        |
|---------------------------------------|------------------------|
| Expenditure non-recurring . . . . .   | 3,500                  |
| " recurring (Rs. 3,100 × 5) . . . . . | 15,500                 |
|                                       | Total . . . . . 19,000 |

W. S. READ, P. V. S.

*Offg. Superintendent,*

*Government Cattle Farm, Hissar.*

31st October, 1935.

## APPENDIX XXIII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 11th January 1936 on Subject No. 42:—Application from the Government of the Punjab for a lump sum grant of Rs. 29,000, for sending an Officer of the Punjab Veterinary Service (Class I) on Deputation to South Africa to study the "Angora" Goat Breeding Industry.**

Attention is invited to the enclosed copy of a letter No. 9-D., dated the 3rd January 1936, forwarding a scheme for sending an officer of the Punjab Veterinary Service (Class I) on deputation to South Africa to study the "Angora" Goat breeding industry for a year at a cost of Rs. 29,000. The Council has been asked to meet the whole expenditure in connection with the scheme. The scheme will be placed before the Cattle Breeding Committee of the Council and its report will be submitted to the Advisory Board in due course.

COPY OF A LETTER NO. 9-D., DATED THE 3RD JANUARY 1936, FROM THE JOINT SECRETARY TO GOVERNMENT, PUNJAB, DEVELOPMENT DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.

*SUBJECT:—Scheme for sending an officer of the Punjab Veterinary Service (Class I) on deputation to South Africa to study the "Angora" Goat breeding industry.*

I am directed by the Punjab Government (Ministry of Agriculture) to forward herewith the scheme (Enclosure I) noted above for consideration by the Imperial Council of Agricultural Research.

2. The scheme was placed before the meeting of the Punjab Council of Research held on the 16th November 1935, and has been revised as indicated by the Council.

3. I am to request that if it is approved, necessary funds be provided to the extent of Rs. 29,000 as detailed on page 7 of the scheme.

\* \* \* \* \*

## ENCLOSURE I.

APPLICATION OF THE PUNJAB GOVERNMENT FOR A LUMP SUM GRANT OF RS. 29,000 FROM THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, FOR THE PURPOSE OF SENDING AN OFFICER OF THE PUNJAB VETERINARY SERVICE, ON DEPUTATION FOR ONE YEAR TO SOUTH AFRICA TO STUDY IN DETAIL ALL ASPECTS OF THE "ANGORA" GOAT-BREEDING INDUSTRY INCLUDING THE COMMERCIAL ASPECT OF GRADING AND MARKETING MOHAIR, AND TO REPORT, FOR THE INFORMATION OF THE GOVERNMENT OF INDIA, THE PRACTICABILITY OF ESTABLISHING THE ANGORA GOAT IN INDIA.

Extract from paragraph 159 (page 175) of the Report of the Royal Commission on Agriculture in India:—

"159. . . . . With the object of improving the quality of the hair, suggestions have been made from time to time that the Angora goat should be tried for crossing. So far as we have been able to discover, this has not been done in India.

at least on any considerable scale. This breed has been used with highly satisfactory results in South Africa and elsewhere and we recommend trials of it in this country. It may be found possible to grade up the pure Angora strain. In that case, improvement would be easy and straightforward;" . . .

1. So far as can be ascertained, no action appears to have been taken elsewhere in India, on the recommendation of the Royal Commission on Agriculture quoted above. Neither has any record that the Angora Goat has ever been tried in India, been traced.

This subject has received some consideration in the Punjab, however, and since as far back as 1934 an officer of the Punjab Veterinary Service has been steadily collecting and examining information with regard to this valuable industry. He has been in touch with the Agricultural Department of South Africa, the Grootfontein School of Agriculture (which is the headquarters of the Angora Goat Expert to the Union Government of South Africa), the South African Angora Goat Breeders' Society, and the Angora Goat Breeders' Stud-book Association, all of whom have been most helpful with information and offers of assistance.

As recently as 1934, the Punjab Government sent this officer on deputation to Bradford—the centre of the world's mohair industry—to investigate the commercial aspect of mohair production, and the future of this textile. His report is both illuminating and encouraging.

After careful consideration of the mass of information now available (full details of which have been supplied to the Animal Husbandry Expert to the Government of India), it is felt that the time is ripe for the next step to be taken towards establishing this valuable industry in India.

From the available data it seems probable, that many suitable places could be found for growing mohair in this country, particularly in North and North-West India. It is also felt that such a venture should promote useful indigenous spinning and weaving industries, and may even ultimately develop into a highly profitable export trade.

It must be clearly recognised, however, that the Angora Goat is an animal which requires specialised expert knowledge, both with regard to breeding and in relation to the preparation of mohair for the market. It is felt that to import valuable pedigree stock, at considerable expense, without some first-hand experience of what is necessary in respect of soil, climate, feeding, handling, shearing, etc., might easily end in disaster. For this reason it is proposed, that the first stage of the experiment should be, the despatch of an officer on deputation to South Africa, to collect all vital information. On his return, he would report on the feasibility of introducing Angora Goat Breeding into India, and should this report be favourable, inspect and advise on the suitability of various localities for commencing experiments. He would also be in a position to advise the Central and Local Governments on the financial aspects of schemes for breeding Angora goats.

2. The "Angora" goat is not a milch goat, its value being in its fleece, which is of very long staple and is known commercially as "mohair". The Angora (or "Mohair") goat is one of the two main types of "wool" goat, the other being the Cashmere (or "Shawl") goat.

Mohair is generally recognized as one of the most versatile of all known fibres, for which there is no good substitute, neither can it be produced

synthetically. For these reasons it has considerable value industrially, and probably explains why the demand for this textile does not appear to be so adversely affected by economic depression as other agricultural products such as wool, cotton, jute, etc. In Bradford, it is considered, that having regard to cost and proportionate yield mohair is certainly the cheapest textile material. The opinion there also is that there is less mohair being grown in the world than the trade can consume in normal times, and the idea of another country taking up mohair growing was received with some satisfaction.

Many authorities hold that the "wool" goats (Angora and Cashmere), owing to their resemblance to sheep, have descended from *Capra falconeri* and not from *Capra aegagrus*, and that their original home was probably Tibet. From this it would appear, that India, with the Cashmere and other species of the "wool" goat readily available, may be able to produce a better cross-bred in a shorter time, than was the case in South Africa where the Angora was crossed with the "milch" goat. An interesting point is the fact that the Turkish mohair grower in Asia Minor commands a higher price per lb. for his fleece, on account of its finer texture, and mohair buyers complain that the South African mohair grower pays too much attention to weight and not sufficient to the fineness and texture of the fleece. In view of the divided opinion as to the origin of the "wool" goat, the real cause of the relative coarseness of the South African fleece, quite possibly may be due to the fact that "milch" goats (*Capra aegagrus*) were used there for cross-breeding. It may, therefore, be found, that in India with various types of the "wool" goat (*Capra falconeri*?) available for crossing, that a fleece equal in quality to the Turkish fleece, can be produced. Cross-breeding with such goats would also probably produce a type of animal which would thrive in a much wider range of climate than the imported Angora.

3. The Angora Goat, prior to 1898, was found only in Asia Minor, but South Africa has now the largest mohair export trade in the world. In 1932-33 (during the economic depression) the turnover of the industry in the latter country was £2,000,000 sterling, or 2½ crores of rupees. This valuable trade has been built up entirely from the extremely small numbers of Angora goats imported from Asia Minor between 1898 and 1880. That is, before the Turkish Government, fearing the loss of their mohair monopoly, prohibited the export of Angora goats from Asia Minor. It may be mentioned that this embargo is still in force and it is now quite impossible to get Angora breeding stock from Asia Minor.

The Angoras imported into South Africa were interbred to some extent, but were chiefly crossed on the white "boer" goat. As a result of a wise and steady policy of selective breeding, South Africa, now possesses an extremely lucrative industry, and the Angora stud herds can be relied upon to throw true to type. By some authorities they are even considered to be the purest breed of Angora goat in the world today. The weight of the fleece of the South African Angora goat now averages 8 lb. against 3 lb. from the Turkish Angora.

4. When the difficulties faced by the pioneers of the industry in South Africa are considered, there really seems no reason why an equally profitable industry should not be developed in suitable parts of India. Mohair

growing could be commenced in this country with many advantages not enjoyed by the South African pioneers, such as:—

- (a) The South Africans purchased their original stock from indigenous herds in Asia Minor, kept by an illiterate people who maintained no pedigree records.

For India we can purchase pedigree stock, authenticated by the South African Angora Goat Breeders' Society's Stud-book.

- (b) In South Africa the pioneers of the industry had no guidance from breeding literature.

In India we should have the benefit of their experience, and the text-books and literature on the subject, produced during the last half century.

- (c) The advantages of having indigenous species of the "wool" goat, available for cross-breeding in this country have already been mentioned.

- (d) South Africa is one of the most expensive countries in the world.

In India, labour, land, buildings and forage are very much cheaper. The cost and standard of living is also very much lower. Mohair can, therefore, be produced here much more cheaply than in South Africa.

- (e) In South Africa, mohair growers have little or no market for the disposal of stock "culled" as not up to breeding standard or because of inferior fleeces. Consequently, some farmers have numbers of uneconomic animals in their herds.

In India, as in Asia Minor, the goat is slaughtered for food (in fact goat meat is usually preferred by the Indian palate) and the trade in goat flesh is very large. The flesh of the Angora goat is extremely tasty, and is known in the trade as "chevon". The Indian mohair grower will, therefore, have a ready market for his casters, which will assist in keeping his mohair herds up to a high standard.

- (f) The South African farmer of mohair depends almost entirely on his export trade, and, therefore, suffers when demand falls off and large stocks of mohair accumulate.

In India, the spinning and weaving of goat hair is a long established indigenous industry, which could be developed to consume all the mohair produced for many years to come.

5. In view of the foregoing it is, therefore, proposed to send an officer on deputation to South Africa to complete these investigations.

The Principal of the Grootfontein School of Agriculture, recommends that the tour should be for a full twelve months in the country, in order to cover every phase of the industry, including the study of soil and climate, mating, kidding, culling, feeding, grazing, shearing, dipping and the observation of the export trade details at the ports during the selling season.

It has also been recommended that he should visit the Grootfontein School of Agriculture for study and consultation with the Angora Goat Expert; visit places where Angoras are bred outside the main Angora area, such as Dundee District, Natal and Basutoland, and that he should tour with the Stud-book Inspectors of the Angora Goat Breeders' Society.

The Angora Goat Expert of South Africa has already been in touch with influential Angora breeders in that country, who have assured him that the officer sent would be most welcome. The Angora Goat Breeders' Stud-book Association have gladly promised all assistance with regard to demonstrating their methods, and will permit the officer on deputation to accompany their Stud-book Inspectors on tour.

6. The financial aspect of this proposal is as follows:—

|   | Rs.    |
|---|--------|
| (a) Return First Class Passage of an officer of the Punjab Veterinary Service (Class 1), Bombay to Cape Town . . . . .                  | 1,600  |
| (b) Salary, 12 months in South Africa and 2 months on journey to and fro . . . . .  | 18,200 |
| (c) Deputation allowance at £1 <i>per diem</i> for 12 months (figure obtained from South Africa which is an expensive country). . . . . | 4,866  |
| (d) Travelling allowances, fees, films, stationery, etc., in South Africa, say . . . . .  | 4,334  |
| Total . . . . .   | 29,000 |

7. It is, therefore, requested that this amount may be placed at the disposal of the Punjab Government, by the Imperial Council of Agricultural Research, as a lump sum grant for the purpose indicated herein.

## APPENDIX XXIV.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 2nd January 1936, on Subject No. 23:—Application from the Government of Travancore for a grant for a scheme for improving the cattle in the West Coast of India, at a cost of Rs. 2,89,136, spread over a period of ten years.**

Attention is invited to the enclosed copy of a letter No. 2757 of 35 Development, dated the 2nd December 1935, forwarding a Scheme for the improvement of Cattle in the Travancore State. The Scheme involves an estimated cost of Rs. 2,89,136 (Rs. 25,000 non-recurring and Rs. 2,64,136 recurring) spread over a period of ten years. The Council has been asked for a grant of Rs. 1,57,400, the balance to be met by the Travancore Government. The Scheme will be placed before the Cattle Breeding Committee of the Council and its report will be submitted to the Advisory Board in due course.

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COPY OF A LETTER No. 57 of 1935/DEVELOPMENT, DATED THE 2ND DECEMBER, 1935, FROM THE CHIEF SECRETARY TO GOVERNMENT, TRIVANDRUM, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.

With reference to your letter No. F.-2 (10)/35/G., dated the 2nd October 1935, I have the honour to forward herewith a Scheme (Enclosure I) for the improvement of cattle in the State, for consideration at the thirteenth meeting of the Advisory Board of the Council proposed to be held from February 10th to 15th, 1936.

## ENCLOSURE I.

## A SCHEME FOR THE IMPROVEMENT OF CATTLE ON THE WEST COAST OF INDIA.

The prosperity of the Indian agriculturist is intimately bound up with that of his cattle. Bullocks supply him with the motive power for all operations, be it at the plough, or the cart or the waterlift. Other sources of power exist only in very few places and even these are not cheap enough for agricultural purposes. Their installation is further prohibited by the small holdings and meagre resources of the average ryot. Hence he will have to depend upon his bullocks for a long time to come. The cows which breed these bullocks yield also milk which together with its products constitutes almost the only animal food most Indians consume.

2. Cattle of the West Coast are, however, notoriously poor. The cows are poor milkers. They do not yield sufficient milk for domestic consumption, which in consequence is a deplorably rare luxury for the majority of the poor people. The bullocks are very puny and weak and on this account, the ryot is generally unable to adopt and make use of many of the modern efficient and labour-saving implements which are now so plentiful in the markets. He has to stick to his crude oil implements which work more slowly and less efficiently at a higher cost. Any serious effort to

improve agricultural practices must therefore embrace the restocking of the country with a better breed of cattle. The problem of livestock improvement is of vital importance and has to be tackled with all earnestness.

3. The cattle in the country may be improved either by replacing the stock with superior breeds imported from foreign countries or by selecting the best among local cattle and grading them up. The results of experiments carried out in various parts of India in the past have proved that it is unwise to import foreign cattle. The climate of the country is very trying, under which conditions imported animals are readily attacked by several malignant diseases, and they rapidly deteriorate or even die. Hence the only alternative is to grade up the local stock.

4. There exist in India several good breeds of fairly satisfactory dual purpose animals. Of these the Scindhi has been found to be the best adopted to the West Coast conditions. Cattle of this breed have been successfully introduced into all the West Coast Districts. There exist small herds of dairy cows of this breed in all experiment farms along this coast. The bulls siring these herds have been serving local cows also and the progeny has always been very satisfactory.

5. Though Scindhi Cattle have thus proved themselves admirably adapted to West Coast conditions, there has never been any organised effort to grade up local cattle. Breeding work was neither systematic nor continuous. There were too few good bulls in any tract and even where they were available, all cows were not brought to them; not even the same cow on all occasions. There were a host of scrub bulls roaming about in country herds and these served even the progeny of the crosses. Thus any improvements resulting from the crossing was allowed to dissipate. It is therefore proposed now to start systematic breeding work in a selected area and let it radiate out in an ever-widening circle.

6. For several reasons, the Municipal Town of Trivandrum will be the best centre to start this work. The cows maintained within this area are better than local cows to be found anywhere else as their well-to-do owners select the best from all over the country. These cows are better fed and more sanitarily housed than elsewhere. The owners may be expected to realise more readily the advantages of a good sire and may, therefore, heartily co-operate with the scheme by voluntarily ridding the area of all scrub bulls and by putting themselves to some trouble and even expense to get their cows served by good bulls. The progeny may thus be kept pure and dissipation of results avoided. In any case of emergency, the Municipal authorities may be counted upon to help the scheme by introducing and enforcing necessary legislation.

7. The work is proposed to be started with 25 selected Scindhi bulls and 12 cows. A census of all the local cows within the Municipal limits will be taken and an area marked out within which there will be about 1,500 cows. Arrangements will be made with the owners to improve the feeding and housing of these cows wherever necessary. All scrub bulls within this area will be castrated. A pair of bulls will be stationed in each of 12 stalls to be specially constructed for them in different parts of the area taken up for work. Each pair of bulls will be in charge of a keeper and all these together under a Sub-Inspector. The cows will be stationed in the farm to be established outside the Municipal limits. One of the bulls will also be stationed in this farm, which will be



under another Sub-Inspector. An Overseer with some training in Veterinary matters will look after the health of the animals, calling in the assistance of the officers at the Trivandrum Veterinary Hospital in all serious cases. A Senior Agricultural Inspector with special training and experience in livestock work will be put in charge of the whole scheme.

8. Every succeeding year four new bulls will be imported to supplement the stock and replace those which are worn out. The bull calves born on the farm will also be carefully reared up to serve as breeding bulls. Two new stalls will be constructed in each year and four fresh cows added to the stock at the farm. The sphere of operations will be steadily expanded as the strength of the stock increases. A regular herd register will be maintained for all the cows and their progeny and the bulls will be shifted each year from one stall to another in a regular cycle.

9. A statement showing the cost of working the scheme for the first ten years of its operation is appended. The stalls are to be built within the Municipal limits and hence the sites will be rather costly. The sites for the farm and stalls will together cost Rs. 55,000, the buildings and equipment Rs. 9,950, the livestock Rs. 22,450, the salary and allowances to the staff Rs. 76,736 and the maintenance of the stock Rs. 1,05,000. A provision of Rs. 20,000 is made for various contingent expenditure making a total of Rs. 2,89,136, for the 10-year-period.

10. This is a novel experiment, the results of which will be of immediate practical benefit to the whole of the West Coast. It is certain to lead to many scientific observations which will be of even wider and more general application.

11. The Travancore Government will provide the sites for the farm and the stalls and meet the cost of the staff, which together aggregate to nearly one half of the total cost. It is requested that the Imperial Council may be pleased to sanction a research grant of Rs. 1,57,400 spread over a period of ten years to provide the balance of the funds required for the work.

## Statement of costs for working the

| Nos.                       | Items.  | 1st year. |            | 2nd year. |            | 3rd year. |            | 4th year. |            |
|----------------------------|---|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
|                            |   | No.       | Cost (Rs.) | No.       | Cost (Rs.) | No.       | Cost (Rs.) | No.       | Cost (Rs.) |
| <i>Land and buildings.</i> |   |           |            |           |            |           |            |           |            |
| 1                          | Site for the Farm 250 acres at Rs. 100.           | 250       | 25,000     | ...       | ...        | ...       | ...        | ...       | ...        |
| 2                          | Site for bull stalls at Rs. 1,000 each.           | 12        | 12,000     | 2         | 2,000      | 2         | 2,000      | 2         | 2,000      |
| 3                          | Bull stalls at Rs. 150 each.                      | 12        | 1,800      | 2         | 300        | 2         | 300        | 2         | 300        |
| 4                          | Cow shed  | 1         | 1,000      | ...       | 200        | ...       | 200        | ...       | 200        |
| <i>Live stock.</i>         |   |           |            |           |            |           |            |           |            |
| 5                          | Breeding bulls at Rs. 250 each.                   | 25        | 6,250      | 4         | 1,000      | 4         | 1,000      | 4         | 1,000      |
| 6                          | Cows at Rs. 150 each                              | 12        | 1,800      | 4         | 600        | 4         | 600        | 4         | 600        |
| <i>Staff.</i>              |   |           |            |           |            |           |            |           |            |
| 7                          | Agricultural Inspector on Rs. 150 per month.      | 1         | 1,800      | 1         | 1,800      | 1         | 1,800      | 1         | 1,800      |
| 8                          | Sub-Inspectors on Rs. 50 per month.               | 2         | 1,200      | 2         | 1,200      | 2         | 1,200      | 2         | 1,200      |
| 9                          | Overseer (Veterinary) on Rs. 20—1/2—25 per month. | 1         | 240        | 1         | 240        | 1         | 252        | 1         | 252        |
| 10                         | Clerk Rs. 20—1/2—25 per month.                    | 1         | 240        | 1         | 240        | 1         | 252        | 1         | 252        |
| 11                         | Peons on Rs. 9—1/6—11 per month.                  | 2         | 216        | 2         | 216        | 2         | 216        | 2         | 216        |
| 12                         | Bull keepers on Rs. 10 per month.                 | 14        | 1,680      | 16        | 1,920      | 19        | 2,280      | 21        | 2,520      |
| <i>Allowances.</i>         |   |           |            |           |            |           |            |           |            |
| 13                         | Travelling allowance to the staff.                |           | 500        |           | 500        |           | 500        |           | 500        |
| 14                         | Cycle allowance to the Overseer.                  |           | 120        |           | 120        |           | 120        |           | 120        |
| 15                         | Office rent                                       |           | 300        |           | 300        |           | 300        |           | 300        |
| <i>Equipments.</i>         |   |           |            |           |            |           |            |           |            |
| 16                         | Furniture, vessels, etc.                          |           | 300        |           | 150        |           | 150        |           | 150        |
| 17                         | Books and periodicals                             |           | 100        |           | 100        |           | 100        |           | 100        |
| 18                         | Contingencies                                     |           | 2,000      |           | 2,000      |           | 2,000      |           | 2,000      |
| 19                         | Feeding charges                                   |           | 6,000      |           | 7,000      |           | 8,000      |           | 9,000      |
|                            | Total for the year                                |           | 62,546     |           | 19,886     |           | 21,270     |           | 22,510     |
|                            | Grand total to the end of the year.               |           | 62,546     |           | 82,432     |           | 1,03,702   |           | 1,26,212   |

## Cattle Improvement Scheme for ten years.

| 5th year. |            | 6th year. |            | 7th year. |            | 8th year. |            | 9th year. |            | 10th year. |            | Total<br>(Rs.) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|-----------|------------|------------|------------|----------------|
| No.       | Cost (Rs.) | No.       | Cost (Rs.) | No.       | Cost (Rs.) | No.       | Cost (Rs.) | No.       | Cost (Rs.) | No.        | Cost (Rs.) |                |
| ...       | ...        | ...       | ...        | ...       | ...        | ...       | ...        | ...       | ...        | ...        | ...        | 25,000         |
| 2         | 2,000      | 2         | 2,000      | 2         | 2,000      | 2         | 2,000      | 2         | 2,000      | 2          | 2,000      | 30,000         |
| 2         | 300        | 2         | 300        | 2         | 300        | 2         | 300        | 2         | 300        | 2          | 300        | 4,500          |
| ...       | 200        | ...       | 200        | ...       | 200        | ...       | 200        | ...       | 200        | ...        | 200        | 2,800          |
| 4         | 1,000      | 4         | 1,000      | 4         | 1,000      | 4         | 1,000      | 4         | 1,000      | 4          | 1,000      | 15,250         |
| 4         | 600        | 4         | 600        | 4         | 600        | 4         | 600        | 4         | 600        | 4          | 600        | 7,200          |
| 1         | 1,800      | 1         | 1,800      | 1         | 1,800      | 1         | 1,800      | 1         | 1,800      | 1          | 1,800      | 18,000         |
| 2         | 1,200      | 2         | 1,200      | 2         | 1,200      | 2         | 1,200      | 2         | 1,200      | 2          | 1,200      | 12,000         |
| 1         | 264        | 1         | 264        | 1         | 276        | 1         | 276        | 1         | 288        | 1          | 288        | 2,640          |
| 1         | 264        | 1         | 264        | 1         | 276        | 1         | 276        | 1         | 288        | 1          | 288        | 2,640          |
| 2         | 216        | 2         | 216        | 2         | 240        | 2         | 240        | 2         | 240        | 2          | 240        | 2,256          |
| 24        | 2,880      | 26        | 3,120      | 29        | 3,480      | 31        | 3,720      | 34        | 4,080      | 36         | 4,320      | 30,000         |
|           | 500        |           | 500        |           | 500        |           | 500        |           | 500        |            | 500        | 5,000          |
|           | 120        |           | 120        |           | 120        |           | 120        |           | 120        |            | 120        | 1,200          |
|           | 300        |           | 300        |           | 300        |           | 300        |           | 300        |            | 300        | 3,000          |
|           | 150        |           | 150        |           | 150        |           | 150        |           | 150        |            | 150        | 1,650          |
|           | 100        |           | 100        |           | 100        |           | 100        |           | 100        |            | 100        | 1,000          |
|           | 2,000      |           | 2,000      |           | 2,000      |           | 2,000      |           | 2,000      |            | 2,000      | 20,000         |
|           | 10,000     |           | 11,000     |           | 12,000     |           | 13,000     |           | 14,000     |            | 15,000     | 1,05,000       |
|           | 23,894     |           | 25,134     |           | 26,342     |           | 27,782     |           | 29,166     |            | 30,406     |                |
|           | 1,50,106   |           | 1,75,240   |           | 2,01,782   |           | 2,29,564   |           | 2,58,730   |            | 2,89,136   |                |

## APPENDIX XXV.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 20th January 1936, on Subject No. 45:—Establishment of Pedigree Herd Books in India.**

Attention is invited to the attached note (enclosure) by the Animal Husbandry Expert to the Council on the Establishment of Pedigree Herd Books in India.

2. The note will be first considered by the Standing Cattle Breeding Committee and its recommendations will be placed before the Advisory Board in due course.

## ENCLOSURE.

*Establishment of Pedigree Herd Books in India.*

This subject has received the attention of the Council for nearly three years. In February 1933 the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry in India considered it and resolved that All-India Herd Books should be established in the case of a few well-known dairy breeds commencing with the breeds at present maintained on Government Farms and other Institutions where reliable records are kept. In the case of other breeds the Board recommended that provincial herd registration should precede the more detailed individual records needed for pedigree dairy stock.

2. In February of the following year the Standing Cattle Breeding Committee of the Council went further into the question and considered that the first step in establishing pedigree registers would be to carry out an all-India survey to decide (a) which of the present so-called breeds are valid breeds and worthy of organised development, and (b) to decide on an official definition of the breed characteristics of each breed which it is proposed to recognise.

3. With a view to defining the breed characteristics the Secretariat of the Council subsequently addressed all Provinces and Constituent States requesting them to furnish the necessary information in regard to those breeds in their respective provinces which they consider worthy of registration as pure indigenous breeds. With the exception of Bhopal and Hyderabad States all the addressees have replied to the circular. But only Burma, Baroda, Madras and Central Provinces have furnished detailed information. Relevant extracts from their letters are given in the Annexure. These contain details about Burmese cow in Burma, the Gir and Kankrej in Baroda, Ongole and Kangayam in Madras and the Gaolao in Central Provinces.

The Punjab Government is conducting a series of Veterinary Surveys but some considerable time must elapse before the necessary information becomes available. Bombay favours the appointment by the Central Government of a special itinerating officer or Committee for the collection of the necessary information, and considers that, since certain breeds are known by different names in different provinces, provincial attempts to define breed characteristics will not be successful.

The remaining Provinces consider their existing breeds as unworthy of registration and do not therefore furnish any information.

4. Subsequent to the issue of the above circular a proposal for the appointment of Provincial Committees for the purpose of defining breed

characteristics was placed before the Cattle Breeding Committee and the Advisory Board in February 1935. This Committee after discussion recommended the appointment of a special officer. The Advisory Board, however, negated this recommendation; and as regards appointment of Provincial Committees, the Board deferred decision till replies from Local Governments had been received.

5. As will be seen from the above the subject has been on the tapis for nearly three years and has not yet assumed definite shape. The matter is an urgent one and I would like to have it placed again before the Cattle Breeding Committee to obtain a fresh recommendation likely to be acceptable to the Advisory Board, which could be put into action early. The points which the Cattle Breeding Committee may consider specifically are:—

1. To decide which dairy breeds are of sufficient importance to warrant the maintenance of pedigree herd books at the Centre.
2. To decide how the definition of breed characteristics of these selected breeds is to be carried out.

I propose that when the characteristics of the accepted breeds have been authoritatively defined they should be published by the Council in the form of a brochure and that Pedigree Herd Books should be started and maintained by the Animal Husbandry Bureau of the Council, in collaboration with the Provinces and States concerned, in order to encourage the development of these breeds over as wide an area as possible.

A. OLVER,  
Colonel.

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#### ANNEXURES.

(a)

EXTRACT FROM A LETTER No. 424-0-34, DATED THE 23RD MAY 1935, FROM  
THE SECRETARY TO THE GOVERNMENT OF BURMA, FOREST DEPARTMENT,  
TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

\* \* \* \* \*

(6) Burmese cows are not accustomed to milking except at a very limited area known as Dada-U and Nga-zun near Sagaing in Upper Burma where *ghi* manufacturing is carried on. No experiments have been carried out recently. But six pure Burmese cows from these areas were stall-fed and milked twice daily at the experimental dairy run at Mandalay from 1914—1918.

Average milk yield per day was about 3 pounds.

Maximum daily yield was as high as 7 pounds.

Average fat percentage was 5, but the milk of one particular cow was as high as 8.5 per cent. though its daily milk yield was above average.

Days in milk were from 8 months to 13 months.

Frequency of calving under the experimental conditions was 12-13 months.

Reported from Tatkôn Stock Breeding Farm—13 months and 11 days.

Under village condition—12 months.

The following is the statement of the analyses of the milk of Burmese cows in the villages round about Mandalay as recorded in the Agricultural Department Bulletin No. 15 of 1917 by F. J. Warth, M.Sc., Agricultural Chemist, Burma, Mandalay.

| Sample No. and locality. | Age of calves (Months.) | Milk yield per day. | Specific gravity. | Freezing point. | Per cent Nitrogen. | Per cent Proteid. | Per cent Fat. | Per cent Total solids. | Total solids not fat per cent. |
|--------------------------|-------------------------|---------------------|-------------------|-----------------|--------------------|-------------------|---------------|------------------------|--------------------------------|
| 5 East . . .             | 3                       | Lbs.<br>6'0         | 1'030             | —'553           | '5265              | 3'361             | 5'76          | 14'25                  | 8'49                           |
| 6 East . . .             | 3                       | 8'5                 | 1'032             | —'535           | '4739              | 3'023             | 4'41          | 14'25                  | 8'83                           |
| 7 East . . .             | 1                       | 6'5                 | 1'032             | —'550           | '5867              | 3'743             | 6'05          | 15'09                  | 9'04                           |
| 8 East . . .             | 3                       | 6'0                 | 1'030             | —'545           | '5318              | 3'393             | 5'45          | 15'09                  | 9'64                           |
| 5 North . . .            | 2                       | 5'0                 | 1'031             | —'543           | '6616              | 4'221             | 5'82          | 12'12                  | 6'80                           |
| 8 North . . .            | 1                       | 5'0                 | 1'030             | —'556           | '6302              | 4'021             | 6'37          | 13'83                  | 7'46                           |
| 5 West . . .             | 2                       | 5'0                 | 1'036             | —'555           | '7528              | 4'803             | 4'41          | 14'00                  | 9'59                           |
| 6 West . . .             | 4                       | 4'0                 | 1'035             | —'542           | '7046              | 4'495             | 3'75          | 13'26                  | 9'51                           |
| 7 West . . .             | 6                       | 5'0                 | 1'035             | —'540           | '7217              | 4'605             | 3'64          | 13'21                  | 9'57                           |
| 8 West . . .             | 6                       | 4'0                 | 1'036             | —'535           | '8148              | 5'198             | 4'94          | 15'54                  | 10'60                          |
| 5 South . . .            | 2                       | 3'5                 | 1'034             | —'545           | '5365              | 3'423             | 3'73          | 13'75                  | 9'52                           |
| 6 South . . .            | 5                       | 3'5                 | 1'032             | —'540           | '5797              | 3'698             | 4'23          | 13'40                  | 9'17                           |
| 7 South . . .            | 2                       | 5'0                 | 1'031             | —'550           | '7162              | 4'566             | 6'98          | 16'12                  | 9'14                           |
| 8 South . . .            | 2½                      | 3'5                 | 1'035             | —'550           | '6209              | 3'961             | 3'71          | 13'34                  | 9'63                           |
| Average . . .            |                         | 5'04                |                   | —'546           |                    | 4'026             | 4'91          | 14'05                  | 9'14                           |
|                          | *                       | *                   | *                 | *               | *                  | *                 | *             |                        |                                |

(b)

EXTRACT FROM A LETTER No. 2690.2.34-35, DATED THE 8TH JUNE 1935, FROM THE DIRECTOR OF AGRICULTURE, BARODA STATE. BARODA, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

### Report.

Baroda territory is very irregularly intercepted by the British districts of the Bombay Presidency and the other Indian States, thus influencing the local cattle breeds to a great extent.

The Mehsana breed of buffaloes is the result of such influence by the Sindh and the Punjab buffaloes via Radhanpur State. The Murrah breed after various crosses in the Mehsana district has maintained the same typical head and horns of the breed but has deteriorated in milk yield and size. This, after long breeding at this place has become a fixed type.

The original breeds of the Baroda State as have been recorded for a long time and which stand to a certain extent to-day are the Gir and Kankrej in cows and the Charotar and the Mehsana in buffaloes.

*The Gir Breed.*—This breed is originally traced from the Gir jungle of Kathiawar. This forest covers an area of 52 miles by 10 miles strip

of land. This breed of cattle is supposed to do well in that particular area but deteriorates when removed.

| Particulars of the breed.           |            | Deviation. |
|-------------------------------------|------------|------------|
| Height behind hump . . . . .        | 4'-5"      | 5"         |
| Girth . . . . .                     | 8'-6"      | 10"        |
| Weight . . . . .                    | 800 lbs.   | 100 lbs.   |
| Measurements below knee . . . . .   | 0'-11"     | 2"         |
| Average milk yield . . . . .        | 4,000 lbs. | 1,500 lbs. |
| Fat percentage . . . . .            | 5.5%       | 1%         |
| Days in milk . . . . .              | 350        | 100        |
| Interval between calvings . . . . . | 500 days.  | 100 days.  |

*Colour.*—The chief colour of the breed is red with a mixture of red and white locally known as "Galakadi" which is much appreciated. A mixture of black and white is seldom to be found and is not accepted as breed colour.

*Conformation.*—The body built is of beef type with a characteristic head of the breed. The forehead is very broad, convex and prominent. The horns are very much separated. The distance between them being to about 1 foot 6 inches and are pressed away downwards with a curve to a upward turn. The ears are typically long and pendulous with turns in tips occasionally meeting under the jaw. The sheath and dewlap being well developed and hanging. The general appearance of the original Gir cattle is little rough but the Kathiawar which appears better is the more domesticated and little deteriorated form of the same.

*Note.*—The maximum milk yield noted in a typical cow was 5,500 lbs. in a single lactation of 540 days.

*The Kankrej Breed.*—This breed originated from the Kankrej district lying to west of over Mehsana district with the river Banas as its southern boundary.

| Particulars.                       |            | Deviation. |
|------------------------------------|------------|------------|
| Height . . . . .                   | 4'-8"      | 4"         |
| Girth . . . . .                    | 5'-9"      | 7"         |
| Weight . . . . .                   | 850 lbs.   | 200 lbs.   |
| Measurement below knee . . . . .   | 1'-1"      | 2"         |
| Average milk yield . . . . .       | 2,000 lbs. | 1,000 lbs. |
| Days in milk . . . . .             | 250        | 60         |
| Butter fat . . . . .               | 4%         | 1%         |
| Interval between calving . . . . . | 500 days.  | 100 days.  |

*Note.*—One best bullock measured 60 inches behind hump with a girth of 7'-4" and the weight 1,200 lbs. One best bull recently purchased from the Kankrej district measured 56 inches with a girth of 8'-6".

*Conformation.*—This breed of cattle are tall with a particularly well-carried head. The face is typical of its kind measuring about 20 inches long with the upper half practically square, set in with prominent eyes about 10" apart. The horns spring from the upper ridge which is prominent. The base of the horns is covered with skin up to 2 to 3 inches. They are curved outwards and upwards roughly forming equal

semi-circles with tips directed backwards. The shape is locally known as "kundla". The ears are fairly long. The animals are very proportionately built, and with a well-carried head and short neck present a very majestic appearance when in good condition.

*Colours.*—The accepted colour is white, silver grey and iron grey, with the front of the forearms, knee, fet-locks pastures and the tuft of the tail being generally black.

*The Charotar Buffalo.*—This is a medium sized animal and is the same as Surat buffalo breed. All the other breeds of this State are common with the breeds of the surrounding districts of the Bombay Presidency.

\* \* \* \* \*

(c)

EXTRACT FROM A LETTER NO. 5266-III/35-1, DATED THE 19TH DECEMBER 1935, FROM THE GOVERNMENT OF MADRAS, DEVELOPMENT DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

(ANNEXURE 1.)

INFORMATION FROM OFFICIAL SOURCE.

*Ongole Breed.*

|  | Ongole bull. | Ongole cow. | Permissible deviation. |              |
|--|--------------|-------------|------------------------|--------------|
|  |              |             | Bull.                  | Cow.         |
| (1) Average height behind hump . Inches.         | 58½          | 52          | 57 to 60               | 51 to 53     |
| Height at croup ..                               | 61           | 54½         | 60 to 62               | 53 to 56     |
| Girth of chest ..                                | 82           | 68          | 80 to 85               | 67 to 69     |
| Weight . lbs.                                    | 1,250        | 900         | 1,150 to 1,300         | 800 to 1,000 |
| (2) Average length of shank of foreleg . Inches. | 8½           | 8½          | 8 to 9                 | 8 to 9       |

(3, 4 and 5).—The characteristics of the Ongole breed are:—

*Head.*—Should not be too big or heavy; face moderately long; muzzle well developed with fairly wide nostrils, black in colour; forehead broad with well-set bright eyes, elliptical in shape with dark eye lashes, a ring of black skin about ¼ inch wide round the eyes; the ears moderately long and slightly drooping; horns short and inclined to be stumpy and turning sideways or backwards. In cows the horns are longer and thinner than in bulls and are directed outwards and slightly backwards. The horns should not be split at the base.

*Neck.*—Short and thick.

*Dewlap.*—Fleshy and hanging in folds, extends to the navel.

*Hump.*—Well developed and erect; if at all it leans, it should be to the right and not to the left; better if it is filled up on sides and not concave.



*Body*.—Massive, long and deep, but some are inclined to be flat sided; in fine specimens, the girth behind the hump is 84 inches and height behind the hump 63 inches.

*Chest*.—Deep and wide, broad between the forearms.

*Barrel*.—Long and deep with well arched ribs equal in number on both sides.

*Back*.—Of moderate length, broad and slightly higher at the croup; the sides from the point of the croup should not be sloping, but fairly level; so also the slope from the line of croup towards the tail should be gentle and not prominent.

*Quarters*.—Strong, with a gentle droop towards the root of tail; broad loin, rump broad and long.

*Sheath*.—Pendulous but not too much; well tucked up and thin black hairs on the tip; cows have also a fold of skin in the position of the sheath.

*Tail*.—Thick at the base without coarseness; long and tapering finely to a full switch, which is black. The tip of the tail should reach or just beyond, the point of the hook.

*Anus*.—The hollow under the tail should be wide, well inside the points of the buttocks, but the anus should protrude out sufficiently, so that the dung may fall clear from the surface of the body.

*Thighs*.—Muscular, well developed and deep.

*Legs*.—Strong and somewhat coarse; not too long, straight with strong shoulders, and set wide apart firmly and squarely under the body; toes pointing straight

*Feet*.—Large and somewhat soft looking; the cleft should be closely set in all the four as far as possible.

*Height*.—Should possess good height, measuring on an average 56 to 62 inches when full grown from ground level to the back behind the hump.

*Hair and hide*.—Hair fine and smooth, black skin of medium thickness. mellow and loose.

*Colour and markings*.—White or greyish with black or dark grey markings on the hump, neck and quarters, black muzzle, black markings on the knees and above the fetlocks on fore and hind legs. Some animals have grey patches or spots showing through their white coats. A few are red and white in colour but are not appreciated as breeding bulls.

|                                   | Village conditions. | Special conditions. |
|-----------------------------------|---------------------|---------------------|
| (6)                               |                     |                     |
| Average milk yield . . . . . lb.  | 2,500               | 3,500               |
| Maximum daily yield . . . . . lb. | 15                  | 28                  |
| Fat percentage . . . . .          | Not known.          | 4.3                 |
| Days in milk . . . . .            | 240                 | 300                 |
| Frequency of calving . . . . .    | 24 months.          | 15 months.          |

(7) Photographs separately sent.

(8) *Special points*.—Cow No. 95 yielded 7,190 lb. with a daily average of 21.5 lb. and has averaged for three lactations 5,618 lb. with a daily average of 17.1 lb.

## Kangayam Breed.

|  | Kangayam. |      | Permissible deviation. |            |
|--|-----------|------|------------------------|------------|
|  | Bull.     | Cow. | Bull.                  | Cow.       |
| (1) Average height behind hump . Inches.         | 50½       | 47½  | 49½ to 52              | 46 to 49   |
| Height at croup ..                               | 54        | 50   | 53 to 55               | 49 to 51   |
| Girth of chest. ..                               | 76        | 65   | 74 to 78               | 63 to 67   |
| Weight . lb.                                     | 1,100     | 800  | 1,050 to 1,150         | 750 to 850 |
| (2) Average length of shank of foreleg . Inches. | 7         | 7    | 6½ to 7½               | 6½ to 7½   |

(3, 4 and 5).—A description of the breed is as follows:—

*Head.*—Short with broad level forehead, eyes dark and prominent, ears short and erect. Horns in the smaller variety are spreading apart, straight with a slight curve backwards, short and thick with sharp points. In the larger variety the horns are much longer, curve outwards and backwards and almost complete a circle at the point where they approach the tips.

*Neck.*—Short and thick.

*Hump.*—Fairly well developed.

*Dewlap.*—Thin and extending to the sternum only.

*Body.*—Compact and well ribbed up.

*Back.* Short, broad and level.

*Quarters.*—Strong and slightly drooping.

*Sheath.*—Not pendulous, well tucked up to the body.

*Tail.*—Moderately long and thin and tapering with a good switch of hair (black).

*Legs.*—Short and of good bone.

*Feet.*—Small and hard.

*Hair and hide.*—The hair is fine and short and the skin is black.

*Colour and markings.*—Bulls are grey in colour with black or very dark grey colouring on the head, neck, hump and quarters. In the cows the prevailing colour is white and grey with black markings on the knees and just above the fetlocks on all four legs. They have a black ring around the eyes. The teats are flesh coloured or mottled. Some cows are found which are fawn, red, black and broken colours, but these are not desirable.

| (6)                            |     | Village conditions. | Special conditions. |
|--------------------------------|-----|---------------------|---------------------|
| Average milk yield . . . . .   | lb. | 1,000               | 1,800               |
| Maximum daily yield . . . . .  | lb. | Not known.          | 19½                 |
| Fat percentage . . . . .       |     | Not known.          | 4.4                 |
| Average days in milk . . . . . |     | 150                 | 240                 |
| Frequency of calving . . . . . |     | 18 months.          | 14½ months.         |

(7) Photographs separately sent.

(8) *Special points.*—One Kangayam cow has yielded 4,105 lb. with a daily average of 10.9 lb. This cow has averaged for 8 lactations an average yield of 3,471 lb. with a daily average of 11.4 lb.

## (ANNEXURE 2.)

INFORMATION OBTAINED FROM PRIVATE BREEDERS.

*Ongole Breed.*

|  | Ongole<br>Bull.  | Ongole<br>Cow. | Permissible deviation. |          |
|--|--|----------------|------------------------|----------|
|  |  |                | Bull.                  | Cow.     |
| (1) Average height behind hump . Inches.         | 59   | 54             | 57 to 64               | 50 to 58 |
| Height at croup ..                               | 63   | 57             | 60 to 67               | 53 to 61 |
| Girth of chest . . .                             | Local breeders are not accustomed to take this measurement and hence have no idea. |                |                        |          |
| Weight . . . . .                                 | Ditto.   |                | Ditto                  |          |
| (2) Average length of shank of foreleg . Inches. | 9  | 10             | 10 to 14               | 8 to 12  |

*Head.*—Ears do not droop in good animals. Except this they have nothing to add or alter what is given in the main statement.

*Neck.*—Nothing to alter.

*Devlap.*—Will not be fatty or too big in good bulls.

*Body.*—In good animals the body is rounded and long. Except this they have nothing to add or alter. They have no idea of girth measurement. Height behind the hump in their opinion is about 60 inches in good bulls.

*Chest.*—Nothing to alter.

*Barrel.*—Nothing to alter.

*Back.*—In a good bull the base of the tail will not be too thick. In a good cow the tail is long extending beyond the hock.

*Quarters.*—Nothing to alter.

(d)

EXTRACT FROM A LETTER No. 1279/1032/XIV, DATED THE 8TH NOVEMBER 1935, FROM THE REVENUE SECRETARY TO GOVERNMENT, CENTRAL PROVINCES, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

*Gaolao Breed.*

*Origin.*—This is the only indigenous breed of the province and its name is apparently derived from the caste of professional milkmen—Gaolies. It is found in the foot hills of the Setpuras in the Wardha district the Sausar tahsil of Chhindwara and Korai pargana in the extreme South of Seoni.

(1) & (2).—Weight and measurements of typical animals of this breed on queries Nos. 1 & 2 are annexed.

(3) The usual colour is white, but in some cases may be bluish over the neck, face and hump. The head has a prominent convex profile. The face is long with tapering nose. Eyes are bright and prominent with black rims. Horns are short and blunt at the point, sloping backward. Ears are of medium size and droop slightly.

(A) *Indicating capacity*:—

*Muzzle*.—Wide.

*Jaw*.—Strong.

*Barrel*.—Long, cylindrical in shape, compact, well held-up, with ribs fairly far apart and broad.

(b) *Constitutional vigour and strength*:—

*Eyes*.—Prominent, bright and intelligent.

*Chest*.—Full and wide.

*Frame*.—The body is light and the legs rather long in proportion; the pasterns in particular are long and sloping; the fore-quarters are strong; the distance between the shoulder point is wide; the brisket prominent; the back is rather hollow behind the hump and rises to the croup; thighs and fore-arms are muscular; bone clean and fine.

*Skin*.—The coat is fine and silky. Skin loose and mellow.

*Carriage*.—Energetic, prompt and alert.

(c) *Milk secreting system*:

*Udder*.—Not big, evenly quartered and not fleshy. Teats squarely placed and of convenient size.

*Milk veins*.—Not very prominent, moderate length, and branching.

(d) *Temperament*.—Nervous and responsive.

(e) *Breed types*:

*Colour*.—Generally white.

*Temperament*.—Fiery but obedient and alert.

*Build of body*.—Slender, rather leggy, slightly wedge-shaped; graceful, majestic appearance. The animal always walks with head well up. Two types are found in this breed. Body conformation, quality, temperament, etc., are the same in both the types, but there is a marked difference in head and horns.

*Type A*.—Head broad with prominent convex profile.

*Horns*.—Thick at the base, rough and short with a tendency to slope backward.

*Type B*.—Head broad, fore-head bulging slightly.

*Horns*.—Horns of medium size and thickness with a tendency to slope backward, outward and upward, ends tapering.

(5) *Special characteristics of the breed.*—These have already been mentioned, namely—under 3 and 4. Bullocks of this breed are particularly suitable to fast road work, being speedy. They are however inclined to be weak in the loins and delicate in constitution. In heavy work they remain thin and leggy.

(6) The cows yield from 3 to 4 seers of milk per day; good animals give upto 5 seers.

Maximum yield per day—5 seers.

Fat percentage—4.5

Days in milk—270.

Frequency of calvings—430 days under well managed farm conditions and 540 days under village conditions.

(7) From its name it would appear that the cows of this breed were good milkers in the past, but in the careless breeding-methods followed by the local breeders no attention was paid to this quality. Some cows are still found giving 8 to 9 seers of milk as a maximum yield per day, but such cows are very rare. Efforts are being made at the Garhi Cattle-breeding Farm to develop a good milking strain and with this object in view, some cows have been very recently selected. Milk records are being maintained.

## APPENDIX XXVI.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 30th January 1936, on Subject No. 50:—Application from Khan Sahib Dost Mohammed Khan, Proprietor, Cattle Farm, Jehangirabad, for a grant of Rs. 720, spread over a period of two years for the appointment of a Milk Tester in his Zail.**

Attention is invited to the attached letter (Annexure) from Khan Sahib Dost Mohammed Khan, Proprietor, Cattle Farm, Jehangirabad, requesting for a grant of Rs. 720 for the appointment of a Milk Tester, on Rs. 30 (including all allowances), per month, for a period of two years, for checking the performances and entries in his Zail.

2. The letter will be first considered by the Standing Cattle Breeding Committee and its recommendations (Appendix XX) will be placed before the Advisory Board in due course.

## ANNEXURE.

COPY OF A LETTER No. 12/J., DATED THE 11TH JANUARY 1936, FROM KHAN SAHIB DOST MOHAMMED KHAN, PROPRIETOR, CATTLE FARM, JEHANGIRABAD, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

I am very much thankful to you for your letter Nos. F.-12/35-V, and F.-28/35, Vet., dated 23rd November 1935 and 20th December 1935, respectively. The delay in reply is to be excused.

I have arranged a Cattle Breeding Committee in my Zail and have selected 5 members for the said committee. The members are requested to use the History sheet forms for the milch cattle with them, with which they will be able to know the value of their cattle. I have assured them that keeping of such records is a very useful thing for them. After trying full two months the members have now promised to help this scheme and pay special attention in the matter. I will be sending you a few history sheet forms of my own cows duly filled in, in a day or two which may very kindly be put before the Standing Dairying Committee for further instructions. But I would strongly propose that, until and unless these records are checked by some responsible person the people at present interested in the matter will not take further pain to continue such milk records in future. The checking system of milk records on my farm is, that, the Director, Veterinary Services, Punjab, has issued instructions to the V. A. S. Khanewal Dispensary which is at the distance of 15 miles from my farm to visit each Friday and get the cows milked in his presence and record their milk yields in the milk recording register with his own pen. In this system there can be no possibility of the milk records being unreliable. For an experiment I also deputed one of my brothers and my manager Sh. Mohammed Umar to visit a few villages of my Zail and see if the members of the Cattle Breeding Committee were doing some work in their villages.

They have visited 10 villages twice and have checked the milk yield of the cows with the Zimindars (now members of the cattle breeding committee). The yield of milk of their best cows was 3 to 4 lb. in the morning and 5 lb. in the evening. My manager gave them some useful instructions about milking and feeding their cows and buffaloes on his visit and

found some increase in the milk yield on his next visit. He has also suggested to select at least 50 cows out of my farm cows, viz., 500 and feed them very properly which must give good result to their milk yields. I have agreed to his proposal and have allowed him to start this experiment before April 1936 and increase this special herd of cows to about 100 in the next two years.

Similarly I wish to introduce this practice of milk recording in my Zail which contains 25 villages and are within the radius of 10 miles from my Farm. People of this *Ilaqa* generally keep different breeds with them. I may again point out that without having proper check, no zimindar can keep reliable records, though they will have no objection to submit statements after every two months as desired in your letter No. 12,85/Vet., dated 23rd November. I would suggest that each Zimindar willing to keep milk records of their cattle may be supplied the attached forms to fill in and submit to my office monthly to enable me to forward the same to your office for further action. If no objection to the Government of India I would suggest that a sum of Rs. 720 for a period of two years may kindly be sanctioned which amount will be paid to the gentleman who will visit the village cows and check their milk yields twice a week and submit his reports to the Government. He will be paid Rs. 30 per month including his travelling allowance and cost of stationery, etc., etc.

I hope this proposal will be favourably considered by the members. This letter may very kindly be acknowledged for which I am thanking you in anticipation.

P.S.—I have also supplied a few history sheet forms to K. S. Ch. Alla Dad Khan at Jahanian who is also one of the grantees. He is requested to use these forms for his farm cows.

## APPENDIX XXVII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 25th January 1936, on Subject No. 13:—Application from the Government of Bombay for a grant of Rs. 78,650 spread over a period of five years for a Scheme for Improvement of Papaya Breeding and Cultural Practices.**

Attention is invited to (i) the note for the Advisory Board, dated the 22nd January 1935 (Enclosure I) regarding the scheme mentioned above; (ii) the report of the Fruit Committee thereon (Enclosure II) and (iii) extracts from the proceedings of the Advisory Board, February 1935 (Enclosure III). (Enclosures I to III not printed. See Appendices XXI and XXI-A. and pages 17—21 of the Proceedings of the Advisory Board held in February 1935.) The Advisory Board considered that a good deal of useful work had been done on the subject which had not perhaps received full publicity so far and decided that the author of the scheme should be asked to make a further study of previous literature on the subject and to furnish a report. The Economic Botanist to Government, Bombay, has since consulted two references mentioned by Dr. Agharkar and also previous literature on papaya breeding. Two reports submitted by him are now attached. (Enclosures IV and V.)

The scheme together with the supplementary information now furnished will be considered in the first instance by the Fruit Sub-Committee of the Advisory Board at 2-00 P.M. on Tuesday the 11th February 1936. The Committee's report will be circulated to the Advisory Board in due course.

## ENCLOSURE IV.

COPY OF LETTER NO. E.B./357, DATED 29TH MARCH 1935, FROM THE ECONOMIC BOTANIST TO THE GOVERNMENT OF BOMBAY.

I have the honour to return the joint publication of Dr. Agharkar and Banerji on "The Development of the Embryo-Sac in *Carica Papaya*" with the following remarks:—

The paper gives the details of the development of the female gametophyte from the initial mother cell stage to the final embryo-sac stage. The study is confined to the stages leading to the formation and subsequent behaviour of the eight nuclei in an embryo-sac but throws no light whatever on the chromosome complex of the normal female plant and much less of the abnormal types. In the cytological studies proposed in the scheme on *Papaya* submitted to the Imperial Council of Agricultural Research, it was my intention to work out the similarity or otherwise of the chromosome complex of the different sex-forms in order to find out what relation, if any, it may bear to the inheritance of sex in *Papaya*, which latter also forms an item of the scheme. As a piece of pure histological work this paper has its value but from a cytogenetical point of view there is no information to be obtained from it.

I have also consulted Prof. Asana and Sutar's paper on "A Cytological study of pollen development in *Carica Papaya* Linn" in the Journal of the Indian Botanical Society and find that beyond giving a description of the different stages of the nuclear division and determining the number of chromosomes in the male plant, which are nine (9), even these authors fail to give the result of any comparative study of chromosomes of the two sexes and the abnormal types in regard to number, morphological



character and other peculiarities. It is on these points I should like to take up the investigation, if the Imperial Council of Agricultural Research would be good enough to furnish the grants.

As suggested by the Imperial Council of Agricultural Research, I shall write to various institutions for obtaining references to work done on different aspects of Papaya breeding.

ENCLOSURE V.

COPY OF LETTER NO. E. B.-702, DATED 19TH JUNE 1935, FROM THE ECONOMIC BOTANIST TO GOVERNMENT, BOMBAY PRESIDENCY, POONA.

I have the honour to attach herewith a bibliography on literature relating to Papaya in duplicate for forwarding one of the copies to the Agricultural Expert, Imperial Council of Agricultural Research, Simla.

A cursory glance through the titles in the bibliography will show that the cytology of the normal and abnormal types and the study of inheritance of sex in the different forms has not been completed anywhere. The only piece of work relating to sex has been the study to correlate certain morphological characters with the sex of the plant by Sakurai. From Sakurai's results it is found that none of the morphological characters show any correlation with sex and as such the recognition of the male and female plants in early stages by morphological characters is not possible.

It is now a matter for finding out if a hermaphrodite race of papaya could be evolved by a continuous selfing of such a type. If such a race could be evolved much of the difficulties, experienced by the cultivators of half their crop turning out to be male plants could be overcome. The Hawaii Experimenting Station is attempting to breed a hermaphrodite strain and has demonstrated the possibility of increasing the percentage of fruit-bearing plants although no success has been achieved with the recognition of the sex of the plant in early stages.

From a reference to literature it appears that it is more possible to fix types in papaya by selfing than by crossing even though different forms readily cross. Owing to the very high heterozygosity existing in papaya because of its dioecious nature any attempt to fix a type will be a long and slow process. But continued attempt at selfing hermaphrodite type for five years as laid down in the scheme will give some clue as to the possibility of breeding such a type true to its character.

COPY OF LETTER NO. E. B.-788, DATED 8TH JULY 1935, FROM THE ECONOMIC BOTANIST TO GOVERNMENT, TO THE DIRECTOR OF AGRICULTURE, BOMBAY PRESIDENCY, POONA, REGARDING SCHEME FOR THE IMPROVEMENT OF PAPAYA.

I have the honour to attach herewith two copies of references to work done on the Cytology of *Carica papaya* that it has been possible for me to obtain. The only reference on this subject it was possible to obtain from the Imperial Bureau of Plant Genetics, Cambridge, was that on Asana's work. On going through the references available I find that all the cytological work on papaya has been confined to that on the male plant. The chromosome numbers determined also relate to the male plant and not a single reference gives the number in the female plant. It, therefore, appears to me that a study of the comparative morphology of the chromosomes between the two sexes in papaya remains yet to be made and to see whether any correlation exists between the sexes and the characters of the chromosomal complex in this species.

2. I am prepared to accept the offer made by the Imperial Council of Agricultural Research for sanctioning a sum of Rs. 6,000 spread over three years on terms mentioned by them for preliminary cytological investigation on Papaya.

3. The paper by Agharkar and Banerjee "On the development of embryo-sac in *Carica papaya*" gives the details of the development of the female gametophyte from the initial mother cell stage to the final embryo-sac stage. The study is confined to the stages leading to the formation and subsequent behaviour of the eight nuclei in an embryo-sac but throws no light whatever on the chromosome complex of the normal female plant and much less of the abnormal types. In the cytological studies proposed in the scheme on Papaya submitted to the Imperial Council of Agricultural Research it was my intention to work out the similarity or otherwise of the chromosome complex of the different sex-forms in order to find out what relation, if any, it may bear to the inheritance of sex in Papaya, which latter also forms an item of the scheme. As a piece of pure histological work this paper has its value but from a cytogenetical point of view there is no information to be obtained from it.

4. I have also consulted Prof. Asana and Sutaria's paper on "A Cytological study of pollen development in *Carica Papaya* Linn" published in the *Journal of the Indian Botanical Society* and find that beyond giving a description of the different stages of the nuclear division and determining the number of chromosomes in the male plant, which are nine (9), even those authors fail to give the result of any comparative study of chromosomes of the two sexes and the abnormal types in regard to number, morphological character and other peculiarities. It is on these points I should like to take up the investigation if the Imperial Council of Agricultural Research would be good enough to furnish the grant.

5. In the publication "A list of chromosome numbers of plants cultivated in Japan" by Hitoshi Kihara *et al.*, reference is given to works of Heilborn, [1921], Mourman [1925] and Sugura [1927] who have found the chromosome number in male papaya as  $n=9$  and  $2n=18$ . Even in this book on chromosome numbers no reference is available as to the number in female papaya.

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## APPENDIX XXVII-A.

**Note by the Secretary, Imperial Council of Agricultural Research, dated 15th January 1936, on Subject No. 12 (a), Brief Report of the Cold Storage Trials on the Alphonso Mangoes for the 1935 Season.**

At its meeting held in July 1935, the Advisory Board considered the annual report on the investigations relating to the Cold Storage Scheme, Bombay, for the season 1934. The Fruit Research Sub-Committee which considered the report expressed the hope that it would be possible to place before the next meeting of the Advisory Board the report on the 1935 storage experiments in order that any changes in programme might be made before the 1936 season. The report for the 1935 season (not printed) copies of which have been circulated to the members of the Board with Memorandum No. F. 52-II/35-A., dated the 6th December 1935, is accordingly for the consideration of the Advisory Board.

2. The report will, as usual, be examined in the first instance by the Fruit Research Sub-Committee of the Advisory Board whose report will be circulated in due course.

3. The Board will be interested in the arrangements made in connection with the cold storage research scheme for 1936 given in the attached copy of the letter from the Secretary, Imperial Council of Agricultural Research, to the Secretary to the Government of Bombay, Revenue Department, No. F. 52-II/35/Agri., dated the 6th November 1935.

N. C. MEHTA,

*Secretary.*

NEW DELHI;

*The 15th January 1936.*

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ENCLOSURE I

COPY OF A LETTER NO. F. 52-II/35/AGRI., DATED THE 6TH NOVEMBER 1935, FROM THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI, TO THE SECRETARY TO THE GOVERNMENT OF BOMBAY, REVENUE DEPARTMENT, BOMBAY.

SUBJECT:—*Progress of research work under the Cold Storage Research Scheme.*

I am directed to say that the question has been discussed by Mr. Burt with Mr. B. S. Patel and Dr. Cheema at Poona. It would appear from the discussion that the point requiring attention next year in the mango experiments is the fact that mangoes from Madras and the United Provinces which take four to five days in transit to Poona are not in a strictly comparable condition to the fruit grown at Poona itself. There is a distinct difference in storage behaviour between the Ratnagiri Alphonso and the Poona Alphonso which may not all be due to actual differences in the local varieties of fruit but to the fact of the Ratnagiri fruit having remained for some days at a higher temperature after picking. The fruit from outstations should therefore be pre-cooled and transported in insulated containers which Dr. Cheema has promised to arrange.

2. Regarding the experimental programme, I am to say that the following arrangement has been agreed to at the discussion referred to above:—

- (a) that apricots and peaches need not be included in the present experiments but facilities for this purpose may be given if the Baluchistan Administration ask for them and are prepared to meet the cost of fruit and transit charges;
- (b) that Dr. Paul's experiments with seed-potato storage should continue;
- (c) that Dr. Cheema should carry out storage experiments on Poona and Mahabeshwar potatoes of Italian origin with a view to see what can be done regarding the storage of seed-potatoes from February to October and to what extent the need for importing Italian seed can be obviated;
- (d) that the experiments with Bananas should be taken up now and the experiments with the Punjab Malta oranges approved by the Advisory Board should begin in December;
- (e) that Provincial Governments will bear the cost of fruit, packing and transit charges for all the new experiments which they want to be carried out and that Dr. Cheema will lend insulated containers as far as possible;
- (f) that the plant should henceforth be run throughout the year. This will entail an extra expenditure of Rs. 1,740 per annum, as detailed below, a substantial part of which should as far as possible be met from savings, which is sanctioned subject to the condition stated above.

|  | Rs.       |
|--|-----------|
| Two trained coolis and one boy for 12 months instead of six            | 426 extra |
| One junior mechanic at Rs. 48 (Shift mechanic for refrigerating plant) | 288 „     |
| Extra postage, etc.  | 25 „      |
| Running of machinery (principle item is electric power)                | 1,000 „   |
| Total  | 1,739     |

or say Rs. 1,740

## APPENDIX XXVIII.

**Report of the Fruit Committee held at New Delhi on Tuesday, the 11th February at 3-0 p.m.**

## PRESENT.

DR. F. J. F. SHAW (*Chairman*),  
 DR. S. P. AGHARKAR,  
 MR. R. G. ALLAN,  
 RAO BAHADUR D. ANANDA RAO,  
 DR. W. BURNS,  
 MR. M. CARBERRY,  
 DR. HEDAYAT ULLAH,  
 MR. H. C. JAVARAYYA,  
 MR. A. M. MUSTAFA,  
 MR. NIZAM-UD-DIN HYDER,  
 MR. J. H. RITCHIE.

*Report of the Cold Storage Trials on the Alphonso Mangoes for the 1935 Season [item 12 (a) of the agenda].*

The Committee considered the brief interim report of the Cold Storage Station and recognised that in the case of the Alphonso mangoes a definite result of economic importance has been achieved. The Committee considered the experimental programme and approved of it and regard the results that are likely to accrue from this work as large in proportion to the extra expense involved. The Committee considered the question of developing gas storage of fruit in India and recommend that the Director of Agriculture, Bombay, be asked to collect information on this subject and to place it before the next meeting of the Advisory Board with a small scheme for investigating this subject. It may be possible for the Cold Storage research staff to do a few preliminary experiment on a laboratory scale which will yield information of value for the next meeting of the Advisory Board.

*Annual Report of the Hill Fruit Research Scheme at Chaubattia (United Provinces) for 1934-35 [item 12 (b) of the agenda].*

The report deals with the first year of the scheme and the Committee note that as the Entomologist and the Horticulturist had been working before the scheme was initiated, the progress in these branches is rather more than in the case of the Chemical and the Plant Pathological branches. With regard to the work on the rejuvenation of peaches, the Committee consider that more extensive details of this experiment should be given in the next report.

In the storage experiments the particular varieties of apples used should be recorded in the report and the marketing experiment should be described under the designation of grading and packing experiments.

In considering the programme of work of the Soil Chemist, the Committee noted from the introduction of the Director of Agriculture, United Provinces, that his activities were restricted to the ten orchard sites and

centres which are relatively near to Chaubattia. The Committee consider that the item under the head "Outlines of future work" on page 8 of the report should be altered to read as follows:—

1. An analytical study of the soil types in Chaubattia orchard with special reference to the occurrence of diseases and pests prevailing therein and the preparation of soil profile maps.

2. A study of the different orchard soils in relation to the incidence of diseases and pests.

3. A general analytical study of the orchard soils in Kumaon and their placing in the recognised world soil groups.

4. Experiments on fruit preservation in collaboration with the Horticulturists and Mycologist of this research station.

The report and progress of work, subject to the above modifications, was approved.

*Annual Report of the Horticultural Research Station, Krishnagar, Bengal, for the year 1934-35 [item 12 (c) of the agenda].*

The Committee considered this report and note that the scheme is in its first year of working. There is no definite programme of work attached to the report and the Committee suggest that work should be restricted to mangoes, papayas, citrus, pine-apple and plantain. The Committee considered that the Director of Agriculture, Bengal, should be asked to submit immediately to the Research Council a definite programme of work and the proposed lay-out of the station which should be provisionally approved by the Imperial Council of Agricultural Research and submitted to the next meeting of the Advisory Board.

*Annual Report of the Horticultural Research Station, United Provinces and Bihar and Orissa, Sabour, for 1934-35 [item 12 (d) of the agenda].*

The Committee consider that the devotion of one acre of land and presumably a proportion of the funds provided by the Imperial Council of Agricultural Research to an ornamental garden is outside the scope of the scheme. The Committee note that 267 varieties of fruits are under trial in an area of approximately 13 acres and consider that the scheme should restrict itself to the fruit for which the grant was originally sanctioned.

The Committee consider that the first year's report of a fruit station should include a statement of the area of the station and a plan of the lay-out, and that every annual report should include a programme of work.

*Application from the Government of Bombay for a grant of Rs. 78,650 spread over a period of five years for a scheme for improvement of papaya breeding and cultural practices (item 13 of the agenda).*

The Committee considered the application from the Government of Bombay for a scheme for the improvement of papaya breeding as revised by the Advisory Board on 20th February 1935 and approved of the scheme as modified, the maximum cost of the scheme to be Rs. 6,000.

F. J. F. SHAW.

11th February 1936.

## APPENDIX XXIX.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 2nd January 1936 on Subject No. 19:—Application from the Government of Bombay for the Grant of Rs. 59,485 spread over 5 years for the control of ticks.**

Attention is invited to the attached copy of a letter from the Government of Bombay No. 4650-A/33, dated 13th December 1935 (Enclosure) forwarding the scheme mentioned above. The scheme involves a recurring expenditure of Rs. 59,485 (spread over five years) to the I. C. A. R. and a non-recurring expenditure of Rs. 3,200 to the Local Government. The scheme will first be considered by an *ad hoc* committee of the Council and its report (Appendix XXIII) will be submitted to the Board in due course.

## ENCLOSURE.

LETTER FROM J. A. MADAN, Esq., C.I.E., I.C.S., SECRETARY TO THE GOVERNMENT OF BOMBAY, REVENUE DEPARTMENT, No. 4650-A/33, DATED 13TH DECEMBER 1935.

I am directed by the Government of Bombay (Transferred Departments) to forward the following scheme for grants-in-aid from the funds of the Imperial Council of Agricultural Research:—

\* \* \* \* \*

(2) Scheme for the Control of Ticks (Annexure).

I am to add that both the schemes were approved by the Provincial Agricultural Research Committee at a meeting held on 11th November 1935. The Government of Bombay recommend these schemes for the favourable consideration of the Imperial Council of Agricultural Research. They are unable to undertake any financial liability on account of the cost of the first scheme. As regards the tick control scheme they agree to bear the expenditure of Rs. 3,200 on the purchase of spraying machines.

## ANNEXURE.

## A SCHEME FOR THE CONTROL OF TICKS.

## INTRODUCTION.

Tick infestation is an ever present menace to animal husbandry in India as it causes immense suffering to live-stock and enormous economic loss to cattle owners, but no action has been taken to deal with it for want of knowledge of what practical measures are suitable to the peculiar conditions existing in rural areas in India. This scheme has therefore been drawn up to test the value of different methods of controlling or eradicating ticks in this country.

## HARMFUL EFFECTS AND ECONOMIC LOSSES CAUSED BY TICKS.

2. The ticks are comparatively large mites which infest the body surface and live exclusively by sucking blood. The principal harmful effect caused by them are:—

(i) The abstraction of blood and consequent debility.

(ii) Tick bite wounds.



(iii) Transmission of disease.

(iv) Tick toxaemia.

3. The quantity of blood extracted by each tick is frequently as much as 0.4 c.c. Animals harbour ticks, not only in thousands, but frequently in millions and when the infestation is so heavy the quantity of blood extracted can easily be imagined. Tick bite wounds which frequently become infected with pathogenic organisms or with maggots, as very common and sometimes act as a predisposing cause of mammitis and other diseases. Piroplasmosis and Theileriasis which are caused by parasites analogous to the malaria parasite, are very common in India and are transmitted by ticks. (Cooper H.: "Tick borne diseases, with some remarks on the diseases of cattle caused by protozoa." *Agri. Journal, India*, 1926, and Piroplasmosis of cattle, *ibid.*) Tick Toxaemia is a serious condition attended with mortality and caused by the injurious effects of the saliva injected by the ticks when they suck blood. (Naik, R. N.: "Tick Infestation in the coastal tract of N. Kanara" *Ind. Jour. Vety. Science and Animal Husbandry*, 1931.) The economic loss to the Indian cultivator is due to the following:—

(i) *Loss of condition.*—Cattle heavily infested with ticks are reported to lose as much as 500 lbs. of blood in a year. In the United States of America, Department of Agriculture bulletin No. 498, it was shown how an animal heavily infested with ticks and weighing 730 lbs. increased in weight to 1,015 lbs. in the course of two months when freed from ticks the feed being the same throughout, thus showing a gain of 285 lbs. or a daily gain of 4½ lbs.

(ii) *Decreased milk yield.*—The United States Department of Agriculture has further demonstrated that with a light tick infestation the milk yield of a cow was decreased by 1½ quarts causing a loss to the farmer of 3½d. daily, and with a heavy infestation the loss would amount to 3.4 quarts or 8½d. per day. In the latter case, the loss amounts to £6.9.0 or Rs. 86.1.0 per lactation period.

(iii) *Reduced working power.*—Cattle whose bodily strength and vitality are reduced as a result of tick infestation cannot give the same results in work as cattle in good condition.

(iv) *Damage to hides.*—The tick causes minute perforations in the hide and the value of the hide is consequently reduced to a certain extent. In Western countries tick bitten hides are valued at ½d. per lb. less than uninjured hides.

(v) *Decreased fecundity.*—Owing to the constant drain of blood, the cow frequently fails to come into regular oestrus. It is not uncommon to find lean cows remaining sterile for a year or two.

(vi) *Higher mortality rate.*—It has been recorded (Naik, R. N., 1931, *Ind. Jour. Vety. Sci. and Anim. Husb.*, Vol. I) that the death rate in cattle in tick infested areas is much higher than in areas comparatively free from ticks. In the United States of America, it has been calculated that in tick infested areas the death rate among cattle is three times greater than in tick free areas. It has been found in the Bombay Presidency that in heavily infested tracts the mortality due to ticks ranges from 3 per cent. to 8 per cent. of the cattle population. In one village in N. Kanara the village officer, who possesses about 30 head of cattle, stated

that he had lost 12 in one season due to ticks. In tick infested areas the percentage mortality from rinderpest is always higher than in tick free areas, due to the resuscitation of protozoasms.

(vii) *Stunted growth*.—This is one of the most evident results of tick infestation as ticks attack cattle from early calf-hood. The body cells are deprived of sufficient nourishment for natural development and as a result the body growth is slow, the cattle are stunted and maturity is delayed by at least two years.

(viii) *Predisposition to other diseases*.—By reducing the vitality ticks like internal parasites, render the host more liable to contract the various contagious diseases or to suffer from constitutional disturbances and less able to withstand the rigors of the monsoon season.

(ix) *Decrease in value*.—In the United States Department of Agriculture Circular No. 198, dated 8th February 1912, it was stated that the average value of a three year old steer before tick eradication work was started was 16.15 dollars and that after eradication, it increased to 23.25 dollars.

4. A conservative estimate of the loss caused in these ways would amount to approximately 20 per cent. of the value of cattle. Even if one estimates the loss at 10 per cent. the loss sustained by a village having 1,000 head of cattle, valued on the average at Rs. 30 each, would amount to Rs. 3,000. The total cattle population of India is about 300 millions and therefore the annual loss caused by ticks will amount to Rs. 9 crores. This is a colossal amount and is entirely borne by cultivators whose annual income is only about Rs. 40.

#### DISTRIBUTION AND ECONOMICS OF TICKS.

5. Ticks are prevalent all over India irrespective of altitude and extremes of humidity and temperature. Recently Sharif M. (Records of Indian Museum, 1928) recorded 9 genera, 45 species, 4 sub-species and 6 varieties of ticks in India, a list of which is given in Appendix I. These are mainly divided into two groups—continuous feeders and intermittent feeders, the grouping being based on the feeding habits of the ticks. They are very prolific, each fecundated tick laying from 2,000 to 5,000 eggs and some kinds may lay as many as 20,000. From these eggs larvae are hatched which undergo two moults and then become sexually mature adults. The continuous feeders finish their life cycle in about two months and the intermittent feeders in about six months. In the larval or nymph stage they can withstand starvation for from 6 to 7 months and adults for 14 months or more. As a result, they have gained a very strong foothold in this country and are even found in human habitations. During the optimum season one will find cattle literally covered with them.

#### NATIVE REMEDIES.

6. Enquiries made in various parts of the Bombay Presidency show that the cattle owners are fully alive to the harmful effects from these parasites. It has been noticed that they spend considerable time and money on country remedies which ordinarily consist of:—

(i) The application of some bitter oil.

(ii) The application of the decoction of some astringent plant.

- (iii) Standing the animals out in the open at night.
- (iv) Sorcery and the placing of charms in the cattle shed at the time of the new or full moon or at the time of an eclipse.

7. These native remedies do not give any substantial relief to the cattle as they are not poisonous to the tick. Sometimes the application of the remedy or the hanging up of a charm in the cattle shed coincides with the end of one of the stages in the life of the tick at which time intermittent feeders naturally fall down for moulting (and there is an apparent reduction in their numbers which is attributed to the treatment, but when re-infestation occurs the owners are bitterly disappointed. They consider that this infestation causes greater losses than rinderpest, for while ticks are always present, rinderpest occurs only once in three to five years.

#### MODERN METHODS OF CURE AND PREVENTION.

8. There are three ways of treating tick infested cattle viz., removing the ticks by hand, the soiling method and the application of medicinal solutions. The first method is not possible when the ticks are present in very great numbers and even when the greatest care is taken, it is rarely possible to remove them without leaving the proboscis in the skin. The soiling method requires a large area divided into a series of enclosures. The cattle are transferred from enclosure to enclosure until all the ticks have fallen, either to moult or to lay eggs, and are then left to die of starvation. In view of Indian conditions, such a procedure is not possible and the only remaining method is therefore the application of medicinal solutions. Although a large number of such solutions are available, only those having arsenic as the principal ingredient have been found really effective. On account of the presence of Arsenic, the solution is usually used in the form of a dip or spray at a specified place in order to avoid soiling the pastures or much handling of the animals by attendants. For the rapid and convenient treatment of large herds, special dipping tanks have been used in the United States of America, Australia and South Africa for the past 25 years and it is understood that such dipping has largely succeeded in controlling ticks in those countries. In the United States of America, where dipping is carried out under legislation, it has been reported that from an area of 728,565 square miles, complete eradication of ticks was effected in 517,781 square miles. In India, such dipping tanks have only been introduced in a few Military dairies and other Government institutions and they are reported to have proved very effective.

9. Having freed cattle from ticks there are two ways of keeping them free by housing the clean animals in tick proof sheds and allowing them to graze on tick free pastures only and (ii) by regular dipping or spraying with large machines invented for the purpose. The former method is not possible in India as the average Indian cultivator is a poor man and cannot afford to construct tick proof cattle sheds and does not own sufficient land. Regular dipping or spraying only is therefore available. As a result of regular dipping any ticks which become attached to the cattle will be killed or effectually sterilised by the immersion in the arsenical solution and if the process is kept up regularly, no ticks will eventually be available for breeding purposes.

## THE NECESSITY OF THE SCHEME.

10. Although from the foregoing it is obvious that it is quite possible to eradicate ticks by the use of arsenical dips or sprays, we cannot advise the cultivators to resort to this method without having sufficient experimental data of our own. Owing to the peculiar conditions under which cattle are maintained in India, the experience of other countries may not apply. Indian cultivators usually possess only a few head of cattle and are therefore unable to maintain expensive dipping tanks individually as do farmers in other countries. Had it not been for this, dipping would undoubtedly have been one among the numerous modern innovations introduced into India since the advent of British rule. It is therefore necessary to carry out research on dipping and spraying, either of which method might be suitable in some parts of India and not in others, to decide the following points:—

(i) Whether arsenical dips could be introduced into rural areas with safety to human beings and cattle.

(ii) Whether an inexpensive but effective dipping bath could be devised so that it can come within the easy reach of Indian villagers.

(iii) If so, whether villagers would join together to take advantage of it.

(iv) Whether it could be run properly under the supervision of a village committee or other similar arrangement.

(v) Whether other methods, such as spraying would be equally effective.

(vi) How many years would be required to effect the complete eradication of ticks in an area when dipping operations are carried out —

(a) throughout the year.

(b) during the period when infestation is heaviest only.

(vii) What would be the cost of dipping and spraying operations per animal per year when the operations are continued throughout the year or during the tick season only.

(viii) Whether any untoward results would occur when animals, debilitated as a result of external parasitism, innutritious food, semi-starvation or excessive work, are subjected to dipping or spraying in an arsenical solution.

(ix) Whether buffaloes could be dipped without risk. If not, how should they be treated.

(x) Whether these operations will improve the economic condition of the people by preventing the losses referred to in the previous pages and if so to what extent.

The scheme for investigating these points has been divided into two parts.

*Part I.*

11. In this part of the scheme, it is proposed to provide the running expenses for five years for dipping tanks which have been constructed at the cost of the villagers on an approved plan. The type of tank which it is proposed to have constructed is shown on the attached plan and is estimated to cost Rs. 875. The plan has been specially prepared by the Concrete Association of India, Bombay, and is very cheap compared to the cost, *vis.*,

Rs. 3,082 as estimated by the Executive Engineer, Dharwar Division, of one constructed on the model of those used in foreign countries.

12. The cultivators of the following five villages in districts entirely different in every respect have agreed to have dipping tanks constructed provided the running expenses are met by Government for five years:—

| Village.            | Taluka.          | District.            | Cattle population. |
|---------------------|------------------|----------------------|--------------------|
| Devgiri . . . .     | Haveri . . . .   | Dharwar . . . .      | 1,500              |
| Malgi . . . . .     | Sirsi . . . . .  | North Kanara . . . . | 600                |
| Bankatti . . . .    | Bagalkot . . . . | Bijapur . . . . .    | 600                |
| Saigaon . . . . .   | Medha . . . . .  | Satara . . . . .     | 600                |
| Kaji-Sangvi . . . . | Chandvad . . . . | Nasik . . . . .      | 600                |

13. The people in some of the villages have already begun collecting the money so that construction may begin as soon as the funds for the recurring expenditure are provided.

14. In this part of the scheme, it is proposed to use Cooper's arsenical cattle dipping solution as it is easy to use and can be handled if necessary by a layman and also as it is proposed to instruct the more educated villagers in making up the solution and testing its strength. One part of the concentrated solution is required to be diluted in 150 parts of water. The Manufacturers state that each animal takes away on its body, after dipping,  $\frac{1}{2}$  to  $\frac{3}{4}$  of a gallon of the solution on the average. The amount of dip required for each village depends therefore, on the cattle population.

15. The recurring expenditure for each village has been estimated and is set out in appendix II, a summary of which is as follows:—

|                       | Rs.   |
|-----------------------|-------|
| Devgiri . . . . .     | 1,325 |
| Malgi . . . . .       | 600   |
| Bankatti . . . . .    | 600   |
| Saigaon . . . . .     | 600   |
| Kaji-Sangvi . . . . . | 600   |
| Total . . . . .       | 3,725 |

or Rs. 18,625 for five years.

16. Dipping operations will be mainly supervised by the local Veterinary Assistant Surgeons under the general supervision of the Veterinary Investigation Officer or other Officer appointed by the Director of Veterinary Services. The supervising officer will submit progress reports from time to time.

#### Part II.

17. In the second part of the scheme, it is proposed to test the efficacy, under Indian village conditions, of spraying cattle at regular intervals by

means of a large spraying machines manufactured by Messrs. Cooper McDougal and Robertson. These machines cost £113-15-0 approximately and will be provided by the local Government.

18. Two groups of villages have been selected for this purpose, one in Honavar Taluka of Kanara District consisting of the seven villages, Mngwe, Hosakuli, Aroli, Salkod, Nilkod, Vandur and Kadle, and the other in Sholapur District consisting of the villages Kumbhari, Mulegaon, Doddi, Tagarhalli, Chincholi, Boramani and Yetnal. Honavar Taluka is a forest area in the Western Ghats with a cool humid climate and a rainfall of about 130 inches annually and Sholapur District is a plains country with a dry hot climate and a rainfall of about 12 inches, so that the conditions under which the two machines will work are entirely different. The cattle of the first group are of the indigenous breed, stunted in growth and possessing little stamina and resistance to disease, while those of the second group contain some from the notable breeds of the Presidency in addition to the local breed. The cattle population of each area is about 5,000, and the people of both groups have agreed to submit their stock to spraying and to co-operate in carrying on the experiment. A spraying machine will be put into operation in each group and all cattle sprayed once a fortnight each machine being placed in charge of a specially appointed Veterinary Assistant Surgeon. As it will not be possible to collect all the cattle of each group in a central place for spraying it will be necessary to transfer the machine from village to village.

19. It is proposed to use with these machines, a solution of arsenic other than Cooper's and the formula that has been selected is that used in the United States of America as it is much cheaper and also because a whole time Veterinary Officer will be available to make up the solution. The formula is as follows:—

|                        |              | Cost.     |
|------------------------|--------------|-----------|
|                        |              | Rs. a. p. |
| White arsenic          | 8 lbs.       | 7 0 0     |
| Sodium carbonate       | 24 „         | 1 8 0     |
| Pure Tat (Pix Liquida) | 1 gallon     | 2 8 0     |
| Water                  | 500 gallons. |           |
|                        |              | 11 0 0    |

20. The cost of this part of the scheme, excluding the cost of the two spraying machines is estimated to be Re. 40,860, details of which are given in appendix III and the cost of the whole scheme will therefore amount to Rs. 59,485 and in view of the importance and usefulness of the work to the agricultural community of the whole of India, it is requested that the Imperial Council of Agricultural Research will provide this sum.

(Signed) R. N. NAIK,  
Veterinary Investigation Officer,  
Bombay Presidency.

## APPENDIX No. I.

List of ticks found in India, Burma, Ceylon,  
the Andamans and Nicobars.

Genus—*Ixodes*.

Species—*Holocyclus*.

*Ricinus*.

*Acutitarsus*.

*Granulatus*.

Genus—*Haemaphysalis*.

Species—*Turturis*.

*Hystricis*.

*Birmanioe*.

*Montomeryi*.

*Cornigera* forma typica.

*Cornigera* var. anomala.

*Spinigera*.

*Flava*.

*Aculeata*.

*Cuspidata*.

*Bispinosa* forma typica.

*Bispinosa* var. intermedia.

*Parva*.

*Formosensis*.

*Leachi* forma typica.

*Leachi* var. indica.

*Wellingtoni*.

*Howletti*.

*Campanulata*.

*Inermis* var. aponommoidea

*Kinneari*.

*Sewelli*.

*Sundrai*.

*Choprai*.

Genus—*Aponomma*.

Species—*Pattani*.

*Gervaisi* forma typica.

*Gervaisi* var. lucasi.

*Laeve*.

*Trimaculatum*.

- Genus—*Nosomma*.  
 Species—*Nosomma (Hyalomma) monstrosa*.
- Genus—*Dermacentor*.  
 Species—*Auratus*.  
           *Feai*.  
           *Longipes*.  
           *Indicus*. (*Amphyomma Sublaeve* Neum.)
- Genus—*Boophilus*.  
 Species—*Australis*.  
           *Annulatus subsp. calcaratus*.
- Genus—*Rhipicephalus*.  
 Species—*Sanguineus*.  
           *Haemaphysaloides*.
- Genus—*Hyalomma*.  
 Species—*Syriacum*.  
           *Aegyptium subsp. dromedarii*.  
           *Aegyptium subsp. isaaci*.  
           *Aegyptium forma typica*.  
           *Aegyptium subsp. ferozedini*.
- Genus—*Hyalomina*.  
 Species—*Hussaini*.  
           *Hussaini var. brevipunctata*.  
           *Kumari*.
- Genus—*Amblyomma*.  
 Species—*Clypeolatum*.  
           *Itgrum*.  
           *Supinoi*.  
           *Nitidum*.  
           *Sublaeve*.  
           *Helvolum*.  
           *Testudinarium*.

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 APPENDIX No. II.

Recurring expenditure for one cattle dipping bath where the cattle population is 600:—

|   | Rs. s. p.      |
|---|----------------|
| Cost of 55 gallons of Cooper's Dip at Rs. 37-8-0 per 5 gallons drum | 412 8 0        |
| Pay of the attendant at Rs. 10 per month                            | 120 0 0        |
| Contingency including transport of dip from Bombay                  | 67 8 0         |
| <b>Total for one year</b>   | <b>600 0 0</b> |



Recurring expenditure for one cattle dipping bath where the cattle population is 1,500:—

|   | Rs. a. p. |
|---|-----------|
| Cost of 150 gallons of Cooper's Dip at Rs. 37-8-0 per 5 gallon drum . . . . . | 1,125 0 0 |
| Pay of the attendant at Rs. 10 per month . . . . .                            | 120 0 0   |
| Contingency . . . . .   | 80 0 0    |
| Total for one year . . . . .  | 1,325 0 0 |

Recurring expenditure for one year:—

|   |           |
|---|-----------|
| (1) For 4 dipping baths at Rs. 600 each . . . . . | 2,400 0 0 |
| (2) For 1 dipping bath at Rs. 1,325 . . . . .     | 1,325 0 0 |
| Total . . . . .                                   | 3,725 0 0 |

Recurring expenditure for 5 dipping baths for five years—  
 Rs. 3,725 × 5 . . . . . 18,625 0 0

#### APPENDIX No. III.

Cost of spraying mentioned in the second part of the scheme. *Non-recurring expenditure*—

|   | Rs.    |
|---|--------|
| Two spraying machines at the rate of £113-15-0 approximately . . . . .                                  | 3,200  |
| <i>Recurring expenditure</i> —  |        |
| 180,000 gallons of dipping solution prepared according to the formula mentioned in the scheme . . . . . | 3,960  |
| Two Veterinary Assistant Surgeons at the rate of Rs. 94 per month . . . . .                             | 2,256  |
| Two attendants at the rate of Rs. 13 per month . . . . .  | 312    |
| Travelling allowance for Veterinary Assistant Surgeons at the rate of Rs. 30 per month each . . . . .   | 720    |
| Travelling allowance for attendants at the rate of Rs. 7 per month each . . . . .                       | 168    |
| Transport charges . . . . .   | 400    |
| Contingencies . . . . .   | 156    |
| Erection of machinery . . . . .   | 100    |
| Repairs to machinery . . . . .  | 100    |
| Total . . . . .   | 8,172  |
| <i>Total for 5 years</i> —  |        |
| Non-recurring . . . . .   | 3,200  |
| Recurring Rs. 8,172 × 5 . . . . .   | 40,860 |
| Total . . . . .   | 44,060 |

## APPENDIX XXX.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 5th December 1935, on Subject No. 27:—Application from the Government of Bombay for a grant of Rs. 30,030 spread over two years for a Scheme of Research on Agricultural Economics by the Director, Gokhale Institute of Politics and Economics.**

Attention is invited to the attached copy of a note (Enclosure I) (not printed See proceedings of the Advisory Board held in February 1935, *vide* pages 96-102 and 10), dated the 26th January 1935 on the subject mentioned above which was circulated to the Advisory Board for consideration at its meeting held in February 1935. The Board recommended the rejection of the marketing portion of the scheme as it was covered by the main marketing scheme already in operation under the Council. As regards the portion relating to "Farm Management Studies" it was considered that as the Council was already financing an economic enquiry into the cost of production of crops in India, by the cost accounting method, there was an opening for a co-ordinated scheme of work in which it might be possible to utilise the services of provincial officers engaged in the enquiry. The Board therefore recommended that suggestions on this matter might be invited from the provinces and considered by a suitable Sub-Committee of the Board (Enclosure II not printed).

2. Enclosure III contains the opinions of the Directors of Agriculture of the Provinces and the Constituent States of the Council on the scheme. As recommended by the Board the Vice-Chairman to the Council has appointed the following Sub-Committee which will examine the subject in the first instance:—

1. The Vice-Chairman, Imperial Council of Agricultural Research, Chairman, *ex-officio*.
2. The Agricultural Expert, Imperial Council of Agricultural Research.
3. The Agricultural Marketing Adviser to the Government of India.
4. Dr. L. K. Hyder.
5. Professor C. N. Vakil.
6. Dr. W. Burns, Director of Agriculture, Bombay.
7. Mr. J. H. Ritchie, Director of Agriculture, United Provinces.
8. Mr. H. R. Stewart, Director of Agriculture, Punjab.
9. Mr. J. C. MacDougal, Director of Agriculture, Central Provinces.
10. Professor D. R. Gadgil, Director, Gokhale Institute of Politics and Economics.
11. Mr. R. D. Kapur, Chief Economist, Imperial Council of Agricultural Research.

The Secretary, Imperial Council of Agricultural Research, Secretary *ex-officio*.

The Sub-Committee will meet on an afternoon, between the 10th and 15th February 1936 and its report App. XXXI will be circulated to the Advisory Board in due course.

## ENCLOSURE III.

COCHIN.

LETTER FROM THE SUPERINTENDENT OF AGRICULTURE, TRICHUR, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, R. O. C. No. 1585/10, DATED THE 17TH MAY 1935.

I have the honour to inform you that the scheme for "Farm Management" Studies by the "Survey Method" is worth a trial on account of the superior advantages claimed for it over the "Costing" method.

BIHAR AND ORISSA.

LETTER FROM THE OFFG. DIRECTOR OF AGRICULTURE, BIHAR AND ORISSA, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. 7300/1-44-35, DATED THE 11TH JUNE 1935.

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2. The Survey Scheme submitted follows methods found applicable to the educated farmers of Great Britain and America. Its success is dependent, amongst others, on two essential factors, (i) a genuine feeling of co-operation between the investigator and the farmer, and (ii) a more or less intimate knowledge of the financial side of his business on the part of the latter. I doubt if these factors are to be generally found amongst the Indian ryots, who are invariably suspicious of officialdom and will say that they think will please rather than give expression to actual facts. Further the ryot in the main has no idea of the costings side of his work. I am accordingly inclined to think that data collected in this manner will be inaccurate, and being inaccurate will be more harmful than useful.
3. The method adopted in the economic enquiry into the cost of crop production at present being carried out is the only safe method to be pursued in India at the present stage of its development. It may be slow but its results are accurate.
4. I consulted in this matter Professor B. B. Mukherjee of the Economic Department of Patna College and a copy of his reply is forwarded herewith for information. He favours a modified survey scheme, making use of the students in the classes of economics for the purpose. The estimated cost for a survey of 150 villages is so extremely moderate that it seems that it appears well worthy of consideration. But it should be clearly laid down that only students born and brought up under village conditions would be entrusted with the work. The Chief Economist to the Imperial Council of Agricultural Research recently drew attention in an Inspection Note of a case which came under his notice in which a supervisor passed an entry of a food of 20 seers a day for a bullock a clerical error in the first place but the city-bred graduate was unable to detect it.
5. Finally, therefore, I disapprove of the survey method for India, but at the same time, I consider that Professor Mukherjee's suggestion is worthy of further consideration. It may result in eliciting valuable information but even should it not do so the experiment is worth the small cost suggested.

LETTER FROM B. B. MUKHERJEE, Esq., ECONOMIC DEPARTMENT, PATNA COLLEGE, TO THE DIRECTOR OF AGRICULTURE, BIHAR AND ORISSA, PATNA, DATED THE 1ST JUNE 1935.

With reference to your letter No. 5726-29/I-44-35, dated the 21st May 1935, I have the honour to state that Farm Management Studies by the Survey Method may be undertaken as supplementary to the costing enquiry already taken up by the Imperial Council. It is true that the Survey Method has been adopted with good results in the U. S. A. and England and many Indian Universities have also taken it up from time to time. The Punjab Board of Economic Enquiry have prepared a detailed questionnaire. When I was Principal of the Sabour, Co-operative Institute I prepared a detailed scheme and also carried out the enquiry with the help of the students, but my experience was that in view of the illiteracy of the cultivators and their lack of definite knowledge about their cost of production these surveys are not likely to yield definite results although there is no doubt that we may get more general information about the cost of production over a wide area than we possess now. The costing enquiry now undertaken by the Council is limited to a few villages and owing to the wide diversity of Agricultural conditions, the results of this enquiry may not be of general application. Under these circumstances, I beg to suggest that these two methods may be combined and for the survey method a less expensive scheme than that suggested by the Gokhale Institute, may be adopted. For this work, the services of the Economic students of our Colleges may be utilised.

The Provincial Council of Agricultural Research in consultation with the Professors of Economics who have specialised in Agricultural Economics will prepare a detailed questionnaire and the students will carry out the survey during the Summer Vacation preferably in their home villages. Before submitting the reports, the Professors will hold test enquiries and check the results. This will mean that Farm Management Surveys in at least 150 villages may be carried out annually. The estimated cost will be as follows:—

| Name of College.                           | T. A. to                         | Out of pocket             |
|--|----------------------------------|---------------------------|
|  | Professor<br>for<br>supervision. | expenses for<br>students. |
|  | Rs.                              | Rs.                       |
| Patna College . . . . .                    | 400                              | 300                       |
| Ravenshaw College . . . . .                | 300                              | 200                       |
| G. B. B. College, Muzaffarpur . . . . .    | 250                              | 150                       |
| St. Columbus College, Hazaribagh . . . . . | 100                              | 50                        |
| T. N. J. College, Bhagalpur . . . . .      | 250                              | 150                       |
| Total . . . . .                            | 1,300 plus                       | 850                       |
|  | Total Rs. 2,150                  |                           |

In conclusion, I beg to add that this Enquiry will be of great use to the Co-operative Department as information about cost of production is necessary for determining the normal credit of members of village societies.

## PUNJAB.

LETTER FROM THE DIRECTOR OF AGRICULTURE, PUNJAB, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. 833-S., DATED THE 11TH JUNE 1935.

I have the honour to say that there is undoubtedly a vast field for investigation in the realm of farm management and the different factors which contribute towards efficiency in it, but in view of the diversity of farming conditions throughout India any co-ordinated scheme would have to be on a very large scale, which it would probably be beyond the means of the Imperial Council of Agricultural Research to finance, if the scheme is to be on an all India basis.

Local investigations have been carried out from time to time in this province on most of the Agricultural Department's main Farms. They have proved to be of great value in determining to what extent labour, bullocks, irrigation, etc., were being used efficiently. They have indicated the weak points in management and have enabled the Department to improve the management considerably and with resulting financial gain. If the Imperial Council of Agricultural Research consider that a co-ordinated scheme should be drawn up, the Punjab will be glad to submit its proposals.

The services of the Provincial Officers employed on the Crop Costings Enquiry in the Punjab would not be available till the completion of the scheme on which they are engaged, as it requires their whole time, but they are all permanent officials in the Punjab Agricultural Department and their services can be made available at any time later on, if and when the farm management scheme is sanctioned.

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 HYDERABAD.

LETTER FROM THE DIRECTOR OF AGRICULTURE, H. E. H. THE NIZAM'S GOVERNMENT, HYDERABAD, DECCAN, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. 10449, DATED THE 13/9/1344 F.

I have the honour to say that in my opinion the Farm Management Studies by the Survey method will be useful if carried out in different parts of India. I do not think that the studies carried out in one province alone will be of much value.

This work can very well be done by the staff employed for the enquiry into Cost of Production of Crops. Having this staff available which possesses experience of work of similar nature, it will not in my opinion be wise to entrust it to new persons. If the Universities are interested, they can co-operate, but the work should as far as possible be carried out with Council's present staff.

In Hyderabad we have got about a dozen Farms in the various districts which belong to cultivators and are aided by Government and are used for demonstration purposes. A few of these may very well serve the purpose of the studies in view, if a scheme is sanctioned and the Hyderabad State is included in the same.

## UNITED PROVINCES.

LETTER FROM THE DIRECTOR OF AGRICULTURE, UNITED PROVINCES, LUCKNOW,  
TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH,  
No. 2160-C./L., DATED THE 26TH JUNE 1935.

I regret the delay which has occurred in dealing with this letter but the proposal reached me after the University vacations had set in and I have had considerable difficulty in getting in touch with the Heads of the Economics Sections of these bodies. Indeed up-to-date I have had but little direct response. I agree with the Advisory Board that an enquiry into farm costs and management on the lines suggested by Mr. Gadgil *i.e.*, according to the Survey Method would be of valuable help in the study of the question when taken in conjunction with the detailed enquiries which are being conducted under the present Cost of Cultivation Enquiry Scheme. A single enquiry unit I feel would scarcely suffice. It appears to me to be a problem which should be tackled at 3 or 4 centres in the Province where agricultural and economic conditions are different. For this purpose I suggest that there might be one enquiry under the control of the Director of Statistics United Provinces, Cawnpore, and under the guidance of Dr. R. B. Gupta, the Provincial Statistician, who is at present the Chief Executive Officer in the present Cost of Cultivation Enquiry Scheme.

Further I suggest that the three Universities or the College bodies associated with the Universities in which there is an Economics Branch should conduct somewhat similar surveys possibly on a slightly more restricted scale. The only authority of this kind with whom I have got into touch is the St. John's College, Agra, but I am fairly certain that I will get like co-operation certainly in Allahabad and Lucknow. Each of these units would conduct its enquiry on something on the lines of that suggested by Mr. Gadgil and the work of each could be correlated by Dr. R. B. Gupta. Assuming these three centres to co-operate then the unit under the Director of Statistics would operate in the Western Districts of the Province which is more or less unassociated with any University; the others would work in the region of the Universities mentioned. I estimate that the cost of the Director of Statistics unit would be as below:—

|   | Rs.   |
|---|-------|
| 1. Allowance to the Director of Survey at Rs. 75 p.m. . . . . | 900   |
| 2. Chief Investigator at Rs. 100 p.m. . . . .                 | 1,200 |
| 3. Assistant Investigator at Rs. 50 p.m. . . . .              | 600   |
| 4. Two fieldmen at Rs. 30 p.m. each . . . . .                 | 720   |
| 5. One clerk at Rs. 25 p.m. . . . .                           | 420   |
| 6. Two peons at Rs. 10. p.m. each . . . . .                   | 240   |
| 7. Travelling allowance to Investigators . . . . .            | 800   |
| 8. Travelling allowance to fieldmen . . . . .                 | 360   |
| 9. Postage, Stationery and other contingencies . . . . .      | 500   |
| 10. Books, Bulletins, Periodicals, etc. . . . .               | 260   |
| Total . . . . .   | 6,000 |

While the University units working on rather a more restricted area thus reducing the Travelling Allowance and under the guidance of the Head of the Economics Sections, assumed to receive no allowance, would cost as under—

|   | Rs.   |
|---|-------|
| 1. Chief Investigator at Rs. 100 p.m. . . . .             | 1,200 |
| 2. Assistant Investigator at Rs. 50 p.m. . . . .          | 600   |
| 3. Two fieldmen at Rs. 30 p.m. each . . . . .             | 720   |
| 4. Two peons at Rs. 10 p.m. each . . . . .                | 240   |
| 5. Travelling allowance to Investigators . . . . .        | 600   |
| 6. Travelling allowance to fieldmen . . . . .             | 300   |
| 7. Stationery, Postage, and other contingencies . . . . . | 300   |
| 8. Books, Bulletins, Periodicals, etc. . . . .            | 200   |
|   | <hr/> |
| Total . . . . .   | 4,160 |
|   | <hr/> |

Total cost for 3 centres =  $4,160 \times 3 = 12,480$   
 be (Rs. 6,000 + Rs. 12,480) = Rs. 18,480.

I think the enquiry will have to extend over two years. The total cost, therefore, may be put down in round figures as Rs. 37,000.

I am forwarding this to you in the present condition though I would point out of course that the scheme has had no chance of going up before the U. P. Provincial Research Committee which might quite possibly see fit to amplify the scheme. It will also be noticed that I have assumed the co-operation of at any rate 2 of the 8 University bodies, but I feel, however, that what I have suggested above is approximately what the United Provinces would require if there is any question of a general survey enquiry of this kind on the lines suggested by Mr. Gadgil of the Gokhale Institute of Politics and Economics.

I am forwarding this as it appears possible that the matter will be discussed by the Advisory Board.

BENGAL.

*(Received from the Director of Agriculture, Bengal.)*

Note regarding Farm Management Studies by the Survey Method  
by

Dr. H. L. Dey, Reader in Economics, University of Dacca.

1. There can be no doubt that Farm Management Studies by the Survey Method will be extremely useful in giving an outline picture of the Economics of Farming in India and thus in helping in the formulation of an Agricultural Policy. But such a survey, if it is to be of practical value, must be carried out in a large number of representative areas.

2. The work of survey may be done either through the Provincial Department of Agriculture or the Economics Departments of Provincial Universities or the Provincial Boards of Economic Enquiries. In my opinion, anyone of these three agencies should be competent to carry out the survey in question. I beg to suggest that the Imperial Council of Agricultural Research should draw up standard schedules and forms to be used in Provincial Enquiries.

3. So far as the University of Dacca is concerned, it being located in one of the most fertile and densely populated and multiple-cropped regions of India, it has ample opportunities of undertaking a highly valuable survey of this nature. I may also add that the University Authorities are favourably disposed towards carrying out a survey of this kind through its Department of Economics, although no definite scheme has been adopted so far for lack of funds. If the Imperial Council of Agricultural Research so desires, I shall be glad to place the matter before the University authorities. I submit below a detailed estimate of expenditure for the survey.

Two years' Budget Estimate for a Farm Management Survey at Dacca.

|  | First year.   | 2nd year. |
|--|---------------|-----------|
|  | Rs.           | Rs.       |
| 1. Director's Honorarium . . . . .                   | 1,800         | 1,800     |
| 2. Two Investigators at Rs. 60 p.m. . . . .          | 1,400         | 1,440     |
| 3. One clerk at Rs. 25 p.m. . . . .                  | 300           | 300       |
| 4. T. A. for Director and Investigators . . . . .    | 500           | 500       |
| 5. Remuneration for local help in villages . . . . . | 250           | 250       |
| 6. One peon at Rs. 15 p.m. . . . .                   | 180           | 180       |
| 7. Printing of schedules and forms . . . . .         | 100           | 100       |
| 8. Stationery and postage . . . . .                  | 100           | 100       |
| 9. Books, Bulletins and periodicals . . . . .        | 250           | 250       |
| 10. Publication of the Report . . . . .              | ..            | 600       |
| 11. Miscellaneous . . . . .                          | 100           | 100       |
|  | 5,020         | 5,620     |
| <b>Grand Total</b> . . . . .                         | <b>10,640</b> |           |



LETTER FROM DR. J. C. SINHA, M.A., PH.D., PROFESSOR OF ECONOMICS, PRESIDENCY COLLEGE, CALCUTTA, TO THE DIRECTOR OF AGRICULTURE, BENGAL, DATED THE 19TH JUNE 1935.

The Survey Method of inquiry has to satisfy two conditions if it is to yield results of value. One is that it must be carried out over an area which is sufficiently homogeneous to permit safe generalisation. The other is that the investigators must be sufficiently trained in the technique of local agriculture and of economic inquiry to be able to set up suitable standards with reference to which the efficiency of individual farms may be judged. Cost Accountancy Method is preferred because it gives more intensive details lending itself to easier standardisation. But in India where agriculturists are quite ignorant about farming costs, the difficulties of applying this method are much greater than in western countries.

The scheme for Research submitted by the Gokhale Institute does not make it clear that the potato tract of the Khed Taluka in Poona District where the survey is proposed to be carried on, is sufficiently uniform for our purpose. The research in agricultural economics carried out by the Institute so far relates to marketing, which is stated to be the direct concern of the Imperial Council. The published research however shows that the investigators are in touch with local conditions and are able to collect information of value.

I therefore feel that the grant applied for, may be sanctioned if the area proposed to be surveyed is uniform.

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MADRAS.

LETTER FROM THE DIRECTOR OF AGRICULTURE, TRIPPLICANE, MADRAS, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. E.-159-35, DATED THE 27TH JUNE 1935.

The Scheme proposed by the Gokhale Institute of Economics on the survey method is worth consideration by the Imperial Council of Agricultural Research.

2. The University Professor of Economics, Madras, was consulted as suggested in your letter. He is of opinion that the survey method in farm management is not likely to prove useful in the present state of knowledge of the ryots in India, as the information that could be got will not be sufficiently accurate. According to him the success of the method in England and United States of America is due to the ability of the farmer to give intelligent and accurate information on farm management, but in India there are difficulties in getting at the correct information.

3. In investigations of the kind much depends on the ability of the investigator, and it should be possible to overcome difficulties by the choice of an intelligent officer for the purpose. Information of the kind got from a large number of holdings will allow for inaccuracies and is likely to give useful results.

4. I am giving below an outline of the Scheme recently proposed for such a survey by Mr. Munro, Deputy Director of Agriculture, VIII Circle. The details are to be gathered under the following heads:—

1. Name, address, village, etc.
2. Nature of ownership—tenant or owner.
3. Number in household, adults, youths and children.
4. Distance from market, railway station, post office and residence.
5. Land whether dry, garden or wet area, classification and value.
6. Implements. Kind and value.
7. Buildings. Number and value.
8. Permanent improvements as wells, bunding, etc., nature and value.
9. Rent, assessment and miscellaneous payments, etc., particulars and value.
10. Crops grown, acreage, yield, house consumption, varam rent, sales, rate and value.
11. Manures produced or purchased, quantity, rate and value.
12. Method of irrigation and area.
13. (a) Livestock—work bullocks, cows, calves, etc., purchased or sold and value  
(b) Livestock produce, quantity, rate and value.
14. Labour: permanent, casual, paid in kind or family with monthly particulars, preferably crop-war; also festival presents.
15. Miscellaneous receipts from hire of livestock or human labour.
16. Purchase of food stuff—quantity, rate, value.
17. Purchase of seeds, quantity, rate, value.
18. Miscellaneous expenses on implements and livestock, social functions, etc.
19. Financial position at beginning and end of the year as credits and debits.
20. General remarks and summary.

5. It is also desirable that enquiry conducted as above is extended to some important details outside the scope of the survey method to ensure that accurate information is obtained. A scheme of investigation which will also include the main items of the cost of cultivation of crops such as seed, irrigation, manuring, &c., will help considerably in making the enquiry more efficient. I have had a scheme prepared by my Agricultural Statistics Committee for an enquiry into the cost of cultivation of money crops in the Presidency. The enquiry will be conducted in ten districts where the crops under cultivation are the major crops; it consists in the selection of 125 holdings at random in each district where the expenditure in cash or kind under each item of cultivation is noted by a special investigator for each district through periodical visits suited to the time of these operations.

6. In the scheme of cost of cultivation of crops now in progress under the Imperial Council of Agricultural Research the main difficulty lies in the fact that while the information is gathered in great details, the number

of holdings examined is not adequate. I am of opinion that at least one hundred holdings per district ought to be examined to get a fairly reliable figure, while the scheme should cover the major items of the cost of cultivation of crops. The advantage will be that while the information is gathered on all salient points, the scope of the enquiry will be sufficiently extensive to permit of useful results both for the costing as well as the survey method. In any case, for the purpose of the survey method more details will have to be gathered. Additional information on the broad heads of costing for each crop, will not materially increase the work, while it will add greatly to the usefulness of the enquiry.

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BURMA.

LETTER FROM THE DIRECTOR OF AGRICULTURE, BURMA, RANGOON, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, SIMLA, S. W., No. 5324/I.A.-12-XVI, DATED THE 28TH JUNE 1935.

I have the honour to acknowledge receipt of your letter No. 86/35-Agri., dated the 2nd May 1935, and to state in reply that I have come to the conclusion that the best course of procedure, will be for the Council to sanction the grant applied for by the Gokhale Institute of Politics and Economics on the understanding that the Institute shall work out a standard method for determining the cost of production of crops in India by the survey method. This, to my mind, is the first essential because at the present time it is often a matter of dispute as to whether certain items should be included in the accounts or left out. The enquiry should have reference to all the principal crops of India.

2. When such a standardised method has been worked out the provinces could proceed to utilise it in the conduct of their local surveys. These surveys can best be done by an officer of the same status (but with the necessary special qualifications) as Assistant Marketing Officers. He should be placed under the executive charge of the local Marketing Officer and under the administrative control of the Director of Agriculture in each province. It is estimated that for this purpose 25 per cent. would require to be added to the marketing grant. The Economic Department of the University in this province has expressed its willingness to cooperate in the work.

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ASSAM.

LETTER FROM THE DIRECTOR OF AGRICULTURE, ASSAM, SHILLONG, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. IIB-63/1641, DATED THE 3RD JULY 1935.

I have the honour to inform you that I have consulted the two Professors of Economics of this province and to note as follows:—I agree that it would be desirable to conduct the farm management survey as proposed. I do not see, however, any reason why a part of the Director's and the Chief Investigator's salaries should be provided by the Imperial Council of Agricultural Research. If this is to be provided by the Imperial Council of Agricultural Research, similar investigations might be carried on in many other institutions. I would suggest that the amount may be sanctioned between Rs. 60,000 provided for the purpose during the two years.

## BOMBAY.

LETTER FROM THE DIRECTOR OF AGRICULTURE, BOMBAY, POONA, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. 493-L. OF 1935, DATED THE 4TH JULY 1935.

I have the honour to enclose herewith a copy of the scheme proposed for applying survey methods of economic enquiry into the dairy tract of Gujarat known as "Charotar" tract where the Department of Agriculture has been studying the economics of mixed farming combined with livestock farming for the last two years. This scheme was drawn up by Dr. T. G. Shirname and shows why and how such a method should be tested out with a view to its wider applicability under different conditions in different tracts of India. The scheme offers better scope for testing out survey method and if funds are made available such scheme can be undertaken by the Professor of Agricultural Economics.

A SCHEME FOR A FARM ECONOMICS SURVEY OF CHAROTAR TRACT IN GUJARAT.

Investigations into the economics of farming is a recent development and it would not be an exaggeration to say that agricultural economics as an organised branch of knowledge did not exist before about the year 1900. The United States of America led the way in the subject and at present most of the civilised countries in the world have established separate organisations for studying the economics of farming. The subject is still new in India and it is only in the Punjab and Bombay that organised efforts are being made by the Departments of Agriculture to study the subject scientifically.

*Principal Methods of Studying Farm Economics.*

*Cost Accounting Method.*—This method, in its broad outline, begins with the recording, in complete detail, every move of labour and equipment and all the transactions on a farm from day to day. It consists of a system of book-keeping for the whole farm and of an attempt to determine the cost of production, receipts and profits or losses of each of the crops or enterprizes and processes of farm production. This is the earliest and still the most widely and universally used method. The method is however slow and most costly. Because of the cost and time involved it places a limit on the number of farms that can be studied. The few farms that are studied by this method do not give a reliable and dependable picture for as an area as would be desirable.

*Enterprise Cost Method.*—This method consists of keeping records and finding out costs, receipts and profits or losses of one crop or enterprise. The method is important in tracts where only one crop dominates and where the success of the farm depends to a large extent on the success of this principal enterprise.

But the difficulty about this method is that we cannot find out the cost of production of any one crop unless we have details about other crops grown by the farmer. Besides no crop or enterprise can afford to stand by itself in any system of farming and the plan of the different farm enterprises depends not on their individual profits but more on the balancing of their complementary relationships and the maintenance of soil fertility. In the absence of details of other crops given by the farmer, a number of estimates creep in and the resultant cost of production figures have a tendency to become fictitious. When details of all the crops are kept day by day the method ultimately become that of cost accounting.

*Survey Method.*—The survey method is the one most popular at present among agricultural economists in Europe and America. The chief advantages of this method are :—

- (1) It is the least costly method.
- (2) It gives results in a much shorter period.
- (3) A large number of farms can be studied within a short time and with less expense.
- (4) Because of the large number of farms that are possible of being studied by this method, the results obtained yield conclusions that are applicable to the whole of a typical farming area.

The intensive application of the survey method to the study of agricultural economic problems is quite a recent introduction. The development of the method and its application to the farm management problems is largely the work of G. F. Warren of Cornell and the business survey of entire farms had its origin first in the New York State in 1907. By about 1911-12 it gave very useful results and since then it has grown in favour very rapidly not only in the United States of America but also in England and the Continent. Carslaw of Cambridge and Orwin and Bridges of the Oxford Agricultural Economics Research Institute recently studied the economics of farming by survey method. The possibilities of the survey method have been discussed at length by various agricultural economists like Bridges, Franendorfer, Maxton, Spillman, Warren and Mrs. B. Webb and also in the First International Conference of Agricultural Economics held in 1929.

In the general procedure of a survey, a typical farm area, which is fairly well-defined, is first selected and the recorder or surveyor, equipped with a uniform list of questions—the schedule—visits as many farms as possible in the chosen area, with the intention of eliciting answers to a given series of questions on each of the forces that effect the success of a farm.

*Work done and the methods successfully tried by the Professor of Agricultural Economics, Poona.*

Since 1925 when the Agricultural Economics Section was created at the College of Agriculture, Poona, the enterpris. cost method and the cost accounting method have been successfully adopted and the results

published in the form of two publications by the Department of Agriculture, Bombay:—

- (1) Preliminary Studies of Important Crops in the Bombay-Deccan in the Post-War Period.
- (2) Principles and practice of Farm Costing with Farm Studies.

Another exhaustive publication embodying the economics of farming in a typical dry tract of the Bombay-Deccan by cost accounting method will soon be ready. Since 1933, we have been studying the economics of mixed farming with live-stock raising in the *Charotar* tract of Gujarat by the cost accounting method and one year's results have already been obtained.

#### *Possibilities of the Survey Method.*

From what has been said previously on the general procedure of a farm economics survey, it is clear that the value of the survey method depends upon:—

- (1) The efficiency of the schedule with which the farmers are interviewed.
- (2) The training of the person in charge of the survey work.
- (3) The number and representativeness of the farms that can be studied.

We have now nine years' experience in preparing schedules and for experienced workers it will be quite easy to prepare schedule that will include questions prepared in a manner that will confirm to the terms in which the farmer's knowledge exists. The questions have to be so arranged as will enable the workers to check the replies given by the farmer.

A number of graduate assistants have been trained for farm economics investigation work. One of our trained assistants is now working as Provincial Officer in charge, Economics Enquiry, guiding investigation into the cost of production of cotton and sugarcane taken up by the Imperial Council of Agricultural Research and Indian Central Cotton Committee jointly. An agricultural overseer is in immediate charge of the farm economics investigation work in Gujarat.

The number of farms that can be surveyed will depend upon the extent to which the farmers are prepared to co-operate and the accuracy of information secured from farmers on the relations between the farmers and the investigators. The preparation of the field of enquiry is therefore extremely important. We are having our cost accounting study in the *Charotar* tract since June 1933, and it is expected that the investigation will be continued till about June 1936 so that we can get average results for three years. The farmers in this tract are extremely intelligent and they are now thoroughly satisfied with the importance of our study. An informal talk with several farmers in the tract leads me to think that there will not be any difficulty in getting as many farmers as we want for the survey work. We are therefore confident that the results of the proposed survey work.

Since the method at present followed by us is the cost accounting method, we are able to study only 31 representative farmers in 3 typical villages. While there are about 170 villages and 60,000 farmers in the Charotar tract which is a typical farming area for mixed farming and live-stock raising.

*The criterion of success of the trial of a method.*

It may be stated nowhere in India has the survey method been tried to study farm management problems over as wide an area as is expected to be covered by this scheme and if the proposal is adopted, we will be able to get not only a cross-section picture of farming conditions in the whole of Charotar area, but we can also indicate the possibilities of the use of the survey method in studying farm economics in India. It is an acknowledged fact that the cost accounting method is the one which gives the most accurate and reliable results. The survey method is essentially a method of estimates and does not record the actual happenings. There are bound to be errors in the estimates of individual farmers and the accuracy of final results secured by the survey method very largely depends on whether the errors involved in the individual estimates are of the compensating or cumulative type. If there is no personal bias present while telling the estimate when a large number of items is averaged, plus errors of estimate are neutralised by the occurrence of similar minor errors, in accordance with the law of statistical regularity or the law of averages. It is on this principle that the value of the survey method is based and in order to know exactly the possibilities of this method, we must have results secured by the cost accounting method, so that we can compare the survey results with those obtained by the cost accounting method and say definitely the extent of application of survey method to farm economics research. In all the foreign countries where the survey method is now extensively used, the method first used in farm management research was the cost accounting method and when the survey method was first tried, the investigators already had with them the results secured by the cost accounting method. In the tract proposed for survey, we are already getting results. These results will be compared with the survey results. *Indeed we expect that results obtained by both these methods will supplement each other and will enable us to draw reliable and dependable conclusions on the economic position of farmers in the Charotar area.*

*Scope of Survey.*

There are about 60,000 farms in the tract and it is proposed to cover at least 600 farms by the survey, if not more. Including the time that will be required for the collation of the survey material and the writing of the report, the work is expected to last for about 15 months.

The Charotar tract consists of Borsad and Anand Talukas and the southern portion of the Nadiad Taluka. The Revenue Records classifying the villages into different groups have already been analysed in close details and it is thought that selection of six villages (in addition to the three already being studied by cost accounting method), representative of the tract, may be sufficient to get survey material that will yield results that will be applicable to the whole of the Charotar area.

*Budget Estimate of the Proposed Survey.*

The scheme is estimated to cost Rs. 6,930 as per details given below :—

|   | Total cost<br>for 15<br>months. |
|---|---------------------------------|
|   | Rs.                             |
| 1. One Graduate Assistant in the 2nd Grade at Rs. 110 p.m.<br>in the grade of Rs. 110—8—150 . . . . . | 1,674                           |
| 2. Six kangars at Rs. 35 p.m. each in the grade of Rs. 35—5/2—60 . . . . .                            | 3,150                           |
| 3. One clerk at Rs. 30 p.m. in the grade of Rs. 25—5/2—55 . . . . .                                   | 450                             |
| 4. One peon at Rs. 15 p.m. . . . .  | 225                             |
| 5. Travelling expenses . . . . .  | 1,000                           |
| 6. Contingencies, including printing of forms . . . . .   | 430                             |
|   | 6,929                           |
|   | or                              |
|   | 6,930                           |

## CENTRAL PROVINCES.

MEMO. FROM THE PROVINCIAL OFFICER, COST ENQUIRY SCHEME, C. P.,  
NAGPUR, TO THE DIRECTOR OF AGRICULTURE, CENTRAL PROVINCES,  
NAGPUR, No. 605, DATED THE 8TH JULY 1935.

The idea of starting a scheme of research into farm management by the Survey method is a very commendable one. Our knowledge of farm management in this country is extremely limited, and I feel the limitations of our knowledge on the subject at every step while lecturing to the students on Agricultural economics. A good deal of very valuable material is available in the books of the Cost Enquiry Scheme but they have to be analysed from the farm management point of view and statistically studied before they could be made use of. The staff now employed under the Cost Enquiry Scheme will never be able to do this, unless their period is extended specifically for this work. But the work is worth doing.

The scheme of research proposed by the Gokhale Institute is by the Survey Method. This method is cheap and quick. In this province, however, on account of the specialization of cropping, the enquiry will have to be extended to all the three tracts, viz., wheat, rice and cotton tracts. With three investigators and one Assistant for each it should be possible to finish a fairly intensive survey in about three years. While doing the cotton tract the services of the staff may also be utilized for analysing the figures collected by the Cost Enquiry Scheme. A comparative study of the data collected by the two methods, the cost accounting method and the survey method, would be very interesting and would throw light on the value of the two methods under Indian conditions.

The District Supervisors and a few of the village investigators now employed in the cost enquiry scheme would be very suitable men for this work, if these men become available by the time this work starts. They



would be able to bring into the work a good deal of the experience gained during the course of the cost enquiry work and this would be very valuable in a work of this nature. The success of the survey method depends upon the ability of the investigator to tackle the farmers and to get out of them what he wants. This is a very difficult piece of work in India where the mass of the cultivators are illiterate and have no account books of any kind. Hence the data collected during informal conversations have to be sifted carefully before they could be made use of, and it is here that the previous experience of the investigators will be found valuable.

Before starting the work, the problems for investigators will have to be decided upon and a suitable questionnaire drawn up for the guidance of the investigators.

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SIND.

LETTER FROM THE CHIEF AGRICULTURAL OFFICER IN SIND, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, No. 417 of 1935, DATED THE 14TH OCTOBER 1935.

I have the honour to state that I am in agreement with the Board that the scheme put up by the Gokhale Institute of Politics and Economics so far as it relates to 'Farm Management' studies by the 'Survey Method' is worth consideration and that Universities and private bodies (*i.e.* the Gokhale Institute of Politics and Economics) may be encouraged to take up such studies.

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MYSORE.

NOTE BY THE PROFESSOR OF ECONOMICS, UNIVERSITY OF MYSORE, ON THE 'SCHEME FOR RESEARCH IN AGRICULTURAL ECONOMICS'.

*(Received from the Director of Agriculture, Mysore.)*

The field of economic research in India is so vast that the co-operation of all the duly qualified agencies and institutions is necessary. The Royal Commission on Agriculture in India as well as the Bowley-Robertson report on an Economic Census for India suggest that the universities must be increasingly associated with the Government Departments in economic enquiries and investigations. The universities on their side have again and again expressed their willingness to carry out pieces of research in so far as their resources permit and in so far as those resources could be augmented by grants from the Imperial Council of Agricultural Research.

The University of Mysore has a fully equipped Department of Economics. There are many teachers of Economics. Rural Economics which includes subjects like Marketing Surveys and Farm Management has been a special subject in the University. The members of the Department have done a considerable amount of spade work in the rural economics of the Mysore State. I suggest that the Department of Economic should be linked on to any scheme of research in agricultural economics organised by the Imperial Council.

"Farm Management" studies by the Survey Method proposed by the Gokhale Institute for Politics and Economics presuppose that a large number of farms in the different regions of the country are investigated. Mysore State is a region by itself with certain agricultural and economic peculiarities, and a study of conditions on typical Mysore farms will reveal valuable conclusions which would be not only of local importance but also of importance for the whole country. Mysore State possesses a highly developed Department of Agriculture and the University can count upon its assistance in technical matters.

No project of economic research which involves field enquiries can be carried out without adequate funds. If the Imperial Council desires to associate the University of Mysore in its "Farm Management" studies and other studies it may kindly make a money grant for the purpose on the same scale as it would for other Universities. The Department of Economics will be very ready to avail itself of the opportunity for research and to co-operate in the conduct of all-India economic investigation.

## APPENDIX XXXI.

Proceedings of the meeting of the *ad hoc* Committee appointed to consider the scheme submitted by the Director, Gokhale Institute, Poona, held at 3 p. m. on the 11th February 1936.

The following were present:—

1. Mr. N. C. MEHTA, I.C.S.—(*Chairman.*)
2. Dr. W. BURNS,
3. PROF. GADGIL.
4. Dr. R. D. KAPUR,
5. Mr. A. M. LIVINGSTONE.
6. Mr. J. C. McDOUGALL.
7. Prof. C. N. VAKIL.

Mr. McDougall enquired how far the scheme was going to be of more than local importance especially when it is known that it was not possible to embark on a scheme of an all-India scale in view of the present financial condition of the Imperial Council of Agricultural Research. Professor Gadgil explained that the scheme was one of methodology and that the survey-method which had produced such important results in America and elsewhere has not hitherto been applied in this country. This method has been recognised to be cheaper and quicker in producing the results than the cost-accounting method which has hitherto been tried in this country. The choice of a particular crop was not fundamental to the scheme; it was merely incidental and the selection depended merely upon convenience and the available facilities in the neighbourhood. The results of the proposed experiment were likely to be of general importance and should enable us to see whether the survey method could not be adapted to conditions in India as elsewhere. The Institute had already done some preliminary work in that direction, had trained staff available and was prepared to bear half the estimated cost. Dr. Burns in supporting the scheme said that this was another case where a competent man was available and a suitable scheme had been put forward which would be worked by him. Agricultural workers often found themselves in difficulties when the economic aspect of agricultural improvement was to be ascertained. He was therefore in favour of the scheme being supported. Professor Vakil also supported the scheme.

2. It was felt that though the scheme was essentially of an academical nature, it was one of considerable importance especially in view of the fact that the Council in collaboration with the Indian Central Cotton Committee had already agreed to finance an ambitious scheme relating to the enquiry into the cost of production by the cost-accounting method. The application of the survey method which was proposed by Professor Gadgil was likely to be particularly useful in giving us some valuable data in connection with agricultural economy.

3. The financial aspect of the scheme was then considered and the sum of Rs. 6,000 provided for printing the report was cut down as the report could be printed by the Imperial Council of Agricultural Research as one of its own publications. In view of the facts that the Gokhale Institute is prepared to contribute to the extent of half the amount required for the scheme, *viz.*, Rs. 14,400 spread over a period

of two years, that the trained staff in the person of the Director and the Chief Investigator are available for the purpose of this enquiry and that it is desirable to ascertain the extent to which the survey method can be profitably adopted in this country *vis-a-vis* the cost-accounting method. The Sub-Committee unanimously recommend the scheme to the Board.

An explanatory note on the survey method prepared by Professor Gadgil is attached. (Enclosure.)

#### ENCLOSURE.

##### NOTE ON THE SURVEY METHOD BY PROF. GADGIL.

The survey seeks to do something entirely different from that attempted by the cost-accounting method. Cost-accounting goes into the minutest details regarding a few individual farmers and aims at the greatest measure of accuracy. Survey, on the other hand, tries to cover as large a number of cases as possible and present a general picture of the economy of a whole tract. *Its aim further is to determine not so much the cost of production of a particular crop or the extent of profitable of farming but to see why some make more profits or suffer less loss than others.* By comparing a large number of farmers with one another the survey tries to determine the factors that make for efficiency in farming. In the study of farm organization of farm business, therefore, the survey method is all-important. Further, as the number of records obtained by cost-accounting are necessarily very few there is great danger in generalising from them. As these records cannot be presumed to be typical they cannot be made the basis of conclusions of wide applicability and it is necessary to obtain more extensive data on which to lay the foundations of agricultural policy. The survey method is the only one which can produce such data. Just because also the survey finds out facts about the average farmer the results yielded by it are of great utility in the work of extension and propaganda. It is generally agreed that it has special possibilities "under conditions of inadequate financial resources and an inadequate supply of even elementary data of large number of individual farms". It is thus a method whose application to Indian conditions would be of the greatest help in the investigation in India's agricultural economy.

In India all work done hitherto has been by the method of cost-accounting. So far as we are aware till the Institute put up this project nobody attempted or discussed the use of this method in India.

The much greater element of self-sufficiency in the farming business, the differences in the credit mechanism, the absence of written accounts or memoranda, the illiteracy of the peasant, all these create problems in the way of applying the method to India. The great differences between Indian conditions and those obtaining in United States of America and England make it impossible to adopt directly the methods of work evolved in the latter countries. It is necessary to adapt both the procedure of work and schedules to Indian conditions and ascertain under what conditions and with what safeguards the survey methods could be worked in India.

## APPENDIX XXXII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 30th January 1936, on Subject No. 41:—Application from the Director, Imperial Institute of Veterinary Research, Muktesar for a grant of Rs. 16,342 (Rs. 11,298 recurring and Rs. 5,044 non-recurring) spread over a period of 2 years and 8 months for a scheme for Research on an Anti-Rabic Vaccine for Dogs.**

Attention is invited to the enclosed copy of a letter No. F.-35-1/36-A., dated the 25th January 1936 from the Department of Education, Health and Lands (Enclosure), forwarding a scheme for research on an anti-rabic vaccine for dogs, at a cost of Rs. 16,342 spread over a period of 2 years and 8 months. The Council has been asked to meet the whole expenditure in connection with the scheme. The scheme will be placed before the Committee to consider Bombay Scheme for control of ticks and progress reports of Veterinary Investigation Officers, etc., and its report (Appendix XXXIII) will be submitted to the Advisory Board in due course.

## ENCLOSURE.

COPY OF A LETTER No. F.-35-1/36-A. DATED THE 25TH JANUARY 1936, FROM THE EDUCATION, HEALTH AND LANDS DEPARTMENT, GOVERNMENT OF INDIA, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

*Scheme for research on anti-rabic vaccine for dogs.*

I am directed to forward a scheme submitted by the Director, Imperial Institute of Veterinary Research, Muktesar, for conducting research on anti-rabic vaccine for dogs together with a copy of his letter No. C./255, dated the 30th December, 1935. The Government of India approve the scheme which, it will be seen, involves an expenditure of Rs. 16,342 spread over a period of 2½ years approximately. In the ordinary course the Director, Imperial Institute Veterinary Research Muktesar, would have been directed to forward the scheme to you so that it might be placed before the Imperial Council of Agricultural Research, with a request that a grant should be made to meet the cost. It is, however, understood that the next meeting of the Advisory Board will be held in the beginning of February next, and in order to save time, I am directed to forward the scheme direct, and to ask that the decision of the Council may be communicated to the Government of India in due course.

COPY OF LETTER No. C./255, DATED THE 30TH DECEMBER, 1935, FROM THE IMPERIAL INSTITUTE OF VETERINARY RESEARCH.

*Application for grant from the Imperial Council of Agricultural Research for research on an anti-rabic vaccine for dogs.*

I have the honour to forward herewith a scheme of work amounting to a little over Rs. 16,000 dealing with the preparation of an anti-rabic vaccine for dogs, which it is proposed to carry out at Izatnagar and if the Government of India approve of the proposal. I request that the papers

be forwarded at an early date to the Imperial Council of Agricultural Research so that they may be placed before the next meeting of the Advisory Board of that Council which is timed to take place in the second week of February, 1936.

It is some years since I first conceived the idea of doing some work on this subject but for a variety of reasons it has not been possible for me to make definite proposals for carrying this out until the present moment, and I am able to do so now only because Mr. Riazul Hassan, Deputy Director, Imperial Veterinary Serum Institute, Izatnagar, has suggested that the work might be carried out under his supervision at Izatnagar, and the note and details of the experiment and estimated expenditure enclosed herein have been prepared by him.

As explained in the note of the protection of dogs on a large scale by the use of a single dose vaccine has been in vogue in several other countries for some years past and statistics have been presented for the purpose of showing that this method of control is very efficient, but it appears that no carefully controlled experiment has been undertaken to prove that the type of vaccine, which is used in Japan and would be the most suitable for this country, will really protect dogs against rabies for any length of time, and the piece of work which it is now proposed to do is designed for the purpose of coming to a decision on this point. If this vaccine is really efficient, then its use should be advocated by the Civil Veterinary Department in this country, for it would be a comparatively simple matter in Municipalities and other areas where licensing of dogs is undertaken to insist that each dog before granted a license receives a dose of vaccine, and we should then have made a commencement in bringing this terrible disease under control in India. On the other hand if this vaccine is not really efficient, then we should be doing a great disservice to India to recommend its introduction, for not only would it be putting Municipalities to an unnecessary expense, but it would be placing a large number of people in what is commonly known as a 'Fool's paradise', for they would be under the false impression that their dog was not susceptible to rabies, when he was actually so.

It will be observed that the scheme involves the use of Japanese vaccine which was originally introduced by Umeno and Doi, but work on this type of vaccine is in progress in other countries and it is quite possible that before funds are allotted for this scheme some other vaccine will be thought more promising. In any case, I have the authority of the Director, Pasteur Institute, Kasauli, to say that he is prepared to help us to come to a decision in regard to the best type of vaccine to use when the time comes to commence the work.

One item in the estimates which requires some explanation is the sum of Rs. 3,400 for dog kennels and rabbit houses. I know it is the policy of the Imperial Council of Agricultural Research usually to refuse to provide money for buildings, but I propose that they should be asked to make an exception in this case. It will be necessary to have specially constructed buildings for the care of animals while under this experiment, and nothing suitable is available at Izatnagar. The buildings it is proposed to construct are as *kutchas* as possible but they must be solid enough to hold a rabid dog. They will contain a good deal of such material as angle iron, which can be auctioned at the end of the experiment and the proceeds credited to the Imperial Council of Agricultural Research.

VACCINATION AGAINST RABIES BY S. R. HASSAN, M.R.C.V.S., L.M., DEPUTY DIRECTOR, IMPERIAL VETERINARY SERUM INSTITUTE, IZATNAGAR.

In submitting this scheme it appears to be unnecessary to elaborate to any great degree the urgent necessity for undertaking research work on this disease with special reference to its prevention and control in this country. Examination of the reports of the Pasteur Institute, Kasauli, reveals a steady increase in the number of persons treated there and at other centres in India, from 32 in 1900-01 to 15,933 in 1933.

While the increase probably represents an increase education of the general populace to the danger of the disease rather than to an actual increase in the incidence and spread of the disease, the figures of recent years, which are still almost certainly much less than the number of persons actually bitten, are, I submit, sufficiently impressive to justify considerable expenditure on preventive research, and the time would appear to be ripe for the institution of measures designed to reduce the incidence of the disease in man by prophylactic vaccination of the normal carrier, the dog.

In most other countries where the disease is endemic, as in India, and where direct extermination by a policy of slaughter and segregation of suspects cannot be applied, research work on preventive vaccination has already been done, and in some cases the results have been applied with, it is claimed, marked success. Japan, United States of America, Italy, France and Germany have all contributed to the literature upon the practical application of prophylactic vaccination of dogs against Rabies and in every case data have been accumulated to show that a significant decrease in the incidence of this disease in dogs has resulted.

In Japan out of approximately 2,60,000 dogs vaccinated by the method of Umeno and Doi only 169 contracted the disease during the year following vaccination while 5,881 cases occurred amongst unvaccinated dogs. It has further been shown that a significant decrease in the number of persons bitten and in the number of deaths from rabies has occurred after systematic vaccination by this method. Similar claims with regard to the reduction in the incidence have also been made by workers in the United States of America.

In assessing the value of such claims it is necessary to call attention to the fact that the vaccinated groups of dogs are naturally obtained from those already under some form of administrative control and are therefore less likely to be exposed to the risk of infection than the less controlled unvaccinated dogs. In India it is clear that, though the institution of measures for the prophylactic inoculation of dogs against rabies is unlikely to stamp out the disease at least within a measurable period of time, it should, if really efficient, provide a barrier between the disease in its natural host, the dog, especially the pariah dog, and the jackal, and implantation in adventitious hosts such as man and his domesticated animals. It is also clear that even for application on a small scale in the field the vaccine must be innocuous and easily administered. For these reasons the established methods of vaccination founded on Pasteur's original method and its many modifications which require frequent injection over a considerable time (1-3 weeks) are

impracticable and any investigation upon the relative merits of a particular vaccine can be limited to those which can be given at one or at most two injections.

At present three types of vaccine for the dog have been elaborated, *viz.*:—a glycerinated carbolised vaccine first prepared by Umeno and Doi in Japan, an etherised vaccine prepared by Remlinger in the French Mediterranean colonies, and a dextrinised vaccine prepared by Plantureux in France. Of these the first has received the greatest attention and as only one injection is required and the material is stable for two months it would appear to be the most suitable for Indian conditions. The second lacks stability and requires the administration of two injections. The third is also unstable and requires a double inoculation.

A complete scheme covering approximately 2½ years work for the investigation of the prophylactic value in India of a vaccine prepared according to the method of Umeno and Doi at an estimated cost of Rs. 16,342 is submitted below:—

*Experiments to determine the immunity conferred against Rabies by a single dose of glycerinated carbolised vaccine.*

The vaccine will be prepared according to the method of Umeno and Doi, which in brief is as follows:—the brain and spinal cord of a rabbit killed by fixed virus is emulsified in four parts of the following mixtures:—

5 per cent. aqueous solution of carbolic acid: 40 volumes.

Pure neutral glycerine. 60 volumes.

The emulsion should be kept before use either at a temperature of 18°C. to 20°C. for 14 days or in the ice chest for one month.

A single dose of 5-6 c. c. of vaccine equivalent to about 1 gramme of fixed virus is sufficient to confer immunity on an average-sized dog weighing 15 killogrammes. In the case of rabbits the dose will be fixed according to the body-weight.

The degree of attenuation is the most important factor in the technique of its preparation. A properly prepared vaccine can be used for two months if kept in a dark, cool place. Therefore, the stability of the vaccine ensures its use at a long distance from the centre of its preparation. The vaccine suspension should be well shaken before being taken into the syringe.

*Experimental work.*

The experiments will be limited to testing the efficacy of the vaccine as a prophylactic pre-infection vaccination.

*Method of infection.*

The most useful method of testing the efficacy of the vaccination will be by the natural method, *i.e.*, allowing the experimental dogs to be bitten by a rabid dog. As, however, the provision of rabid dogs in the most stage of the disease to insure the passage of infection is no



likely always to be practicable it is proposed in the first instance to convey infection artificially by the introduction of known infective material either intrathecally in the case of rabbits or intracorneally in the case of dogs.

*Interval between inoculation and infection.*

Batches of rabbits and dogs will be infected at different intervals after inoculation to determine (1) how long it takes for immunity to develop; (2) how long the immunity lasts. Intervals of one, three, five and seven months in the case of the rabbit and one, five, nine and thirteen months in the case of dogs are suggested.

*Experiment on Rabbits.*

To begin with, a batch of 20 rabbits will be vaccinated, and a second lot of the same number will be done a month later. From these two lots 5 will be selected and infected along with 5 controls according to the following table:—

| Number of rabbits.        | Lot. | Interval. |
|---------------------------|------|-----------|
| 5 vaccinated + 5 controls | I    | 1 month.  |
| 5 vaccinated + 5 controls | II   | 1 month.  |
| 5 vaccinated + 5 controls | I    | 3 months. |
| 5 vaccinated + 5 controls | II   | 3 months. |
| 5 vaccinated + 5 controls | I    | 5 months. |
| 5 vaccinated + 5 controls | II   | 5 months. |
| 5 vaccinated + 5 controls | I    | 7 months. |
| 5 vaccinated + 5 controls | II   | 7 months. |

Thus in the above scheme the rabbits will be immunised in two lots at a month's interval and infected in eight batches in a period of 7 months. Rabbits which have been infected will be kept under observation for at least six months.

*Experiments on dogs.*

In order to test the immunity 10 dogs will be used for each experiment. Of these 5 will be vaccinated dogs and the other 5 healthy to act as controls. The infection will be conveyed by intracorneal injection of fixed virus emulsion which is now considered a certain method of infection. The vaccinated and control dogs should be kept in separate kennels after infection for observation and any animal showing early symptoms of rabies will be removed and segregated to prevent its biting other dogs of the batch in order to avoid complications in the experiment. In order to obtain sufficient data 80 dogs will be required, 40 to be vaccinated and 40 kept as controls. The following scheme is suggested: Vaccinate the first lot of 20 dogs, and then one month later the second

lot and infect the vaccinated and control dogs as shown in the following table:—

| Number of dogs.           | Lot. | Interval.  |
|---------------------------|------|------------|
| 5 vaccinated + 5 controls | I    | 1 month.   |
| 5 vaccinated + 5 controls | II   | 1 month.   |
| 5 vaccinated + 5 controls | I    | 5 months.  |
| 5 vaccinated + 5 controls | II   | 5 months.  |
| 5 vaccinated + 5 controls | I    | 9 months.  |
| 5 vaccinated + 5 controls | II   | 9 months.  |
| 5 vaccinated + 5 controls | I    | 13 months. |
| 5 vaccinated + 5 controls | II   | 13 months. |

In the above scheme the dogs will be immunised in two groups at two months' interval and infected in eight batches during a period of 13 months.

Dogs which have been exposed to infection will be kept under observation for one year as immunisation may prolong the incubation period. In the case of any animal developing symptoms of Rabies the usual confirmatory tests will be carried out at post-mortem.

*Details of estimated expenditure, on rabbits.*

|  | Rs.   |
|--|-------|
| 1. Cost of rabbits required for vaccine preparation, virus production and confirmatory test, 176 rabbits at Rs. 2 each | 352   |
| 2. Cost of feed and keep of rabbits at Rs. 2 per mensem  | 1,072 |
| 3. Pay of attendants at Rs. 10-8-0 per mensem  | 189   |
| 4. Cost of cages and trays etc.  | 300   |

*On dogs.*

|  |       |
|--|-------|
| 1. Cost of 80 dogs required for the experiment at Re. 1-8-0 each   | 120   |
| 2. Feeding charges at Rs. 6 per month per dog  | 4,800 |
| 3. Pay of sweepers at Rs. 12 per mensem at the rate of 1 sweeper for 8 dogs                                  | 1,200 |
| 4. Cost of chains, clothing and muzzles etc. at Rs. 3 per dog  | 240   |
| 5. Cost of 106 rabbits required for vaccine preparation virus production and confirmatory test at Rs. 2 each | 212   |
| 6. Cost of feeding 106 rabbits at Rs. 2 per month  | 212   |
| 7. Cost of cages and trays etc.  | 150   |

*General Expenditure.*

|   |        |
|---|--------|
| 1. Chemicals and apparatus  | 250    |
| 2. Stationery   | 100    |
| 3. Pay of Laboratory Assistant at Rs. 40 per mensem for 32 months           | 1,280  |
| 4. Pay of 2 Laboratory Subordinates at Rs. 15 per mensem each for 32 months | 960    |
| 5. Cost of kennels and rabbit houses.                                       | 3,420  |
|   | <hr/>  |
|   | 14,857 |
| 6. Add—10 per cent. miscellaneous expenditure and contingencies             | 1,485  |
|   | <hr/>  |
| Grand Total   | 16,342 |

## APPENDIX XXXIII.

**Report of the Committee appointed to consider Bombay scheme for control of ticks and progress reports of Veterinary Investigation Officers, etc., which met at New Delhi on the 12th February 1936.**

## PRESENT:

1. Col. A. OLVER (*Chairman*).
2. Mr. B. K. BADAMI.
3. Mr. T. J. EGAN.
4. Mr. E. S. FARBROTHER.
5. Rai Sahib S. GHOSH.
6. Mr. P. J. KERR.
7. Mr. R. N. NAIK.
8. Rai Bahadur R. V. PILLAI.
9. Major P. B. RILEY.
10. Mr. P. T. SAUNDERS.
11. Mr. S. M. A. SHAIK.
12. Mr. F. WARE.
13. Rao Bahadur M. VAIDYANATHAN.

1. *Application from the Government of Bombay for a recurring grant of Rs. 59,485 to test the value of different methods of controlling or eradicating ticks in this country. (Subject No. 19 of the Agenda). (App. XXIX).*—It was agreed that the work proposed under this scheme was of very great importance and should be proceeded with as quickly as possible. It was mentioned that it was a matter of great urgency to obtain funds quickly as there was a possibility of the villagers failing to carry out their part of the contract if initiation of the work was long delayed. A plan of a smaller and cheaper bath, which had been in use in the Bombay Presidency for over a year, was shown and it was agreed that this will be suitable for the villagers concerned in this experiment. It was also agreed that it would be very desirable, if possible, to avoid poisonous dips, such as standard arsenical dips, but that it was necessary to start work with one standard dip and to test out a number of others.

Mr. Hare, local representative of Cooper's Sheep Dips in India, was asked to attend the meeting and promised to furnish details and to give costs of their dips.

The first part of the scheme for experimentation with the cattle dipping baths was approved as it stood and as regards the use of spraying machines it was decided to ask Messrs. Cooper to supply full information as to the cost of their big spraying plant, which was considered to be the only one likely to be suitable for the purpose, and as to what facilities the firm could give for carrying out this work. It was understood that this information would be available at an early date and it was decided that further consideration of the scheme should be deferred until the summer meeting of the Advisory Board, by which time it was anticipated that full information would be available from Messrs. Cooper's representative.

**2. Progress Reports on Veterinary Research Scheme sanctioned by the Imperial Council of Agricultural Research:—**

- (i) Annual Report on the work of the Veterinary Investigation Officer, Madras for 1934-35.
- (ii) Annual Report on the work of the Veterinary Investigation Officer, Bombay for 1934-35.
- (iii) Annual Report on the work of the Veterinary Investigation Officer, Bengal, for 1934-35.
- (iv) Annual Report on the work of the Veterinary Investigation Officer, United Provinces, for 1934-35.
- (v) Annual Report on the work of the Veterinary Investigation Officer, Punjab, for 1934-35.
- (vi) Annual Report on the work of the Veterinary Investigation Officer, Bihar and Orissa, for 1934-35.
- (vii) Annual Report on the work of the Veterinary Investigation Officer, Central Provinces, for 1934-35.
- (viii) Annual Report on the work of the Veterinary Investigation Officer, Assam, for 1934-35.
- (ix) Annual Report on the work of the Veterinary Investigation Officer, Hyderabad, for 1934-35.

(Subject No. 7 of the Agenda.)

These reports were considered and it was agreed that very valuable work was being done. It was considered that the reports, in one or two cases, were unnecessarily long for the ordinary annual report of a Disease Investigation Officer. Such reports should deal only with the work done and the conclusions arrived at during the year's working and should show clearly to what extent these conclusions were supported by actual findings. It was not necessary in each yearly report to give a complete survey of the existing position and it was agreed that where special reports on any particular investigation were made they were best put up in the form of an appendix to the main report. It was also agreed that after completion of 4 years' work, each Disease Investigation Officer should prepare a comprehensive survey of the work done during the whole period for submission to the Council, so that it could be available when extension of the work came up for consideration.

In order to avoid overlapping and to ensure that most important lines of work would be taken up in suitable localities, it was agreed that Disease Investigation Officers of the different Provinces and States should concentrate on the following subjects:—

**Madras.**

1. Black-quarter.
2. Hæmorrhagic Septicaemia.
3. Sheep and goat diseases.

*Bombay.*

1. Theileriasis.
2. Tuberculosis and Johne's disease.
3. Poultry diseases.
4. Tick infestation.

*Bengal.*

1. Hump sore.
2. Contagious abortion.
3. Bovine Lymphangitis.
4. Foot and-Mouth disease.

*United Provinces.*

1. Surra.
2. Immunization of buffaloes against Rinderpest.
3. Horn cancer.
4. Poultry diseases.

*Punjab.*

1. The testing of immunity against Rinderpest.
2. Brucella infection at Hissar Farm.
3. Equine surra.
4. Deficiency diseases in calves.
5. Incidence of Tuberculosis in dairy herds.
6. Fowl diseases.

*Bihar and Orissa.*

1. Rinderpest immunization in buffaloes.
2. Fowl diseases.
3. Horn cancer.
4. Enzootic Otorrhoea in buffaloes.

*Central Provinces.*

1. Rinderpest immunization.
2. Treatment of bovine surra.
3. Mange in calves and goats.
4. Fowl diseases.

**Assam.**

1. Johne's disease.
2. Hump sore.
3. Bovine Contagious Pleuro-Pneumonia.
4. Sloughing sickness in Cattle.

*Hyderabad State.*

1. Tuberculosis.
2. Sheep diseases.
3. Bovine surra.
4. Osteomyelitis in cattle.

3. *Application from the Director, Imperial Institute of Veterinary Research, for a grant of Rs. 16,342 (Rs. 11,298 recurring and Rs. 5,041 non-recurring) spread over a period of 2 years and 8 months for a scheme for research on an anti-rabic vaccine for dogs. (Subject No. 41 of the Agenda). App. XXXII.*—This scheme was considered in detail. Mr. Ware referred to the importance of instituting research in regard to the control of Rabies among dogs in India and mentioned that at the Medical Research Council meeting in Calcutta in December 1935, a resolution was passed asking that this matter might be taken up by Veterinary Departments in India. He stated that the experimental work proposed was quite simple, its object being to carry out systematic tests, which had never been done in India, on some of the available methods of control which had been extensively used in other countries. The details of the scheme were discussed and it was agreed that the line of work proposed was suitable for the purpose. As regards the cost of the scheme, certain modifications were made which are shown in the attached table which should be substituted for the details of estimated expenditure given on page 10 of the original scheme. With these modifications the scheme was somewhat cheaper than originally proposed and it was considered that it should be sanctioned. It was pointed out that Mr. Riazul Hasan had been engaged in work on Rabies in the past and it was very desirable that the opportunity should be taken of utilizing his services for this purpose while at Izatnagar where he would be able to work in close touch with the Muktesar Institute.

4. *Application from the University of Madras for a grant of Rs. 21,300 for a scheme of enquiry into Helminthiasis of Cattle in the Madras Presidency spread over a period of 5 years (Subject No. 39 of the Agenda).*—In regard to this scheme it was ascertained from the Director of Veterinary Services, Madras, that no information was available as to the qualifications of the research scholar for carrying out the work proposed under the scheme. It was considered that the scheme should be postponed until the summer meeting of the Advisory Board when more definite information might be available as to the proposed working of the scheme.

A. OLVER.

Colonel

12th February 1936.

*Details of estimated expenditure on rabbits.*

|   | Rs.    |
|---|--------|
| 1. Cost of rabbits required for vaccine preparation virus production and confirmatory test, 176 rabbits at Rs. 2 each . . . . . | 352    |
| 2. Cost of feed and keep of rabbits at Rs. 1-8 per mensem . . . . .   | 804    |
| 3. Pay of attendants at Rs. 10-8-0 per mensem . . . . .   | 129    |
| 4. Cost of cages and trays etc. . . . .   | 300    |
| <i>On dogs.</i>   |        |
| 1. Cost of 80 dogs required for the experiment at Rs. 1-8-0 each . . . . .  | 120    |
| 2. Feeding charges at Rs. 4 per month per dog . . . . .   | 3,200  |
| 3. Pay of sweepers at Rs. 12 per mensem at the rate of 1 sweeper for 8 dogs . . . . .   | 1,200  |
| 4. Cost of chains, and muzzles etc. at Rs. 2 per dog . . . . .  | 160    |
| 5. Cost of 106 rabbits required for vaccine preparation, virus production and confirmatory test Re. 1 each . . . . .            | 106    |
| 6. Cost of feeding 106 rabbits at Rs. 1-8 per month . . . . .   | 159    |
| 7. Cost of cages and trays etc. . . . .   | 150    |
| <i>General Expenditure.</i>   |        |
| 1. Chemicals and apparatus . . . . .  | 250    |
| 2. Stationery . . . . .   | 100    |
| 3. Pay of Laboratory Assistant at Rs. 60 per mensem for 32 months . . . . .   | 1,920  |
| 4. Pay of 2 Laboratory Subordinates at Rs. 15 per mensem each for 32 months . . . . .   | 960    |
| 5. Cost of kennels and rabbit houses . . . . .  | 3,420  |
|   | 13,390 |
| 6. Add—10 per cent. Miscellaneous Expenditure and contingencies . . . . .   | 1,339  |
| Grand Total . . . . .   | 14,729 |

## APPENDIX XXXIV.

Report of the Soil Scheme Committee held at New Delhi, on 12th February 1936 at 2-0 p.m.

## PRESENT:

1. Dr. F. J. F. SHAW (*Chairman*).
2. Mr. D. V. BAL.
3. Dr. J. K. BASU.
4. Mr. M. CARBERY.
5. Mr. J. CHARLTON.
6. Dr. J. C. GHOSH.
7. Dr. P. G. KRISHNA.
8. Dr. T. J. MERCHANTANI.
9. Dr. J. N. MUKHERJEE.
10. Dr. NAZIR AHMAD.
11. Rao Bahadur V. A. TEMBANE.
12. Dr. E. MACKENZIE TAYLOR.
13. Rao Bahadur B. VISWANATH.

*Second progress report on the scheme for a study of soil problems by the Physical Assistant appointed on the staff of the Agricultural Chemist, Bengal, for 1933-34 [item 28 (a) of the Agenda]. (Appendix XXXV).—*The Committee recommend that results should not be stated in *chattacks* and *tolas* but in lbs. and decimals of lbs. They suggest that the whole work should be extended to the level of the water table. The report was approved.

*Report of the work done in the Agricultural Research Section of the Department of Chemistry, Dacca, during 1934-35 [item 28 (b) of the Agenda]. (Appendix XXXVI).—*The Committee consider that typical soil samples not exceeding three should be collected from each of the following provinces. Punjab, Burmah, Sind, Bengal, Bombay, Pusa, Central Provinces, Madras and sent to the following laboratories:—

Dacca,

Dr. Mackenzie Taylor, Lahore,

Dr. Mukherjee at Calcutta,

The Imperial Institute of Agricultural Research, Pusa.

Sind, Sakrand,

Bihar, Sabour,

Hyderabad (Deccan), Dr. Krishna,

Bombay, Padegaon, and

Dr. Bal at Nagpur.

The Committee decided that the methods of mechanical analysis of Truog—the international method and the alkaline permanganate method developed at Dacca, should be tried on these samples and the results compared and reported to the Imperial Council of Agricultural Research.



Regarding the work on nitrogen supply to rice plant carried out at the Dacca University, the Committee approved of the report and recommend that Mr. De be deputed for one year to work in the laboratory of Professor Fritsch.

*Annual report of the work done during 1934-35 under the scheme for research into the properties of colloid soil constituents by Professor J. N. Mukherjee [item 28 (c) of the Agenda]. (Appendix XXXVII).—The Committee approved of the report.*

*Application from the Government of Bengal for a grant of Rs. 27,720 spread over a period of five years on account of the extension of the scheme sanctioned for studying soil problems in Bengal [item 29 of the Agenda]. (Appendix XXXVIII).—The Committee considered that the matter was of an all-India character, as was recognised at the time when the scheme was sanctioned, and applies equally well to other parts of India, e.g., the Punjab, and considered that the work is of general importance for soils in India. The Committee recommend the scheme to the Advisory Board. Regarding the incremental scale of salary of the Physical Chemist, if the Bengal Government does not give the increment, the savings should be refunded to the Imperial Council of Agricultural Research. The Committee decided to change the wording of the sentence at the end of page 2 of the proposal by the Department of Agriculture, Bengal, for the extension of the scheme sanctioned for studying soil problems in Bengal to read as follows:—*

“Thus the investigation might be expected to give information as to whether it is better to give a last or final watering to an existing crop than to establish a succeeding crop”.

*Application from the Government of Bombay for a grant of Rs. 21,672 spread over four years for a scheme to investigate the changes in the micro-flora of kallar soils in Sind (item 52 of the Agenda). (Appendix XXXIX).—The Committee recommend the scheme to the Board, and consider that if the scheme is to be taken up, it should be taken up in Sind for which the scheme is more urgent than for the Punjab (Mr. Charlton dissenting on the ground that it is a matter essentially for the provinces). The scale of salary should be the same as that in the province.*

*Application from the Government of Mysore for a grant for Rs. 10,000 spread over three years for a scheme of study of the colloids in tropical soils at the Chemistry Department, Central College, Bangalore, by Dr. B. Sanjiva Rao (item 33 of the Agenda). (Appendix XL).—The Committee considered that the work is fully covered by schemes already in progress or approved by the Board and do not, therefore, recommend this scheme.*

*Application from the Government of Bihar and Orissa for a grant of Rs. 13,708 spread over three years for the determination of nutrient content in the Indian soils (item 34 of the Agenda). (Appendix XLI).—The Committee considered that the work could be better carried out at the Imperial Institute of Agricultural Research (without any help from the Imperial Council of Agricultural Research) which should first take up the survey of the literature and available information. The information thus collected should be considered by the Soil Science Committee at its next meeting.*

*Sanction for the purchase of apparatus required for the scheme for investigation on the Physico-chemical properties of the clay fraction of lateritic soils and of the Dacca mixed soils and the nutrition of the rice plant out of the grant already sanctioned by the Council (item 35 of the Agenda). (Appendix XLII).—The matter was recorded.*

F. J. F. SHAW.

**APPENDIX XXXV.**

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 1st February 1936 on Subject No. 28 (a):—Second Progress Report on the scheme for a study of Soil Problems by the Physical Assistant appointed on the staff of the Agricultural Chemist, Bengal, for the year 1933-34.**

In view of numerous mistakes contained in the printed copies of the report previously circulated to the Advisory Board, the Director of Agriculture, Bengal has kindly arranged for a fresh reprint of the same, a copy of which is now attached. (Not printed).

As usual the report will be considered in the first instance by the Soil Science Committee whose report will be circulated in due course.

## APPENDIX XXXVI.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 6th February 1936 on Subject No. 28 (b):—Report of the work done in the Agricultural Research Section of the Department of Chemistry, Dacca University, Dacca, during the year 1934-35.**

In continuation of the note, dated the 21st January 1936, already circulated, a copy of a letter from Professor J. C. Ghosh, dated the 22nd January 1936, (and enclosures) regarding a proposal to depute Mr. P. K. De, the Senior Assistant (Biochemist) working under the Scheme to work in the laboratory of Professor Fritsch, Head of the Department of Botany, Queen Mary College, London, for one year in the first instance, is circulated, for consideration.

COPY OF A LETTER FROM PROFESSOR J. C. GHOSH, D.Sc., HEAD OF THE DEPARTMENT OF CHEMISTRY, UNIVERSITY OF DACCA, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, DELHI, DATED THE 22ND JANUARY 1936.

I beg to refer you to the report of the Standing Soil Committee adopted in their meeting of 6th September 1934. The Committee reviewed the work that had been done in this laboratory regarding the problem of N-supply to the rice plant and considered that the green film obtained from Faridpur soil should be identified as soon as possible and the necessary material should be sent to Rothamsted for this purpose. The Director of Rothamsted suggested to me that I should get in touch with Prof. F. E. Fritsch, D.Sc., F.R.S., Head of Department of Botany, Queen Mary College, (University of London) about the solution of this problem. I enclose herewith copies of recent correspondence between Prof. Fritsch and myself on this subject. It appears that in order to bring this work to a satisfactory conclusion, it is necessary to carry on this investigation under the direction of a professor who has specialised in the technique of obtaining pure algae cultures. I, therefore, request that you may be pleased to sanction the deputation of Mr. P. K. De, our senior Research Assistant to the laboratory of Prof. Fritsch in London, for the period of one year in the first instance. He may be permitted to draw his present salary during this period of deputation.

Dr. A. T. Sen, the Agricultural Research Chemist, Dacca University, who is in charge of this investigation, is of opinion that no substitute of Mr. De be appointed during this period of deputation to investigate the other problems relating to the nutrition of rice which we have undertaken. He considers that these other investigations would not suffer materially in view of the assistance he will get from the other two assistants appointed by the Imperial Council of Agricultural Research.

It will be necessary for the Imperial Council of Agricultural Research to contribute a part of the travelling expenses of Mr. De to England. I may point out that an annual grant of Rs. 500 for a period of 3 years has been made by the Imperial Council of Agricultural Research for the purpose of travelling allowance. I suggest that a sum of Rs. 750 out of the sanctioned grant of Rs. 1,500 may be earmarked for the travelling expenses of Mr. De.

Prof. Fritsch has readily agreed to supervise this work, and in view of the possibility that the isolation of algae which are responsible directly or indirectly for the fixation of nitrogen in Indian paddy soils may be a definite contribution to our knowledge of the subject, I recommend very strongly that this proposal may be accepted.

## QUEEN MARY COLLEGE.

(University of London).

8-11-35.

## DEPARTMENT OF BOTANY.

Head of Department: University Professor F. E. Fritsch, D.Sc., F.R.S.

Dear Prof. Ghosh,

I have duly received the two fresh cultures in sealed tubes notified in your letter of September 23 and have spent as much time over their examination as I can spare. Neither are at all pure, although No. 1 is purer than No. 2. Here are the results:—

*Tube No. 1* contains a blue-green alga, together with what I take to be a number of fungal hyphae and a good deal of an undeterminable green unicellular alga. The blue-green alga, which makes up the bulk of the sample, is a species of *Phormidium* closely related to *P. orientale* West. It differs from the published descriptions in narrower width, shorter cells, and the pale colour of the trichomes. Very occasional threads, however, have the elongate cells of the type. I should be inclined to suspect that the shortness of the cells might be a result of rapid cell-division under cultural conditions and would therefore regard the material as a cultural form of *Phormidium orientale* showing the differences above enumerated.

*Tube No. 2* contains quite different material, most of which is in a very unhealthy state; moreover numerous Bacteria appear to be present. There is none of the *Phormidium* and the bulk of the material consists of a species of *Anabaena*, possibly some form of *A. sphaerica*, although it is quite impossible to determine the material satisfactorily in its present condition.

I have re-examined the material of the 3rd sub-culture sent to me last February which I had preserved in formalin. I see no reason to alter the conclusions about this which I expressed in my letter of September 23 to Dr. Sen. The principal form present is a *Plectonema*, certainly very near to *P. notatum*, Schmidle. The narrower form to which I referred in my previous letter is possibly the same *Phormidium orientale* above mentioned as constituting the bulk of tube No. 1.

You will realise from these data that your cultures are far from pure. They contain a mixture of forms, some of which come to the front in one culture and some in another. Moreover, several of your cultures also contain Bacteria and perhaps Fungi. If you desire to get at the organisms responsible for nitrogen fixation you will therefore have to obtain cultures of a much greater degree of purity. The obtaining of blue-green algae (*Myxophyceae*) in pure culture, particularly devoid of Bacteria, involves a difficult technique and is rather laborious, in fact full success has only been achieved in quite recent times.

You sent with your last cultures also a sample of soil. Such a soil-sample would afford a whole host of algae and their individual isolation would take a long time. I have no one I can put on to this work here and I am far too busy to be able to undertake it myself. It appears to me that you want to get hold of some one in India who has had experience of work on soil algae and their isolation. Such a worker might after an

interval be able to isolate the different principal organisms in your soil and to obtain them in really pure culture. I had working here for some years an Indian lady, Miss James, from Madras who carried out these kinds of investigations on British soil algae. She would be competent to carry out the work, but I do not know whether she is available. You could easily ascertain, if you wrote to Prof. Iyengar of the Presidency College, Madras. If this is not feasible, you may be able to find a young botanist in your own University who can carry out the work. I shall be glad to help him by telling him of the literature as to method and by examining his cultures as to purity.

Yours sincerely,

(Sd.) F. E. FRITSCH.

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COPY OF A LETTER NO. G/58, DATED THE 7TH DECEMBER 1935, FROM PROFESSOR J. C. GHOSH, D.Sc., DACCA UNIVERSITY, TO PROFESSOR F. E. FRITSCH.

I thank you for your kind letter of the 8th November 1935. We are much obliged to you for the kind interest you took in the problem of finding the organism responsible for the fixation of nitrogen in the water-logged soil. I quite realise your difficulties in devoting more time to solve our problem. I am doubtful whether your suggestion to find a young Botanist who could carry out such work in my laboratory is feasible in India. Instead, I am thinking of sending Mr. P. K. De, my Research Assistant who has actually been engaged in this Problem in this laboratory to you for learning the technique of obtaining in pure culture blue-green algae or the organism responsible for fixation of nitrogen in water-logged soil. I shall be glad if you would be kind enough to consent to take the Assistant under you for one year's training, provided the Imperial Council of Agricultural Research, India, under whose auspices this work is being carried out agree to the procedure. I am enclosing a statement of qualifications of Mr. P. K. De.

On receipt of your reply if possible by air mail, I shall move the Imperial Council of Agricultural Research in India for deputation of Mr. De to your laboratory for working out the problem under your guidance. Should you find it inconvenient to supervise his work yourself, I shall be glad to know where, in Great Britain, he could be sent for this purpose.

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QUEEN MARY COLLEGE,

(University of London).

7th January, 1936.

DEPARTMENT OF BOTANY.

Head of Department: University Professor F. E. Fritsch, D.Sc., F.R.S.

Dear Professor Ghosh,

I am sorry for the delay in answering your letter of December 7th, but the Christmas vacation has intervened.

My research laboratory is at the moment rather full, but I think I could manage to find a place for Mr. P. K. De with the object of letting

him get practice in making pure cultures of algae. I would recommend that he should bring with him some of the soil in which you are interested, as well as possibly some of the cultures. He could then work on both of these and try and obtain actually pure cultures from them.

I am sending this letter by air mail, and would suggest that Mr. De should telephone this College as soon as he arrives in this Country and to arrange an interview with me.

Your sincerely,

(Sd.) F. E. FRITSCH.

**APPENDIX XXXVII.**

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 8th October 1935 on Subject No. 28 (c):—Annual Report of the work done during 1934-35, under the scheme for Research into the properties of Colloid Soil Constituents, by Professor J. N. Mukherji.**

The attached progress report (Annexure not printed) on the work done during 1934-35, under the scheme for research into the properties of colloid soil constituents by Dr. J. N. Mukherjee of the Calcutta University, is submitted for the consideration of the Advisory Board. The progress reports for the periods 1st October 1930 to the 31st March 1932, 1st April 1932 to 31st March 1933 and 1st April 1933 to 31st March 1934, respectively, have already been submitted to the Advisory Board at its meetings held in July 1932, August 1933 and September 1934.

The Vice-Chairman to the Council considers that as in the past this report should also first be examined by the Standing Soil Science Committee of the Council. The report of the Committee will be submitted to the Advisory Board in due course.



## APPENDIX XXXVIII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 1st January 1936, on Subject No. 29:—Application from the Government of Bengal for a Grant of Rs. 27,720 spread over a period of five years on account of the extension of the scheme sanctioned for studying soil problems in Bengal.**

At its meeting held in January 1931, the Advisory Board recommended for sanction, a scheme for the appointment of a Physical Assistant on the staff of the Agricultural Chemist, Bengal, at a total cost of Rs. 22,568-8-0 spread over a period of five years (*vide* pages 27 and 143-146 of the printed proceedings of the Board). The scheme which was later accepted by the Governing Body was started with effect from the 1st June 1932 and is thus due to terminate at the end of May 1937.

2. The local Government have now applied (Enclosure) for an extension of the scheme for a further period of five years at an estimated cost of Rs. 27,720. The application has been recommended by the Bengal Provincial Agricultural Research Committee, *vide* extracts below:—

"The proposal for the extension of the scheme sanctioned for studying soil problems in Bengal was considered. Both Professor Ghosh and Professor Mukherji referred to the work as being of very high value and said that the results obtained should be examined in other areas under different social conditions. The Committee decided unanimously to press for the extension of the scheme".

3. In accordance with the usual practice, the application will be considered in the first instance by the Standing Soil Science Committee of the Council and its report will be circulated to the Advisory Board in due course.

## ENCLOSURE.

COPY OF LETTER FROM THE SECRETARY TO THE GOVERNMENT OF BENGAL, AGRICULTURE AND INDUSTRIES DEPARTMENT (AGRICULTURE BRANCH), TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI, No. 7038, DATED CALCUTTA, THE 7TH DECEMBER 1935.

SUBJECT:—*Thirteenth meeting of the Advisory Board, Imperial Council of Agricultural Research.*

I am directed to refer to your letter No. F.-2-(10)/35/G., dated the 2nd October, 1935, on the above mentioned subject and to forward herewith, for favour of inclusion in the agenda of the meeting of the Advisory Board to be held in February 1936, the under noted scheme which has been approved by the Bengal Provincial Agricultural Research Committee, together with the relevant extracts from the minutes of the meeting of the Committee held on 30th November 1935. I am to say that Government (Ministry of Agriculture) recommend the scheme subject to the reservation that no financial liability will devolve on them.

Proposal for extension of the scheme sanctioned for studying soil problems in Bengal (Annexure).

2. I am to add that the proposed scales of pay of the staff to be employed in connection with the scheme are being examined with a view to bringing them into line with the provincial scales and that the decision of Government in the matter will be communicated to you later.

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#### ANNEXURE.

#### Proposal by the Department of Agriculture, Bengal, for the extension of the scheme sanctioned for studying soil problems in Bengal.

The Imperial Council of Agricultural Research provided a grant for a Physical Chemist in the staff of the Agricultural Chemist, Bengal, to study physico-chemical problems connected with soil. The scheme was given effect to from 1st June 1932 and it terminates on 31st May 1937.

Of the various soil problems the soil water relationship is perhaps one of the most important factors and until recently the least studied in Indian agriculture. Hence it has now become an economic necessity to accumulate sufficient data about the movement of water in soil in order to utilise them profitably by putting them in some definite form.

Before initiating any investigations into soil moisture relationship it was of necessity to determine some of the physical constants of the typical soils of the province, such as, mechanical composition, permeability constant, maximum water retaining capacity, shrinkage, capillarity, prosity, etc. It is however not possible at this stage to group the soils on the basis of these constants or to discover directly their effect on soil moisture relationship.

Alumina/Silica Ratio of the clay fraction of the more commoner acidic and non-acidic soils of the province have been worked out partly for classification purposes and partly with the object of seeing how far these soils agree with the empirical formula for the laterite and lateritic types. It has been found that the ratios of the so-called laterite soils of the province are much higher than those of the laterite soils examined by Robinson.

Studies on soil moisture formed the main item of investigation. Its movement under field conditions was the first problem to be taken up. The movement of soil moisture may be said to be of two kinds—

- (1) movement within the soil itself—percolation and capillarity; and
- (2) movement away from it—evaporation and transpiration.

No percolation experiment has been done under field conditions but in the laboratory the permeability constant of a large number of soils has been found out. The other two problems, the so-called capillary phenomena and evaporation of water from soil have been studied in detail and it has been possible to show that it is the suction pressure which is responsible for capillary movement of soil water and this suction pressure depends on the curvature of the air water interfaces, i.e., on the water content of the soil. This consideration elucidated the nature of soil water movement and leads to the conclusion that capillarity starts from surface and not from below. This view was also expressed by Dr. Leather.

The second kind of movement that is the escape of water from soil or rather the evaporation of soil moisture depends upon many natural phenomena. The most important of which are temperature and humidity. Neglecting the effect of temperature and humidity, an expression has been deduced to represent the moisture content of the soil.

If  $v$  be the water content of the soil at any time  $t$  then—

$$\frac{dv}{dt} = ka \quad \dots \quad (I)$$

$a$  is the fraction of the surface covered with water film and  $k$  is a constant. (The minus sign is justified in view of the fact that the moisture content decreases with the time.) Assuming that the soil particles are all uniform spheres the moisture film surrounding them that is the thickness of the film will be the same everywhere. Therefore,  $a$  is proportional to  $v$ . Substituting  $v$  for  $a$  we have—

$$\frac{dv}{dt} = k^1 v \quad \dots \quad (II)$$

Integrating we have—

$$\frac{d \log v}{dt} = k^1 \quad \dots \quad (III)$$

Now the volume of the water actually found is not all mobile a part,  $H$  (moisture in the air dry soil) cannot escape from the soil in the field under any circumstances, hence, while considering  $V$ ,  $H$  must be deducted from it. Thus substituting  $(V-H)$  for  $V$  we have—

$$\frac{d \log (V-H)}{dt} = k^1 \quad \dots \quad (IV)$$

$$d \log (V-H) = k^1 dt$$

$$\log (V-H) = k^1 t + \log k^2 \quad \dots \quad (V)$$

at a depth when  $k^1 = 0$

$$\log (V-H) = \log k^2 = \text{constant.}$$

The expression (V) is a true measure of the moisture content of the soil. Experimental results correctly fit the equation. The value of the constants have been calculated from a large number of data collected from the Dacca Farm; so that it is possible with the help of the formula to calculate the moisture content of the soil at any depth and at any time during the dry months.

Another important phenomena brought to light in course of the investigation is that beyond a certain depth there is an "Equilibrium Moisture Zone" which remains at the same moisture content throughout the year and the soil there cannot hold any water excess over its "Equilibrium moisture holding capacity". By the equilibrium moisture holding capacity is meant the amount of moisture the soil can hold at the Equilibrium Moisture Zone. Thus the investigation is expected to be of considerable help in irrigation practices as it affords a means of calculating the requisite amount of water to be given to the cultivators to ensue best results. Knowing the depth of the plant root and the

moisture content of the soil upto the root range it is easy to calculate the quantity of water per acre to be added to raise the moisture content of the soil upto the equilibrium moisture holding capacity of the soil.

(A paper on the subject has been communicated for publication in the Journal of Indian Agricultural Science.)

The investigation however had to be confined to Dacca Farm, only which represents the typical red soil of India. In order to verify the applicability of the results to other types of soil the experiment requires to be extended to other farms representing different soil types in order to make it of general interest.

Investigation into the movement of soil moisture as influenced by the addition of more common manures, such as, lime, bone, green manure and cowdung single by themselves, and in combination with one another have been taken up. Some of the more important physical constants of the treated and untreated soils have been determined. Regarding their water retaining capacity it has been found that the addition of lime in acid soil increases the water retaining capacity while the reverse effect has been noticed in alkaline soil. Lime in combination with bone enhances the retaining capacity in acid soil but the effect is not so marked in alkaline soil.

The above experiment has just been started. Continuous experiment for a number of years is needed before any definite conclusion is possible.

Another important aspect of the investigation is the influence of soil moisture on the yield of a particular crop with respect to a particular manure and soil. This is a much more complicated problem as the absorption of water from soil by a plant or the capacity of the soil to deliver moisture to plant growth depends upon the combined effect of various factors of which soil colloids play an intrinsic part. Investigations on this line are in progress. Experiments have been laid out in 6 farms representing different soil types. Moisture variations in the soil are being studied during the year at an interval of 3 to 4 weeks. The experiments which have been started only last year indicate the existence of an optimum moisture requirement for a particular crop. The optimum moisture requirement for each crop is different. Experiments are being carried out in Pot Culture House where the losses of water being made up by the addition of a fresh quantity after a definite intervals of time. The root development is being studied along with this. The pot culture experiment shows that there are critical periods in the development of the plant. If during the critical periods the water supply is sufficient, drought will do little harm to the plants. Deficient water supply at that stage will ensure permanent injury to the plants resulting in the partial or total failure of crops. Investigation into these critical periods is likely to be of great value.

A miniature agricultural meteorological station which is needed in connection with the studies on soil moisture has been started and observations recorded twice daily. The work so far carried out is of practical interest in Indian agriculture, so that any investigation regarding the relation between the moisture and the plant growth will be of immense value in India. It will be seen from the synopsis of work that the problem is being tackled in the right direction which includes both laboratory and field tests.

It may be mentioned that during the tenure of the present term of the scheme though the work outlined in the original scheme is being

investigated it is not possible within this short period to draw any conclusion especially on the items that necessitate field experiments. It may be pointed out that any investigation that requires field tests is beset with many practical difficulties and the results are never trustworthy unless the data collected for several years show concordance.

The scheme for which the extension is now asked for may be grouped in the following heads:—

(1) The movement of soil moisture under field condition. Though the problem has been comprehensively dealt with in the Dacca Farm it is necessary to see the applicability of the result to other types of soil in order to make it of general interest.

(2) Studies on the effect of manures on soil moisture—on their movement—on the retentive capacity of the soil. How the rate of evaporation and the retentive capacity of the soil are influenced by the addition of more common manures by themselves and in combination with one another and how the capacity of the soil to deliver moisture to plant growth is influenced by the addition of such manures.

(3) Studies on the optimum moisture requirement for a particular crop with respect to various types of soil and manure.

(4) Susceptibility of the plants to drought at various stages of development. The pot culture experiment already referred to shows how the several critical stages in the growth of the plants play an important role in crop production.

(5) Studies on soil texture and tillage with reference to easy ploughing—the use of improved ploughs with the existing cattle population of the country is beset with difficulties. This difficulty is not only felt in Bengal but everywhere in India. Investigations into soil texture and tillage with reference to easy ploughing is expected to be of much value. A few tests of a preliminary nature have been made but the appliance was not upto the mark. Arrangements have, however, been made to indent a dynamometer.

(6) Whether soil water/air ratio has got any relation to the yield of the crop and how this ratio is effected by the addition of manures.

(7) Investigation in soil colloids a knowledge of which will be of great value in studying soil water relationship will be taken up in collaboration with Dr. J. N. Mukerjee of Calcutta University, who is getting grants from the Imperial Council of Agricultural Research for the study of soil colloids.

(8) Effect of meteorological conditions on the movement of soil water.

The work outlined above is of great practical importance not only in Bengal but in India as a whole. The most of the items of work detailed in the original scheme have been taken up but it has not however been possible to come to any definite conclusion within the short time as the work involves field experiments which require to be repeated for a number of years before any conclusion is possible. In the interest of Indian agriculture therefore the scheme should for the present be extended for a further period of five years.

The original scheme provides one Physical Chemist on Rs. 250 per mensem and a laboratory menial on Rs. 20.

It may be mentioned here that in the present term the Government of Bengal have provided ordinary chemicals and apparatus and also the entire



## APPENDIX XXXIX.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 18th January 1936, on Subject No. 32:—Application from the Government of Bombay, for a grant of Rs. 21,672 spread over 4 years for a scheme to investigate the changes in the Microflora of Kalar Soil in Sind.**

Attention is invited to the attached scheme (Enclosure) submitted by the Government of Bombay. The scheme has been approved by the Provincial Agricultural Research Committee, and involves an expenditure of Rs. 21,672 (including a non-recurring expenditure of Rs. 5,400) spread over four years. The local Government does not offer to bear any part of this. The scheme will be examined, in the first instance, by the Standing Soil Science Committee whose report will be circulated to the members of the Advisory Board in due course.

2. It may be noted that a scheme for an investigation of the changes in the Microflora of Kalar and Alkaline Soils during reclamation, submitted by Dr. Jagjiwan Singh, was approved by the Governing Body in January 1935. It will be remembered that during the discussion on that scheme in the Advisory Board session held in February 1934 (*vide* pages 34-35, 359 and 375—381 of the printed proceedings) it was agreed that the Chief Agricultural Officer in Sind should be asked to submit a separate scheme for similar work in Sind.

## ENCLOSURE.

SCHEME TO INVESTIGATE THE CHANGES IN THE MICROFLORA OF  
KALAR SOILS IN SIND.

Sind is an acid country. The average rainfall varies from 3 to 8 inches at different places in the province. The maximum temperature goes often as high as 126° and frosts usually occur in winter. The country is therefore subjected to extremes of climate which greatly influence the weathering of soils. The area of the province is about 47,000 square miles. Excepting on and at the foot of the hills, and in the desert of Thar Parkar district, all the soil of Sind is alluvial. Kalar or salt lands is a peculiar feature of the province. At the Agricultural Research Station, Sakrand, which is situated in Central Sind, as much as 30 per cent. of the total area was found to contain varying amounts of soluble salts, consisting mainly of sodium chloride and sodium sulphate. Vast stretches of kalar lands exist in the province, especially on the right bank of the Indus, which are lying barren. Up to a very recent date, *i.e.*, up to 1932, the only source of irrigation in the province consisted of inundation canals which used to flow from June to October as the water in the Indus rose to a sufficient height to feed these canals. Since 1932, however, perennial supply from the Lloyd Barrage and Canals has been made available and as much as 7,000,000 acres have been now brought under command of the perennial canals, of which 5,000,000 acres can be supplied with water every year. The cost of constructing the Lloyd Barrage and Canals system has been over 20 crores of rupees to Government whereas the vast barren area under kalar lands give no return to the owner and no revenue to the State. Taking 5 per cent. as the lowest estimate of the extent of the existing kalar lands there would be about 250,000 acres of barren land within the command of the canals, each acre of which, when in cultivable condition, would give an average revenue of Rs. 4 per year. This would work out as a net loss of Rs. 1,000,000 every year to Government and a loss of nearly

double that amount to the cultivation taking Rs. 10 as an average net profit per acre to the owner of the land. The problem of reclamation of such *kalar* lands is, therefore, of vital importance to Government and the public alike. Besides, the experience of all the countries in the world show that the evil of the formation of *kalar* lands follows in the wake of irrigation due to seepage, rise of the ground water table, bad drainage, indiscriminate use of irrigation water, etc. As the introduction of perennial irrigation in Sind is only of recent date, it is of paramount importance to study the *modus operandi* of the formation of *kalar* lands as well, in all its details, and to take immediate preventive measures to stop or control the formation of such lands as soon as the first indication is obtained. The study of *kalar* lands includes Chemical, Physical and Biological investigations. Work in connection with Chemical and Physical investigations of the *kalar* lands is already in hand but no work has been undertaken from a biological standpoint. It has been recognised that the microflora of the soil play a very important role in effecting chemical changes in the soil constituents, e.g. nitrification, nitrogen fixation, denitrification, oxidation, reduction, etc., are all due to the activities of the soil microflora, and, it is possible that the study of the micro-organisms in the soil may give an earlier indication of the soil condition both in the process of formation of *kalar* soils as well as in the process of reclamation of *kalar* lands. The importance of the soil micro-organisms will be obvious when it is realised that millions and millions of such organisms have been found in one gram of soil and one acre foot of soils weighs over 1,700 tons. Such an enormous population of the microflora in a soil cannot but have tremendous influence on the constituents of the soil and effect changes in the soil of a very vital importance to the growth of the plants. The presence of a large number of denitrifying bacteria for instance, would indicate that aeration in the soil, was defective, due probably to the soil getting saturated with water and that a condition of water-logging would follow. Thus it is quite possible to locate the damage that is being done to the soil much earlier by a study of the soil microflora than by crop tests.

Similarly, it is quite possible to have clear insight into the process of reclamation of *kalar* lands by a study in the change of microflora of the soil much earlier than by the yield of the crops on such lands. The increase in the number of beneficial micro-organisms in the soil, viz., azotobacter, etc., would indicate that the soil was decidedly undergoing a change for the better and that the reclamation process was going on in the right direction. Thus the study of the microflora of the soil will be a great aid to the Chemical and Physical investigations of *kalar* lands and it is imperative that such a study should be taken in hand as early as possible.

#### *Programme of work.*

The programme of work on the microflora of the soil will consist of—

- (A) Study of the soil microflora during the process of reclamation of *kalar* lands.
- (B) Study of the soil microflora during the process of formation of new *kalar* lands.

(A) *Study of the Soil Microflora during process of reclamation of kalar lands.*—The first operation in the process of reclamation of *kalar* lands is "leaching or flooding the *kalar* lands with water". Starting with bad *kalar*



lands, the following stages have been observed during the process of reclamation:—

- (I) Bad kalar land—barren land, on which seed of ordinary crops, e.g., cotton, wheat, or berseem do not germinate.
- (II) Seed germinates but plants die in the seedling stage.
- (III) Plants grow but are stunted and give a low yield.
- (IV) Plants grow well and give a normal yield.

Under stage IV again, two stages are observed:—

(a) Reclaimed land gradually reverts to *kalar* land if left fallow for a few seasons.

(b) Reclaimed land does not revert to *kalar* land even if left fallow for 2 or 3 seasons at least.

Study in the changes in the species and number of the different micro-organisms will be made in all the above stages from which it will be possible to know which organisms thrive well at different stages of reclamation. Similar study of soil organisms will be made whenever any material is added to the soil in order to hasten the process of reclamation, e.g., green manure, decomposed organic matter, (compost) or mineral substances like gypsum, calcium chloride, sulphur, alum, etc. From such knowledge of the different organisms in the soil, it will be possible to tell the stage of reclamation without incurring any expenditure on growing a crop and waiting for the result.

(B) *Study of the Soil Microflora during the process of formation of new kalar lands.*—The stages during the process of formation of *kalar* lands may be stated as follows:—

- I. Plants turning yellowish and growth stunted.
- II. Patchy growth in the field with localised spots of bad or stunted growth of plants.
- III. Extension of stage II with no germination of seed.

The microflora in all these stages will be studied along with that in the normal soils; this will show which of the beneficial organisms gradually disappear and which ones increase in number during the process of the formation of *kalar* lands.

Chemical and physical study of the *kalar* soils will be continued along with the microbiological study and their correlation obtained. The results will be statistically examined and significance of the results due to different treatments will be determined.

The following would be the probable cost of the scheme:—

*Salaries.*

| —                        | In the grade of | 1st year. | 2nd year. | 3rd year. | 4th year. | Total. |
|--------------------------|-----------------|-----------|-----------|-----------|-----------|--------|
|                          | Rs.             | Rs.       | Rs.       | Rs.       | Rs.       | Rs.    |
| Microbiologist . . .     | 250—20—350      | 3,000     | 3,240     | 3,480     | 3,720     | 13,440 |
| Laboratory Assistant . . | 30—4—50         | 360       | 408       | 456       | 504       | 1,728  |
| Laboratory Boy . . .     | 20—2—30         | 240       | 264       | 288       | 312       | 1,104  |
| Total                    | ..              | 3,600     | 3,912     | 4,224     | 4,536     | 16,272 |

Thus, total for four years will be Rs. 16,272.

|   | Rs.                                |
|---|------------------------------------|
| Laboratory equipment including chemicals and apparatus for four years . . . . . | 2,000 initial,<br>1,200 recurring. |
| Travelling allowance . . . . .  | 1,500                              |
| Contingencies . . . . .   | 700                                |
|   | <hr/> 5,400                        |

The total cost of the scheme would, thus be Rs. 21,672 spread over four years.

The most suitable place for the investigations would be the Agricultural Research Station, Sakrand, where laboratory facilities exist and where chemical and physical investigations of *kalar* lands are being studied.

(Signed) V. A. TAMHANE,  
Agricultural Chemist and Soil Physicist.

## APPENDIX XL.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 20th December 1935 on Subject No. 33:—Application from the Government of Mysore for a grant of Rs. 10,000 spread over three years for a scheme of study of the Colloids in Tropical Soils at the Chemistry Department, Central College, Bangalore, by Dr. B. Sanjiva Rao.**

Attention is invited to the attached note (Annexure) on a scheme of study of the Colloids in Tropical soils, at the Central College, Bangalore, by Dr. B. Sanjiva Rao, which has been received through the Government of Mysore. The scheme would involve, as far as the Council is concerned, non-recurring expenditure of Rs. 2,500 and recurring expenditure of Rs. 7,500 or a total expenditure of Rs. 10,000 spread over a period of three years.

2. The scheme is for the consideration of the Advisory Board. It will first be examined by the Standing Soil Science Committee of the Council on a convenient day between the 10th and 15th February 1936 and the Committee's report will be submitted to the Board in due course.

## ANNEXURE.

A NOTE ON THE SCHEME OF STUDY OF THE COLLOIDS IN TROPICAL SOILS AT THE CHEMISTRY DEPARTMENT, CENTRAL COLLEGE—BY DR. B. SANJIVA RAO.

It is well known that the colloidal matter in soils plays a prominent part in conserving (through the process of adsorption) water and other materials required by plants for their growth and serves these food materials to the plant in a form suitable for assimilation. The colloidal matter also assists the activity of micro-organisms in the soil. A systematic study of soil colloids is being carried out in America under the auspices of the U. S. A. Soil Bureau. Similar work is also being carried out in all other advanced countries.

In tropical places there is a comparatively rapid loss of humus—the organic colloidal matter of soils. The percentage of organic matter in many Indian soils is only 0.6 (expressed as carbon) as against 3.0 in American soils. The retentivity of Indian soils for organic matter is poor as may be gauged from the necessity for supplying to the soil annually organic manures. Preliminary experiments have been carried out in the Central College laboratory to determine the cause of this poor retentivity. It is surmised that the organic matter undergoes photochemical oxidation in presence of certain catalysts present in the soil. A few soils were examined for the presence of vanadium pentoxide—well known as an oxidising catalyst but no vanadium was found in any detectable quantity. We are now exploring the possibility of the catalyst being colloidal ferric oxide. The elucidation of the nature of the catalytic process is of practical importance as it is likely to lead to the conservation of the organic manures employed in Indian agriculture through the use of suitable inhibitors of the oxidation process.

The rapidity in the loss of the humus in Indian soils makes a study of the inorganic colloids in our soils of particular importance as we have to rely on these to compensate for the deficiency in colloidal matter of organic nature. The inorganic colloids in soils consist principally of silica, alumina and ferric oxide. These colloids are in the condition of a gel and

form an envelope round each soil particle. To determine the colloidal matter in the soil this gel has first to be brought into the "sol" form and then isolated. The dispersion of the gel has to be carried out without affecting the non-colloidal content of the soil. The relative merits of the different methods of dispersion are being studied by us and we have tentatively come to the conclusion that Puri's method of dispersion is very satisfactory. More extensive work on methods of dispersion is necessary.

In determining the colloidal content of soils, it is assumed that the adsorptive property of a soil is entirely due to its colloidal content. To determine the colloidal content the adsorptive power of a soil is measured by suitable methods and compared with that possessed by a sample of the colloid isolated from the soil. Adsorption of (a) water (b) ammonia (c) dyestuffs is generally employed. In the "Heat of Wetting" method of Anderson, the heat developed on wetting the soil is compared with that given out by the soil colloid on similar treatment and the colloidal content thus determined. Hydrometer methods have also been employed to determine the colloidal content of soils. The methods employed by (a) Bouyoucos and (b) Puri depend upon the difference in particle size and hence rate of settling of the colloidal and the non-colloidal matter in soils. A comparative study of these methods in their application to tropical soils has already been made by us and we have tentatively come to the following conclusions:—

- (1) Methods based on the adsorption of water, ammonia or dyestuffs are not very satisfactory.
- (2) The Heat of Wetting method gives satisfactory results.
- (3) The hydrometer method of Puri gives better results than the method of Bouyoucos.

In isolating the colloids after their dispersion we have been using the Sharples Supercentrifuge and have found it satisfactory.

We have developed in this laboratory a new method of determining the colloidal content of soils. This method is based on the use of the McBain-Baker quartz spring micro-balance, pyridine being the liquid employed for vapour adsorption studies. The values obtained by this method agree closely with those obtained by the heat of wetting method. Only six soil colloids have been investigated so far by this method. Further work is therefore necessary.

It is now generally recognised that the ratio of silica to the sesquioxides in soil colloids ( $\text{SiO}_2 - \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$ ) is an index of the quality of a soil. The colloidal content of the soil does not by itself tell us very much about the quality of the soil. The silica sesqui-oxide ratio of the soil is usually quite different from the silica sesqui-oxide ratio of the soil colloid. It is believed that the availability of the phosphates in a soil is determined by the silica sesqui-oxide ratio of the soil colloids.

The role of colloidal silica in soils is not clearly understood. It is believed that colloidal silica keeps the other hydrous oxides present, in a dispersible condition. Whether colloidal silica is in the free condition or is present in the form of complex aluminosilicates is another point to be determined. Bradfield is inclined to support the latter view while Weiser believed that no aluminosilicates are present.

We have planned to carry out at the Central College Laboratory the following investigations on soils in active consultation with the Department of Agriculture:—

- (1) Standardisation of the method of dispersing and isolating soil colloids.
- (2) A further comparative study of methods employed in determining the colloidal content of soils.
- (3) Determination of the silica sesqui-oxide ratio of soil colloids of typical tropical soils and correlation of this ratio with the quality of the soils.
- (4) A study of the role of colloidal silica in soils.
- (5) Determination of the extent to which the photo-chemical oxidation of organic matter as catalysed by colloidal ferric oxide is responsible for the rapid loss of organic matter in Indian soils.

The above programme of work requires for reasonably rapid execution, a full time assistant who will work under my direction. At present I am assisted in this work by a Demonstrator at the Intermediate College (Mr. C. Seetharama Rao). But as he can work on these problems during his leisure hours only, progress is very slow. Most of the process employed in the work—the isolation of the colloids, their analysis, the adsorption experiments—are time-consuming and I feel that the investigations will take us at least three years.

A sum of Rs. 10,000 will be required. Most of the apparatus that is required is already available. A centrifuge for fractional separation of the colloid is needed as also a refrigerator for maintenance of a constant temperature (15 to 20°C) in the adsorption apparatus during certain experiments. This additional equipment would cost Rs. 2,500. The assistant's salary will have to be Rs. 125 per month during the first year, Rs. 150 during the second year and Rs. 175 per month during the third. He must be an M.Sc. with qualifications of research in Physical Chemistry—preferably in colloid chemistry. Minor expenses would be Rs. 600 to Rs. 700 per year.

*Details of estimated expenditure.*

|  | Rs.    |
|--|--------|
| Purchase of centrifuge and refrigerator . . . . .  | 2,500  |
| Salary of full time Assistant (3 years) . . . . .  | 5,400  |
| Contingent expenditure at Rs. 700 a year . . . . . | 2,100  |
| Total . . . . .                                    | 10,000 |

A. N. NARASIMHIAH.

## APPENDIX XLI.

**Note by the Secretary Imperial Council of Agricultural Research, dated the 19th November 1935 on Subject No. 34:—Application from the Government of Bihar and Orissa for a grant of Rs. 13,708 spread over a period of three years for the determination of Nutrient content in the Indian Soils.**

Attention is invited to the attached copy of a note dated the 22nd June 1935 (Enclosure I) on the subject mentioned above, which was circulated to the Advisory Board at its meeting held in July 1935. The scheme was first examined by the Soil Science Committee which recommended that, before the scheme was considered, a special report should be obtained from the Indian delegates to the Third International Soil Science Congress (held at Oxford in July-August 1935) which would discuss in considerable detail the methods of determination of nutrient content of soils including the present state of knowledge on the subject (Enclosure II). This recommendation was accepted by the Advisory Board.

2. Professor J. N. Mukherjee, the leader of the Indian Delegation to the Third International Soil Science Congress has accordingly submitted the attached report (Enclosure III) embodying the conclusions arrived at by mutual discussion among the delegates at the Congress. The Vice-Chairman to the Council considers that the subject should now be discussed by the Soil Science Committee which might draw up a scheme of research work and indicate the stations in India at which investigations should be started. This Committee will meet on an afternoon between the 10th and 15th February 1936, and its report will be circulated to the Advisory Board in due course.

3. The subject is for the consideration of the Advisory Board.

## ENCLOSURE I.

IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, ADVISORY BOARD,  
TWELFTH MEETING, JULY 1935, SUBJECT NO. 52:—APPLICATION FROM  
THE GOVERNMENT OF BIHAR AND ORISSA FOR A GRANT OF RS. 13,708,  
SPREAD OVER A PERIOD OF THREE YEARS FOR THE DETERMINATION OF  
NUTRIENT CONTENT IN THE INDIAN SOILS.

Attention is invited to the attached letter (Annexure) from the Government of Bihar and Orissa, No. 837-D, dated the 1st March 1935, forwarding a scheme on the determination of "nutrient content" in Indian Soils. The scheme which has been drawn up by Dr. J. T. Mirchandani (the recently appointed Agricultural Chemist, Bihar and Orissa) has been approved by the Provincial Agricultural Research Committee and recommended by the Local Government. It involves a total expenditure (including a non-recurring expenditure of Rs. 3,700) of Rs. 13,708 spread over a period of three years. The contribution by the Local Government will be a fully equipped laboratory already existing at Sabour where the scheme is proposed to be conducted.

2. The scheme will first be examined by the Soil Science Committee of the Council which meet on the afternoon of Wednesday the 17th July 1935 and will report to the Advisory Board in due course.

3. The subject is now for the consideration of the Advisory Board.

BAZLUL KARIM,  
*offg. Secretary.*

SIMLA,  
The 22nd June 1935.

## ANNEXURE.

COPY OF LETTER No. 887-D., DATED THE 1ST MARCH 1935, FROM THE ASSISTANT SECRETARY TO GOVERNMENT, EDUCATION AND DEVELOPMENT DEPARTMENT, PATNA, TO THE SECRETARY TO THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

*Scheme on the "Determination of nutrient content in the Indian Soils."*

I am directed by the Government of Bihar and Orissa (Ministry of Education) to submit for the consideration of the Imperial Council of Agricultural Research a scheme on the "Determination of nutrient content in the Indian soils" drawn up by the Agricultural Chemist, Bihar and Orissa. The scheme has the support of the Bihar and Orissa Agricultural Research Committee.

\* \* \* \* \*

*Determination of nutrient content in the Indian soils.*

The interest in the nutrient content and the manurial requirement of soils dates back to 1840 when Leibig propounded his "Mineral theory" of plant nutrition. Since then, considerable amount of research work has been directed towards the accurate determination of the available nutrients in the soil. The methods adopted can be grouped under two main heads:—

- A. Chemical *i.e.*, those in which the plant nutrients are extracted and estimated by the use of chemicals.
- B. Plant *i.e.*, those in which the plant is used to indicate qualitatively the amount of nutrients in the soil.

Under A, the following four methods are in vogue—

1. Water extraction of the soil;
2. Soil solution, obtained by different means;
3. Acid extractions, the use of acids of various strengths.
4. Replaceable bases, the determination of the replaceable bases of the soil mass, either by the use of certain salt or by electro dialysis.

Under B, the following three methods are being tried—

1. Neubaur's seedling method.
2. Mitscherlick's plant method.
3. Weissmann's plant method (a modification of Mitscherlick's method).

2. At different centres of agricultural research, different methods are used, the general tendency so far, specially in India, has however been to use one or the other chemical methods of determining available plant nutrients. The chemical methods have been considered inadequate and are being replaced by the seedling or plant method, by certain workers, especially in Europe. A certain amount of work is no doubt being done all over the world on the comparison of some of the methods in use but as far as is known to us no work has yet been made on all the methods, cited above, under strictly comparable conditions, with a view to adopting an uniform method for the determination of available nutrients in the soil, as is being done for the mechanical analysis of the soils.

3. A certain amount of work is already being done in the laboratory of the Agricultural Chemist, Bihar and Orissa, on the comparative value of the chemical (citric acid extraction) and the seedling (Neubaur) methods for

three typical soils of the province. The choice of a suitable crop to replace rye, used by Neubaur and which can not be drawn under climatic conditions in India and a proper period of incubation are being studied and promising results have been obtained with maize and barley. It is however felt that it will not be possible to extend this work with the limited resources of the department in men and money unless the Imperial Council of Agricultural Research is pleased to make a grant in view of the extra provincial importance of the scheme. The programme of work will consist of a comparison under controlled conditions of different methods of determining available plant nutrients in as many soils as possible and the determination of one of these methods suitable for general adoption. The co-operation of the provincial Agricultural Chemists in India will be sought to obtain typical soil samples for experimental purposes.

The work will be directed by the Agricultural Chemist, Bihar and Orissa, at Sabour, where a fully equipped chemical laboratory and a pot house already exist. There will be thus no capital expenditure involved except on the erection of a small special seedling house for Neubaur's experiment.

It is hoped that at the end of three years, the information collected will be of great use to all the research workers in the field.

4. The financial assistance required from the Imperial Council is detailed below:—

|  | Rs.           |
|--|---------------|
| Non-recurring—   |               |
| Special seedling house . . . . .   | 1,000         |
| Pot house equipment (mostly, metal and glazed pots for Mitscherlick's experiment, pans for Neubaur's seedling experiment and a balance for weighing seedling pans) . . . . . | 1,200         |
| Laboratory equipment (special) (Hydraulic press for extraction of soil solution, Electrodialysis apparatus etc.) . . . . .   | 1,500         |
|  | 3,700         |
| Recurring—   |               |
| One research assistant (Chemist) . . . . .   | 130—7—144     |
| *One laboratory attendant . . . . .  | 10            |
| One pot house assistant . . . . .  | 20—1—22       |
| * One pot house attendant . . . . .  | 10            |
| Laboratory and Pot house contingencies . . . . .   | 1,200 a year. |

*Abstract of recurring expenditure for 3 years.*

|                         | 1st year. | 2nd year. | 3rd year. |
|-------------------------|-----------|-----------|-----------|
| Staff . . . . .         | 2,040     | 2,136     | 2,232     |
| Contingencies . . . . . | 1,200     | 1,200     | 1,200     |
|                         | 3,240     | 3,336     | 3,432     |

\* The attendants will be paid Rs. 8 or 9 a month if possible.

## ENCLOSURE II.

### EXTRACTS FROM THE REPORT OF THE SOIL SCIENCE COMMITTEE.

\* \* \* \* \*

*Proposal from the Government of Bihar and Orissa for research on the nutrient content of Indian soil—(Subject No. 52).*

A good deal of work on the methods mentioned in this scheme is in progress in Europe. There are other methods under B besides the three mentioned, e.g., (1) the use of *Asperigillus niger* and (2) *Azotobacter*



plaques. There is a good deal of controversy about the reliability and applicability of the results obtained by these methods and whilst all members of the Sub-Committee would be glad to see the question settled, some of them are in doubt as to the prospects of useful results emerging from this scheme. It is practically certain that these methods will be discussed in considerable detail at the forthcoming International Soil Science Congress which is being attended by several delegates from India. The Sub-Committee therefore recommends that the Indian delegates to the Congress should be asked for a special report on the discussion on this subject, and on the present state of knowledge, and that the scheme should be considered further on receipt of that report.

### ENCLOSURE III.

REPORT BY DR. J. N. MUKHERJI, KAIRA PROF. OF CHEMISTRY, UNIVERSITY OF CALCUTTA, ON THE "SCHEME FROM THE GOVERNMENT OF BIHAR AND ORISSA FOR RESEARCH WORK ON THE NUTRIENT CONTENT OF INDIAN SOILS WHICH HAS BEEN SUBMITTED" FOR A GRANT-IN-AID FROM THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

It would be convenient to refer to Technical Communication No. 25 of the Imperial Bureau of Soil Science, 1932, which deals with "the Mitscherlick, Wiessmann and Neubaur methods of determining the nutrient content of soils". This publication gives a critical review of the literature up to 1930 and summarises the position. Since then the International Society of Soil Science has organised a co-operative investigation on the measure of agreement between the results obtained by the various methods including chemical and microbiological. The co-ordination of the co-operative effort has been entrusted to Prof. Mitscherlick. The results thus obtained have not yet been fully worked out but Prof. Mitscherlick read a preliminary report before one of the plenary sessions of the Third International Congress on Soil Science recently held at Oxford. This report has been published with the title "Die Bestimmung des Nährstoffgehalts, etc." in pp. 95-112 of Vol. II of the Transactions of the Third International Congress of Soil Science (London, 1935; Thomas Murby & Co.).

2. "The manurial or nutrient content relates only to the soil and its estimation is therefore a problem in soil science. The estimation of the manurial requirement on the other hand is a problem in practical plant Physiology and is inseparably related to the investigation of the growth and yield laws". (Tech. Commu. 25, p. 4). The laboratory methods for ascertaining manurial requirements (chemical or microbiological) have therefore to be correlated with the plant Physiological methods. The great merit of the Mitscherlick method and its modifications lie in that they are essentially plant physiological methods and are based on the growth and yield laws. The co-operative effort organised by the I. S. S. S. is based on a recognition of this fact and was initiated by a joint action of the sections ('Commissions') 2, 3 and 4 of the International Society at Copenhagen. Mitscherlick in his report mentioned above stresses the importance of direct plant physiological methods for calculating the manurial requirement of a soil. Field Experiments would therefore constitute the most logical basis for estimation of manurial requirements. But Mitscherlick considers that on account of the non-uniformity of the soil in a plot such experiments could only be useful when the complications arising from the want of uniformity are excluded by an exact standardisation of

the soil. If however the conclusions from the experiments of one year are to be used for the next year unusually large uncertainties crop up as a result of the changes that have taken place in the soil in the intervening period. M. holds that these uncertainties can be remedied if instead of the relative increase in yield one takes into account the absolute increase in yield and uses the law of effective growth factors as formulated by him. Also field experiments can give us information on the manurial requirements only when an increase in the yield is observed. When no such increase is observed there is always the possibility that though the nutrient content is sufficient for that particular year it may not be sufficient for the succeeding year in which the results of the experiment are intended to be utilised. The assay of the nutrient content with the help of field experiments is, therefore, according to M., admissible within very narrow limits and "the estimation of the need of nutrients of a soil (by this method) is wholly impossible".

3. M. in comparing the results of the co-operative effort takes those obtained by his pot experiments as standards for comparison with other methods and his method as the "standard method". Of the 120 samples of soils which have been thus examined 73 samples were from Germany including 51 from East Prussia, 46 were from other European countries, 2 from Honolulu and 1 from Australia. Twenty-two investigators at different places have taken part and 31 methods have been used. The results on the need for manurial treatment of these soils have been discussed so far as the elements phosphorous and potassium were concerned. Mitscherlick states the reason as follows: "for Nitrogen wholly different plant physiological conditions operate with which it is not possible to deal further in this place. Also the question of lime treatment and of soil acidity have for the present to be kept outside the theme of discussion".

4. M. finds that for indications of phosphate requirement the *Aspergillus* method of Smith is not of any value but that of Niklas is relatively more satisfactory. Two per cent. Citric acid is too strong and extracts too much phosphoric acid and the indications by this method show wide disagreement with pot experiments. One per cent. Citric acid dissolves too little and also shows disagreement with pot experiments. The Lactate method of Egner on the other hand appears to be the most suitable for agricultural advice to farmers. The seedling method of Neubaur gives equally satisfactory results.

Of the 120 soils examined pot experiments showed that 98 responded to phosphate treatment and the agreement between the pot method and the two satisfactory methods mentioned above is within 3 per cent. The position with reference to the 22 soils which were found not to be in need of phosphate treatment by pot experiments from 40 to 50 per cent. are shown to be in need of such treatment by these methods and hence advice based on these methods are liable to a corresponding error.

Much less satisfactory is the position regarding potassium requirements. Pot experiments showed that 40 of the soils were in need of such requirement and 80 did not. Neither Neubaur's method nor the two *Aspergillus* methods (of Smith and of Niklas) give good agreements. For example by the Niklas method assuming a limit of availability of 19 mg. Mycel all the soils judged to be in need of potash treatment by pot experiments are also found to be in need of such treatment. But if the 80 soils, which were found by pot experiments not to require any such treatment are considered on the basis of the same limit, 50 per cent. of them are found to be in need of such treatment as adjudged by Niklas method.

M. proceeds to consider the differences in the soils which have been considered in relation to the disagreement between the indications obtained with different methods and between those obtained with the same method for different soils. This discussion is not of immediate interest and obviously an enormous amount of accurately ascertained data is necessary before useful conclusions can be drawn. The observations of the other partners in this joint effort have not yet been published and in view of the comments of some of them at the plenary session on Mitscherlik's paper it would seem desirable to postpone a final conclusion on the subject.

5. A considerable body of literature exists on the relative merits of these different methods. Regarding Mitscherlik's method critical investigations have naturally been directed to test the validity of the specific quantitative formulations of the growth and yield laws which have been postulated by M. and on which his calculations are based. M. recognises that his equation, which assumes that the same equation and the constants in it hold for different types of plants and soils, is of the nature of a first approximation. The general concensus of opinion recognises the scientific importance of the Mitscherlik method (or of its modifications) and the need for further investigations on the growth and yield laws and on exploration of plant physiological methods. Regarding the suitability of the method for practical agricultural advice to farmers, it is interesting to refer to the growth of the Mitscherlik Society in East Prussia (*Vide* Tech. Comm. 25). But it is costly, laborious and slow and requires a staff trained in its technique. For these reasons alone it cannot be expected to easily displace the quicker and cheaper chemical methods.

For practical purposes the ideal to be aimed at is to advise the farmer as to the absolute increase of the yield which would follow the addition of a definite amount of a particular manure to his field. It is not sufficient to tell him that there is a great or small or no deficiency of any particular plant nutrient in his field for the crop he wants to raise (cp. Bondorff, *Transactions of the third congress* Vol. I., p. 229). For a particular soil and plant combination fairly satisfactory qualitative forecasts can be made provided a sufficient number of field experiments and the cheaper and quicker chemical analyses by suitable methods have been carried out over a number of years and the results have been statistically analysed. The general practice at present is to follow this course. In fact an important criticism of the claims by Mitscherlik is that he overlooks the desirability of proper statistical treatment of his results as also the help that such a treatment can render in interpreting results of field experiments. A quantitative estimate of the absolute increase of the yield, however, can only be based on an exact knowledge of the yield curve. The Mitscherlik method and its modifications are considered to constitute the nearest approach at present available to a solution of this problem though it is generally recognised that it does not fully answer the purpose. The pot experiments have also to be restricted to a certain type of plants depending on the size of the pots. In spite of these limitations on account of its scientific and practical interest most of the important stations are fitted with the necessary wherewithals for such pot experiments. It may be of interest to note that the writer saw at the central experimental station at Versailles that in addition to pot experiments 'miniature' field plots are being used.

6. The Neubaur seedling method is based on the estimation of the plant nutrients extracted from a soil by seedlings grown under standardised conditions. It is consequently regarded as being in effect a chemical

method where the chemical extraction is regulated and standardised by definite plant physiological processes. The estimation is made independent of the particular crop to be actually raised and a correlation is established with the type of crop on the basis of limiting values. A correlation with field experiments is required as in all chemical methods. This method has, as is well known, a number of ardent supporters and in spite of the considerable amount of information already available its merits continue to be discussed with unabated zeal. Two papers presented at the Congress illustrate the current attitude. In one of these (Cutler and Malherbe, *Trans. Third J. Congress, Vol. I., pp. 232—235*) it is pointed out that "the method is in many respects irreplaceable by other laboratory methods" but on the ground of cost and of the difficult technique it is stated that "as a routine method to give clues to the nutrient needs of the soil it is better and cheaper to use the more simple and less laborious laboratory methods for determination of available potash and phosphate—save in the case of calcareous soils". On the other hand one of the above authors state in another paper (Malherbe & Myburgh, *Trans. I., pp. 238—242*): "The Neubaur method was not employed on these soils. Previous extensive investigations have shown that this rather cumbersome method does not give reliable enough information for advisory work in grain forming in regard to phosphate requirements" being "encumbered with a grave experimental error. Purely chemical methods allow of a far greater differentiation and are besides incomparably less expensive and speedier". The general consensus of opinion is that the method does qualitatively indicate the need for manurial treatment in the majority of cases and in Germany (excepting East Prussia) it seems to be more in favour compared to the Mitscherlick method.

7. Reference has been made in section 5 to the application of statistical method of analysis in planning and interpreting the results of field experiments. In his presidential address Sir E. J. Russell after referring to the co-operative work co-ordinated by Mitscherlick proceeds to say:

"The problem resembles that of water supply in that the plant food is present in different degrees of mobility and that plants differ in their power of obtaining it; some can take only the most mobile, others can take up less mobile forms. Ultimately the best solution of the problem will probably be . . . some expression of the mobility factor on a scale to which one may hope to fit the various plants as chemists are doing for soil acidity. So far as the plant is concerned there is the further complication that not only do different plants have different requirements, but even for the same plant the requirements are not constant; they vary with the water supply, the climatic and other environmental factors. In one season a soil may respond to phosphate manuring; in another it may not. Further, the value of the plant food depends very much on the time when it becomes available to the plant: late supplies are much less useful than early ones. The more direct connection is not with the yield, but with the quantity of the nutrient taken up: and this probably gives better information about fertiliser requirements. At Rothamsted we are proceeding to obtain more precise information about the responses of field soils to fertilisers with our new designs of field experiments".

8. This question of the design of field experiments with a view to untwine the knots in this bundle of variables is discussed very clearly in a paper read before the plenary session by Prof. R. A. Fisher. (*Trans. Vol. II, pp. 112—119*). "The design would seem to be one of particular value for a co-operative survey of the nutrient needs of any particular

crop as affected by the combined action of soil type and weather conditions" F. explains the fundamental concepts underlying such designs. He first refers to "the need of supplying a control" so "that an experiment should be self contained" and all conclusions can be based "on the contrast in the reaction of two similar bodies of experimental material, subjected to some accurately specified difference in treatment". The first requirement of an experimental design which can yield valid tests of significance "is replication". Replication diminishes the experimental error. The advantages of randomised blocks and of small blocks are discussed in this connection. It is pointed out that "it would be a mistake to regard the high precision attainable in a large experiment as wholly due, properly speaking to increased replication". The increase in precision consequent on replication is partly due to the increased area of the experiment. The increased precision resulting from the process of comminution of an area into increasingly smaller plots, to which a limit is set by agricultural convenience and by the need to discard border rows, can also be attained in other ways. F. remarks incidentally that "it is remarkable that uniformity trials, both with sugar beet and potatoes, using strips and discarding the two edge rows, have repeatedly shown that the maximum precision is attained with strips of only four rows width, and of which, therefore, no less than half the experimental area is discarded". Since these advantages of a subdivision can be obtained in other ways, F. remarks that the advantages should be bought "in the cheapest market" and that "Precautions or modifications of field technique which are costly in time and labour, should in the design of experiments, have their cost assessed on a strictly economic basis" irrespective of the "scientific repute or prestige of the precautions and requirements". "It is" however "the second function of replication, that of providing the experiment with its own appropriate estimate of error, which nothing but replication can perform". He then discusses the bias in estimates of error and emphasises that the bias implied in over-estimates supposed to have the advantage of being "on the safe side" are as much fallacious and misleading and under-estimates and over-estimates are both to be avoided. "Without an unbiased estimate of error, no valid tests of significance are possible". "The means by which this is achieved are extremely simple. The real errors of our experimental errors arise from differences in fertility among the plots, or among the groups of plots, which are treated differently" whereas "the estimates of error are obtained from the discrepancies among the plots treated alike. Consequently we have to make sure that any two plots which may be treated alike have the same probability of being treated alike, to guarantee that each component of error, which may affect our results, may with the same frequency supply the material used in the estimation of error. This practice of making sure that the probabilities of receiving like treatment are equal for every relevant pair of plots in the experiment, is known as randomisation, and is illustrated by the arrangements of randomised blocks, Latin Squares and the large factorial experiments in which confounding may be practised. "For a genuine diminution of error affecting equally the real errors and our estimates, recourse may be had to the practice of combining several single lines of enquiry in a single large factorial experiment, . . . . all the factors . . . . manures, varieties or cultivation" being "varied concurrently in all possible combinations, so that the number of plots differing in some way or other may become large". "It is in such factorial experiment where the number of differently treated kinds of plots is large, that the device known as confounding may be

usefully employed. This consists in having more blocks than there are replications, so that the plots of each replication are divided between two or more blocks". The greater precision of smaller blocks is obtained at the expense of sacrificing some of the information about particular comparisons. By a proper choice of the selection of the treatments which are to occupy the same block, we may make sure that no comparisons of importance are sacrificed. Reference may be made to Fisher's book on 'Design of Plots' recently published where the subject is discussed at length. Fisher concludes his paper with the remark, "Even the most complicated differential reactions would have a good chance of being adequately explored, and any simple generalisations, if in agricultural science there are any simple generalisations, could scarcely fail to be established emphatically".

9. In a paper before the plenary session of commission IV Prof. De Vries gave an account of soil fertility studies in the Dutch Indies initiated at the beginning of this century. "In the beginning (1890—1910) much was hoped for chemical plant analysis and from soil analysis. The former, however, never acquired practical importance, the latter gave little satisfaction and the methods then in use made it pass, as elsewhere, through a time of depression. Field experiments were then adopted for the principal crops, as the chief means of studying problems of manuring cultivation and planting; this method took a large flight, and has remained predominant till the time of the world crisis, although soil mapping and soil analysis on a modern basis are more and more being called into aid. A second feature . . . is that these field experiments, for the very large majority, were annual, in contrast to manuring work in several European countries, where static field experiments are more in vogue and are regarded by some, rather one-sidedly, as the only reliable and safe means to solve the problem". The number of field experiments is exceptionally large as would be seen from the following table for the sugar experiment station at Pasoeroean—

TABLE.

*Number of field experiments of the Sugar Experiment Station, Pasoeroean.*

| Subject.                                  | Year. |       |       |
|---|-------|-------|-------|
|   | 1930. | 1931. | 1932. |
| Clones . . . . .                          | 518   | 1,052 | 608   |
| Optimum sulphate of ammonia . . . . .     | 1,403 | 1,125 | 1,370 |
| Phosphatic manures . . . . .              | 396   | 692   | 412   |
| Potassium manures . . . . .               | 132   | 525   | 367   |
| Other manures . . . . .                   | 330   | 234   | 200   |
| Planting (time, distance, etc.) . . . . . | 393   | 307   | 317   |
| Tillage . . . . .                         | 40    | 208   | 276   |
| Others . . . . .                          | 18    | 208   | 25    |
|   | 3,230 | 4,351 | 3,575 |

The need for a large number of field experiments is emphasised. "There was roughly one field experiment on every 50 hectares yearly" . . . and "in a period of 20 years roughly 40,000 field experiments of this elaborate

type were undertaken". A staff of helpers is engaged for the large amount of calculation and computation work. "Special methods had . . . . . to be developed for the control of such a mass of facts, e.g., the increase or decrease in yield is, for comparisons, always expressed in terms of the standard error of the difference between the two treatments in question" . . . . . "It is not denied" however "that the extensive use of fields experiments has its drawbacks—just as the extensive use of chemical or physiological soil analysis has its limitations, often giving a semblance of certainty and leading to conclusions which differ considerably from actual results in practice. As always in agriculture with its difficult problems a combination of the two methods—field experiment, and analysis—gives better chances". De Vries emphasises that experience in the Dutch Indies differs from that in Europe and gives instances and also refers to some special aspects which have some interest to Indian workers. It will therefore be convenient to refer to them though all of them may not be directly relevant to the determination of manurial requirements or fertility studies.

Rice in irrigated fields in Java and Madura covers more than 3 million hectares and the "experimental work began in 1911 now total more than 1,000 field experiments, with 5 to 8 treatments (for instance O, N, P, NP, NPK, or in addition also K, NK & PK) and mostly 10 replications therefore 50 to 80 plots per experiment" . . . . about 1 on 30,000 hectares per year. "The rice crop was frequently increased 100 per cent. and more by the application of phosphatic and nitrogenous manures". To multiply the usefulness of these large, 50 to 80 plot experiments an ingenious method, well adapted to the mentality of the small farmer, was followed by reproducing the principal results, on fields of the same type of soil in the neighbourhood, in a large number of simple experiments in which only the manurial combinations which gave good results were taken, in a small number of replications. The big model experiment so formed the nucleus for a series of simple tests on an area with comparable soil conditions, whereby its results were broadcasted and at the same time a valuable check under varied practical conditions was obtained with reference to field experiments on irrigated lands. De Vries mentions that plots distributed at random have to be replaced "by plotting in parallel strips" which succeed one another along the direction of the flow of water 'because the fall in fertility of the water, loaded with fertile silt is so large'. The effects of irrigation, on the content of silt and soluble substance in the water and related subjects are included as an important part of soil fertility studies. For crops like tobacco the yield is not the only aim and sometimes not even the principal one and adequate methods and organisation and the special training of women sorters have been built up.

De Vries also stresses the difference between the perennial or static field experiments in Europe and the annual experiments in these large scale organised plantations. Soil conditions are completely altered during the intervals which elapse between the cultivation of the same crops. *Perennial or static experiments lose much of their importance under such conditions and are only undertaken for special problems*", e.g., system of tillage, effect of breaking up deeper layers, etc. "Although the effect of a first year application of manure, in European conditions, should, of course, always be supplemented by a study of its after-effect and of the cumulative effect of continued yearly application, the tendency, in Europe to investigate manuring problems only on the basis of static experiments,

is subject to criticism; one often sees unwarranted or unallowable conclusions drawn from them". It is emphasised again that a large number of experiments are necessary to eliminate casual factors and bring well-founded results in relation with different factors. Regarding the perennial crops such as tea and rubber studies of the nutritional balance reached by a certain manurial treatment and of the after effects of accumulated by-products are not so important as in European countries because "the higher rainfall, humus turnover and several other factors are so different under tropical conditions. Pot cultures take a smaller place than in Europe chiefly because tropical crop plants are large. Neubaur method has been tried with rice and potcultures with tobacco and sugar but the size of the plants restricts the number of pots.

"In later years the limitations of field experiments as a basis for planting programmes became more evident and soil type mapping gave some striking results." The system of mapping is a combination of the Russian, German and American methods, that is, based on modern experience. Instances of its practical utility are given. Soil mapping is done as follows: "Based on a general agrogeological mapping, the detailed mapping for the sugar plantations has been done according to heaviness and to colour; these two maps, combined, gave a soil type map". The results of field experiments, which as stated already were distributed in sufficient numbers over the area, were then plotted in these soil type maps.

Regarding soil analysis, De Vries states that in 1916 in a conference of soil workers in Java "soil analysis was rejected as a basis for advice in manurial problems, being only deemed useful when it was limited to soil of one type and (was correlated!) on the basis of the results of field experiments and practical yield figures". He therefore questions the prominence given in European countries to the analytical data and the confidence placed on them. Mechanical soil analysis on the basis of ten fractions gave more useful results and took a prominent place in soil classification in later decades. The more recent methods of chemical analysis and of approach to the problem are now being attempted. In explanation of the failure of soil analysis to give a general indication of soil fertility it is stated that nitrogen constitutes the most important manure "for which soil analysis 'gives no indications' and phosphate and potassium are of little importance on the rich volcanic soils which form the majority. Further—irrigation in the rotation with rice changes the amount of available plant food and renders the manurial status 'vagrant'. Also the hill crops are grown on such a variety of soils that only analysis on a very broad basis can give a sufficient foundation for predicting manurial needs, and even then it is a difficult task to interpret the results in their mutual interdependence and their united effect on nutrition supply and fertility".

De Vries sums up: "Plant analysis, for various reasons, played only a minor role in the Netherland Indies. Soil analysis, favorite at first, lost importance and was replaced by large scale field experiment work, which has done its part and for some crops is more or less exhausting its possibilities. Modern soil type mapping, combined with soil analysis on modern basis, is providing a better base for the laying out of field experiments and the interpretation of their results". This conclusion agrees with opinions expressed that the experiments in Java until recently were conducted on older lines and the conclusions based on them have not much of a significance for judging the utility of methods of approach based on modern developments which are in vogue over a considerably larger period in Europe.



10. Simultaneously with the evolution and modification of the newer methods mentioned above and of the microbiological methods, e.g., Aspergillus method of Niklas efforts have been continued to improve and modify in the light of recent developments, the older chemical methods. In consequence several alternative methods are simultaneously claimed to have special advantages. A reference to the more important methods of determining the available phosphate which have some authoritative support behind them will illustrate the present position. The more general attitude appears to be to stick to one of the standard or classical methods and to establish a correlation with results of field experiments unless it fails altogether for such a purpose. The variety of soil types and of conditions associated with the growth of the plant obviously necessitates the use of alternative methods. It is therefore recognised that individually worked out modifications of methods may be necessary to suit the demands of a specific need where the failure of existing standard methods has been satisfactorily established. The enthusiasm for developing new methods or, as is mostly the case, a modification of a recognised method may sometimes lead to a fruitless quest. The development of an alternative general method is a matter of pure scientific enquiry which does not come within the normal work of a station, except where such researches have to be undertaken as a result of the failure of existing methods. It is felt that every agricultural station or laboratory should try the more recognised methods and that information as to their suitability and specific failures should be collected over as wide an area as is administratively practicable to handle. The co-operative work organised by the Inter. S. S. S. will have to be brought in relation to such group experiences and such a collation of the available information in India seems to be very urgent.

11. It would appear from the foregoing that the scheme as submitted raises a fundamental question but the scope of the enquiry suggested is beyond the resources of a single station. At the same time the desirability of gradually equipping the most important stations so as to utilise the Mitscherlick and Neubaur methods might be kept in view. It might also be ascertained to what extent it is possible to associate some of the most important centres with the co-operative work now being carried out by the International Society of Soil Science. The immediate practicable steps appear to be (a) to secure a proper collation of the results already obtained at different centres relating to the suitability or otherwise of different methods for agricultural advice either by the I. C. A. R., or through the Indian Society of Soil Science;

(b) to encourage the provincial stations in their effort to establish a correlation of recognised chemical methods with field results by supplementing their resources where considered to be necessary and to request them to co-operate in the matter of collation of the results and specific difficulties and suggest modifications of alternative methods.

## APPENDIX XLII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 25th January 1936, on Subject No. 35:—Sanction for the purchase of apparatus required for the scheme for investigation on the Physico-Chemical Properties of the Clay Fraction of Lateritic Soils and of the Dacca mixed soils and the nutrition of the rice plant out of the grant already sanctioned by the Council.**

When the Advisory Board recommended the extension of the Dacca University scheme of research on the mechanical analysis of lateritic soils and on the nutrition of the rice plant at its meeting held in September 1934, it was suggested that the non-recurring grant of Rs. 3,000 for special apparatus which was to be purchased with the approval of the Board should be made available to the University at any time during the three years' currency of the scheme in such instalments as may be required.

In his letter, dated the 20th September 1935, (Enclosure) Professor J. C. Ghosh, D.Sc., Head of the Department of Chemistry, University of Dacca, requested permission for the purchase of certain apparatus at an estimated cost of Rs. 1,410, which were urgently required for the investigation. As the matter was urgent, the necessary sanction to the purchase was conveyed by the Secretariat of the Council. This is now reported for information.

## ENCLOSURE.

COPY OF D. O. LETTER, DATED THE 20TH SEPTEMBER 1935, FROM PROFESSOR J. C. GHOSH, D.Sc., HEAD OF THE DEPARTMENT OF CHEMISTRY, UNIVERSITY OF DACCA, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

I beg to request you to kindly permit us to spend Rs. 1,500 from the capital grant of Rs. 3,000 made by the Imperial Council of Agricultural Research for the purchase of special apparatus with the approval of the Advisory Board, towards the scheme of research on the mechanical analysis of lateritic soil and the nutrition of rice plant in Dacca University (*vide* your letter No. F. 3634-Agri. of 1st July 1935). The amount asked for will be spent for the purchase of the following apparatus which are urgently required for the above-mentioned investigations:—

|   | Rs.   |
|---|-------|
| (1) The Mcfarlane-Pye valve potentiometer ( <i>Vide</i> page 10 of Messrs. W. G. Pye & Co. List No. 200M) | 835   |
| With accessories such as glass electrode half cells electrode chamber, etc.                               | 200   |
| (For accurate PH measurement).  |       |
| (2) Air-Pump, Cenco Hyvac with motor, etc. For high vacuum distillation                                   | 375   |
| Total   | 1,410 |

## APPENDIX XLIII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 10th January 1936, on Subject No. 7:—Progress Reports on Veterinary Research Scheme sanctioned by the Imperial Council of Agricultural Research.**

The marginally noted progress reports are circulated to all members of the Advisory Board of the Imperial Council of Agricultural Research. The reports will be considered by an *ad hoc* Committee (Appendix XXXIII) at the time of the forthcoming meeting of the Advisory Board and its report will be circulated to the members of the Board in due course.

Annual Report for 1934-35 on the work of the Veterinary Investigation Officers, Madras (will follow). Bombay, Bengal, United Provinces, Punjab, Bihar and Orissa, Central Provinces, Assam, Hyderabad.

## APPENDIX XLIV.

Supplementary note by the Secretary, Imperial Council of Agricultural Research, dated the 31st January 1936, on Subject No. 39:—Application from the University of Madras for a Grant of Rs. 21,300 for a scheme of enquiry into Helminthiasis of Cattle in the Madras Presidency spread over a period of 5 years.

Attention is invited to the note dated the 19th November 1935 (Enclosure) on the subject mentioned above already circulated to members. The *ad hoc* Committee appointed to consider the Bombay tick control scheme and the Progress Reports of the Veterinary Investigation Officers, etc., will also consider this scheme and its report (App. XXXIII) will be placed before the Advisory Board in due course.

## ENCLOSURE.

NOTE BY THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, DATED THE 19TH NOVEMBER 1935, ON SUBJECT NO. 39:—APPLICATION FROM THE UNIVERSITY OF MADRAS FOR A GRANT OF RS. 21,300 FOR A SCHEME OF ENQUIRY INTO HELMINTHIASIS OF CATTLE IN THE MADRAS PRESIDENCY SPREAD OVER A PERIOD OF 5 YEARS.

Attention is invited to the attached application (Enclosure I) from the University of Madras for research into the Helminthiasis of cattle in the Madras Presidency at a cost not exceeding Rs. 21,300 spread over a period of five years. The scheme has been recommended by the Provincial Research Committee.

While forwarding the scheme, the Government of Madras has suggested that a time scale of pay *viz.*, Rs. 125—10—175 and Rs. 55—5/2—110 should be fixed for the research scholar and the veterinary assistant surgeon instead of the fixed pay proposed by the University, *viz.*, Rs. 150 and Rs. 75. If the proposal of the Government of Madras is accepted, the total cost of the scheme will come to Rs. 20,040.

2. In August 1933 the special committee appointed to consider Dr. Thapar's scheme for an enquiry into the Helminthiasis of cattle, sheep and goats in the United Provinces recommended *inter alia* that there should be four main centres of helminthological research *viz.*, (1) the Imperial Institute of Veterinary Research, (2) Lucknow University, (3) The Madras Veterinary College and (4) Nagpur University, *vide* Enclosure II.

5. The scheme is now for the consideration of the Advisory Board.

## ENCLOSURE I.

COPY OF LETTER No. 1978-III/35-8, DATED THE 25TH OCTOBER 1935, FROM THE SECRETARY TO THE GOVERNMENT OF MADRAS, DEVELOPMENT DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH

*A Scheme for Enquiry into Helminthiasis of Cattle in the Madras Presidency.*

I am directed to forward an application from the University of Madras for the grant of a sum of Rs. 21,300 spread over a period of five years for a scheme to conduct an enquiry into the Helminthiasis of cattle in

this Presidency. The scheme is recommended by the Provincial Research Committee. The Government of Madras support the scheme but are of opinion that, in order to sustain the enthusiasm of a research scholar, a time scale of pay is more suitable; and consider that instead of the fixed pay of Rs. 150 and Rs. 75 suggested by the University, it will be more suitable to have scale of pay of Rs. 125—10—175 for the Research Scholar and a pay of Rs. 55—5/2—100 for the Veterinary Assistant Surgeon. The scale proposed for the Assistant is the revised scale of pay allowed to Veterinary Assistants in the Veterinary Department in this Presidency. The University has no objection to the adoption of time scales for these posts. If the University wants to employ a Departmental Officer for any of the posts it will have to provide the actual pay drawn and leave and pension contributions in respect of the officer. The estimated cost of the scheme on the basis of the time scales of pay mentioned above amounts to Rs. 20,040.

2. 150 printed copies of the scheme will be forwarded in due course.

LETTER FROM THE REGISTRAR, UNIVERSITY OF MADRAS, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, SIMLA AND TO THE SECRETARY TO GOVERNMENT, DEVELOPMENT DEPARTMENT, DATED 22ND MAY 1935, No. A. 8474.

I have the honour, by direction, to apply to the Imperial Council of Agricultural Research for a grant of Rs. 21,300 for a scheme of "Enquiry into the Helminthiasis of Cattle in the Madras Presidency." The investigation is to be carried out under the auspices of the University at the Veterinary College, Madras.

A note explaining the scheme is enclosed, and I request the favour of your placing the scheme before the Advisory Board of the Council at its meeting to be held in July next.

ENCLOSURE.

UNIVERSITY OF MADRAS.

*A Scheme for Enquiry into Helminthiasis of Cattle in the Madras Presidency.*

1. *Introduction.*—Very little work has been done on helminthic infections of cattle in the Madras Presidency, but sufficient data has been collected by the laboratory attached to the Madras Veterinary College to show that the condition is widespread and that many of the illnesses and debilitating effects from which cattle suffer are caused directly or indirectly by helminths. It is, therefore, very essential if cattle are to be kept in good health and condition that a knowledge of the helminths found in this Presidency should be known. This scheme has, therefore, been prepared with the object of finding out the prevailing helminths, the districts in which they cause most trouble, their life, histories and methods of treatment and prevention.

2. The work will be carried out at the laboratory attached to the Madras Veterinary College where ample facilities are available.

3. Materials will be collected and every assistance given by the officers of the Civil Veterinary Department, Madras.

4. The scheme will be conducted under the supervision of Mr. Anant Narayan Rao, Lecturer in Parasitology, Madras Veterinary College.

5. *Programme of work.*—The programme of work, spread over five years, is appended. It is suggested that a Veterinary Graduate be appointed to assist the Research Scholar because he will have some working knowledge of the common helminths in cattle and, being a professional man, will be useful in collecting data on the morbid anatomy of animals, etc. During the second and third years, the Research Scholar or his Assistant may have to visit some localities once in two months or so for collecting material and to study environmental conditions.

6. *Expenditure.*—A detailed estimate of expenditure is appended. The total amount comes to Rs. 21,300.

7. *Programme of work (enquiry into Helminthiasis of Cattle in South India).*—During the first year helminths will be collected from animals slaughtered in the Madras Slaughter House, and such other places in the districts where meat inspection is held. In addition to this, worms collected during *post-mortem* examinations of cattle will also be obtained. These worms will be examined, identified and preserved. Careful notes regarding the percentage of infection in each animal and the condition of the animal before slaughter will be maintained. Notes on the localities from which the animals were obtained for slaughter, etc., will also be recorded.

8. During the second year, a study of the conditions under which helminthic ova and larvæ develop in faecal cultures will be made. The developmental stages of the larvæ and the longevity of the ova and larvæ under normal and abnormal conditions either in the free state or in an intermediary host will be studied.

9. During the third and fourth years, experimental infection in calves with chosen helminths for study of the effects on the host and the pathological changes in the organs of the calves that may die will be made; control methods will be studied.

10. *Fifth year.*—Study of anthelmintics with a view to find out the specific action of particular drugs on experimental or naturally infected animals.

*The staff and expenditure spread over five years.*

|  | Rs.    | A. | P. |
|--|--------|----|----|
| (1) One Research Scholar on Rs. 150 per mensem for five years . . . . .  | 9,000  | 0  | 0  |
| (2) One Veterinary Assistant Surgeon to assist the Research Scholar, average salary Rs. 75 per mensem for five years . . . . . | 4,500  | 0  | 0  |
| (3) One attendant or peon, average pay Rs. 20 per mensem for five years . . . . .  | 1,200  | 0  | 0  |
| (4) Travelling allowance at Rs. 500 per annum for two years . . . . .  | 1,000  | 0  | 0  |
| (5) Glassware, reagents, etc., at Rs. 200 per annum for five years . . . . .   | 1,000  | 0  | 0  |
| (6) Cost of 60 calves at Rs. 5 each for all experimental work . . . . .  | 300    | 0  | 0  |
| (7) Cost of feeding 20 calves a year for three years at Rs. 5 each per mensem . . . . .  | 3,600  | 0  | 0  |
| (8) Cost of buckets, ropes, etc. . . . .   | 160    | 0  | 0  |
| (9) Pay of a cattle attendant at Rs. 15 per mensem for three years . . . . .   | 540    | 0  | 0  |
| Total . . . . .  | 21,300 | 0  | 0  |

## ENCLOSURE II.

REPORT OF THE SUB-COMMITTEE APPOINTED TO CONSIDER DR. G. S. THAPAR'S HELMINTHOLOGY SCHEME (SUBJECT NO. 26), WHICH MET AT SIMLA ON WEDNESDAY, THE 9TH AUGUST 1938.

The following were present:—

1. Colonel A. Olver, C.B., C.M.G., F.R.C.V.S.—*Chairman*,
  2. Mr. F. Ware.
  3. Mr. P. J. Kerr.
  4. Major P. B. Riley.
  5. Mr. T. J. Hurley.
  6. Mr. J. H. G. Jerrom.
  7. Mr. W. Taylor.
  8. Dr. G. S. Thapar.
  9. Mr. Afzal Hussain.
  10. Diwan Anand Kumar.
- } Co-opted members.

The meeting of the Committee lasted from 2-30 P.M. to 4 P.M.

I. The Committee after hearing Dr. Thapar's remarks on his scheme decided to take up the question of devising the method of distributing helminthological work so as to obtain the best results. It was suggested that there are 3 main heads under which investigation is required, *viz.*, (a) Systematic identification, (b) Life histories, (c) Field investigations. The work of systematic identification might be allotted: (1) By hosts, (2) By groups of parasites, and (3) Geographically, and it was eventually decided that *geographical distribution* would be the best; with the proviso that workers should pass on any parasite in which they were not particularly interested to other institutes where they could be more thoroughly studied.

II. It was then agreed that there should be 4 main centres of helminthological research, *viz.*, (1) the Imperial Institute of Veterinary Research, Muktesar, (2) Lucknow University, (3) the Madras Veterinary College, and (4) Nagpur University. The 3 first named have agreed to the proposal, but the Nagpur University will have to be addressed in the matter.

It was decided that material from provinces and States should be distributed to these research centres as follows:—

- (1) Material from Madras Presidency, Mysore and Hyderabad States, Coorg, etc., to the Madras Veterinary College;
- (2) That from Bombay, Central Provinces, Baroda and Central Indian States should go to Nagpur;
- (3) That from United Provinces, Bihar and Orissa, Bengal and Assam to Lucknow; and
- (4) That from Punjab, North-West Frontier Province, Sind, Baluchistan, Rajputana, Jammu and Kashmir to the Imperial Institute of Veterinary Research, Muktesar.

III. *Systematic identification of parasites.*—It was proposed that district staffs of provincial veterinary departments, research students of universities and others interested should be invited to carry out the systematic collection of helminth parasites and forward them in the first instance to a local centre, such as a veterinary college or university, where such existed. At these centres material would be sifted out and any requiring further identification should be forwarded to the main research centres in accordance with the distribution mentioned above. It was suggested that this Council should address Universities and acquaint them of these proposals and invite them to co-operate.

IV. *Field Investigations.*—The scheme already sanctioned for work at the Punjab Veterinary College, Lahore, was approved, and it was suggested that other Provinces might be invited to submit schemes for work of all-India importance which they would be able to take up.

V. *Life-histories.*—It was considered that life-histories of a certain number of the most important parasites should be worked out and that this should be done at the main centres already indicated.

Progress reports on the work in hand should be submitted to the Council each year, with the programme of the work proposed for the following year for consideration by the Helminthological Committee. It was considered that this Committee should be a permanent one and that to avoid overlapping Directors of Veterinary Services should be asked to submit suggestions as to the lines on which work should particularly be taken up.

VI. Dr. Thapar's scheme was then considered in detail and certain modifications were suggested in view of the decision that his work should be confined to systematic identification and the working out of life-histories as opportunities occur. It was agreed that with these modifications the scheme should be recommended to the Board for approval.



## APPENDIX XLV.

Report of the Dry Farming Schemes Co-ordination Committee held at New Delhi on the 12th February 1936, at 10 a. m.

## Present.

1. Dr. F. J. F. Shaw, (Chairman),
2. Dr. W. Burns,
3. Mr. N. V. Kanitkar,
4. Dr. P. J. Krishna,
5. Mr. G. S. Kurpad,
6. Dr. A. Subha Rao,
7. Rao Bahadur M. Vaidyanathan,
8. Mr. C. Vijayaraghava Acharya,
9. Rao Bahadur B. Viswanath,
10. Lala Tehl Ram, Visitor.

*Progress report of the Madras Dry Farming Research Scheme for 1934-35 [item 36 (a) of the Agenda].*

The information regarding this scheme is contained in the annual report of the scheme in which a good deal of information is lacking and in the annual report of the farm in which experiments other than those included in the scheme are also described. In future years a complete report of the scheme, which need not be bulkier than the report of 41 pages should be placed before the Committee. With reference to the field experiment on soil moisture, the Committee consider that, whilst this experiment might be continued as part of the ordinary work of the Madras Agricultural Department, an experiment of this defective lay-out should not be included in a scheme which is financed by the Imperial Council of Agricultural Research at a time when modern methods of field technique are well understood. A new experiment should be laid out, adopting modern technique and containing only those varieties which previous experience has shown may give useful results. This will not interfere with the experiment stated at page 11 of the report.

*2. Progress report on the Bombay Dry Farming Research Scheme for the period October 1933 to March 1935 [item 36 (b) of the Agenda].*

The Committee note that this is the first report of this scheme and that naturally the report deals chiefly with the nature of the soil and general lay-out at two very dissimilar stations. At the Sholapur station there is a marked contrast between deep soils and shallow soils. It is surprising that the deep soils occur chiefly on ridges and shallow soils on the depressions of the farm. *Juar* is the dominant crop in this area and the problem of *juar* cultivation is associated with finding some method which will enable *juar* to be grown on soils which dry out very quickly. The study of erosion of soil is one of the principal items of work at this farm and the Committee note that in heavy short bursts of rain the amount of soil removed may reach as much as 115 tons per acre. The work on the physiology of *juar* has been carried out particularly with reference to the secretion of a solution containing cane sugar on the leaves. Experimental work indicates that the occurrence of this

secretion may be caused by low temperature and low humidity occurring at the same time. The problem may assume the proportions of a disease. The Committee consider that the experiment on bunding and mulching (page 154 of the report) should be randomised. The results on page 157 show very pronounced inter-action which should be stated.

The Bombay dry-farming method consists of:—

- (1) a thorough preparatory tillage including ploughing of the land every year,
- (2) harrowing six times,
- (3) bunding the field all round,
- (4) sowing in lines with a low seed rate of 4 lbs. with a wide drill 18" apart so as to control the plant population, mulching during the crop growth,
- (5) three to four interculturings.

The Committee note that in the experiments of the first year the Bombay dry farming method shows appreciable improvement over the local method.

An examination of six varieties of *juar* from Bombay and two from Madras on a comparative basis was carried out with the object of establishing a biological standard for comparison of the results of the different stations.

In physical and chemical experiments it is suggested that the methods employed be indicated and the average results of replications be given with the plus and minus determinations. In the case of field experiments, the original date and lay-out should be given as is indicated in the instructions of the Imperial Council of Agricultural Research dealing with this point. The full details of the analysis of variance need not be printed and it is sufficient if the result and the statistical method is given. The description of a method used in an experiment as "that used in the previous year's report" should be avoided and the actual method should always be mentioned by name in every report. The Committee consider that the size of a report should be limited to 50 pages and that authors should remember that an annual report is not a final publication. The conclusions on the work of the scheme are likely to form the subject of monographs or papers.

The Committee approved of the report.

## APPENDIX XLV-A.

Imperial Council of Agricultural Research, Advisory Board, thirteenth meeting, February 1936. (Dry-Farming Research Schemes Co-ordination Committee). Subject No. 36:—Dry-Farming Schemes—Progress Reports.

(Supplementary).

*Comments on the Annual Reports of the Dry-Farming Schemes.*

By,  
Statistician,

Imperial Council of Agricultural Research.

(a) *Bombay Report, 1933-1935.*

*Pages 79-95.*—The results could be condensed in a tabular form giving the S. E. per cent. in the case of each plot-size.

*Pages 137-140.*—The data could as well be graphed.

*Page 154.*—There is no randomisation in the lay-out, which is an incorrect procedure.

*Page 157.*—It seems necessary to know 'significance' of 'treatments' on the basis of 'interaction' (in the analysis. 'random error' is taken as the basis in all cases).

(b) *Madras Report, 1934-35.*

*No experimental data are given.*

## APPENDIX XLVI.

Note by the Secretary, Imperial Council of Agricultural Research, dated the 1st December 1935, on Subject No. 24:—Application from the Government of Cochin for a grant of Rs. 40,580 spread over a period of 5 years for a scheme of investigation of coconut leaf disease in Cochin State.

Attention is invited to the attached copy of a note (Enclosure I) dated the 21st June 1935, on the subject mentioned above, which was circulated to the Advisory Board at its meeting held in July 1935. The scheme was examined by a special Sub-Committee of the Board which considered that there was scope for a co-ordinated scheme of work on coconut diseases in South India and that an official reference should be made by the Council to the Government of Madras and the Travancore and Cochin Darbars as to the necessity for and the best method of arranging for co-ordinated work on the leaf diseases as well as the other diseases of the coconut palm (Enclosure II). This was accepted by the Advisory Board.

2. Enclosure III contains the remarks of the Madras, Cochin and Travancore Governments on the subject which are now for the consideration of the Advisory Board.

3. The Vice-Chairman to the Council considers that it will be an advantage if the subject is first examined by a Sub-Committee consisting of:—

The Vice-Chairman, Imperial Council of Agricultural Research,—  
Chairman *ex-officio*.

The Agricultural Expert, Imperial Council of Agricultural Research

The Director of Agriculture, Madras.

The Director of Agriculture, Travancore.

The Director of Agriculture, Cochin.

Professor T. Ekambaram.

The Imperial Mycologist (subject to the approval of the Government of India).

Secretary, Imperial Council of Agricultural Research,—Secretary  
*ex-officio*.

This Sub-Committee will meet on a convenient day between the 10th and 15th February 1936, and its report (Appendix XLVIII) will be circulated to the Advisory Board in due course.

## ENCLOSURE I.

IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, ADVISORY BOARD TWELFTH MEETING, JULY 1935, SUBJECT No. 51:—APPLICATION FROM THE GOVERNMENT OF COCHIN FOR A GRANT OF RS. 40,580 SPREAD OVER A PERIOD OF 5 YEARS FOR A SCHEME OF INVESTIGATION OF COCONUT LEAF DISEASE IN COCHIN STATE.

Attention is invited to the attached scheme (Annexure) forwarded by the Government of Cochin for an investigation of coconut leaf disease in the Cochin State. The scheme involves a total expenditure of Rs. 40,580 spread over a period of 5 years.

2. Work on coconut diseases appears to be in progress in Madras, Travancore and Cochin and the Board has already recommended a grant

to Travancore State with special reference to the Coconut Root Disease. In view of principle No. 2 (*viz.*, that where a scheme is suggested for one province the possibility of co-operating with adjoining provinces in its prosecution should be explored) of the principles laid down by the Governing Body, relating to the grants made by the Imperial Council of Agricultural Research, the Advisory Board will doubtless consider whether some degree of co-ordination of work on coconut diseases in South India cannot be effected to avoid overlapping.

3. As the next meeting of the Indian Oil Crushing Industry Committee has been postponed pending a decision on the question of the proposed Cess on Oil Seeds, the Vice-Chairman does not consider it advisable that the consideration of oilseed schemes should be postponed. He is therefore of the opinion that the Advisory Board should consider this scheme along with other oilseed schemes at its forthcoming meeting and that it would be an advantage if the scheme were first examined by a sub-committee of the Advisory Board consisting of:—

The Vice-Chairman, Imperial Council of Agricultural Research,  
Chairman (*ex-officio*).

The Agricultural Expert, Imperial Council of Agricultural Research.  
The Director of Agriculture, Bengal.

The Director of Agriculture, Punjab.

The Director of Agriculture, Central Provinces.

The Director, Imperial Institute of Agricultural Research.

Professor, T. Ekambram.

Mr. T. S. Sabnis, 2nd Economic Botanist, United Provinces (subject to the approval of Local Government).

Mr. A. M. Thompson, Senior Marketing Officer.

Secretary, Imperial Council of Agricultural Research, Secretary  
*ex-officio*.

This Sub-committee will meet on the forenoon of the 16th July (at a time to be announced later) and its report will be submitted to the Board.

The subject is now for the consideration of the Advisory Board.

BAZLUL KARIM,  
*Off. Secretary.*

SIMLA;

The 21st June 1935.

#### ANNEXURE.

#### A SCHEME FOR THE INVESTIGATION OF THE COCONUT LEAF DISEASE OF THE COCHIN STATE.

*History of the Disease.*—The disease came to the notice of the Agricultural Department of the State about the year 1914. Mattancherry in Cochin was the chief centre of infection and the disease was called the

"Cochin Disease of Coconuts". Enquiries then made revealed that the disease was in existence in the locality for about twenty years and hence the disease may be taken to be about forty years old in the State.

*Symptoms of the Disease.*—The crowns of the trees affected by the disease show a characteristic appearance. The outer whorls of leaves are mostly denuded of their leaflets. In the majority of cases there are a few leaflets or stumps of leaflets at the basal portions of the leaves with the naked portions of the midribs shooting out. In the inner whorls of leaves the affected portions (top portions) are wrinkled and curled, dry and brown or dark brown in colour. In the central unopened shoots there are spots or patches of a reddish brown colour which seem to penetrate from the outer surface into the interior, the outer exposed portions being darker and drier in appearance. The crowns of the trees become smaller in size with the progress of the disease and the yield of the trees also considerably falls off. A fall of 60 to 90 per cent. and even complete loss in the yield of nuts have been observed in advanced stages of the disease.

Trees in all stages of growth get attacked. The disease is severe in neglected gardens and in low-lying and badly drained areas; but gardens properly drained and properly cultivated too, are not free from the disease. The trees struggle on with the disease for a number of years and deaths are few and far between. Virulent cases where deaths occur in two or three years after the trees get attacked are also occasionally seen. Recoveries from the disease are rare.

*Work done on the Disease.*—Certain preliminary investigations were conducted by Dr. W. MacRae, on this disease when he was Mycologist to the Government of Madras and later on by Mr. S. Sundara Raman, the present Government Mycologist, Madras. A *Penicillium*-like fungus was isolated which, however, proved to be a weak parasite. No definite conclusions were arrived at and further investigations on the disease are necessary.

The State Agricultural Department has been devoting its attention more to field operations in controlling the disease. The infected portions of the leaves are cut and burnt and the crowns of the trees sprayed with a fungicide like Bordeaux Mixture. The trees are properly manured to enable them to put forth a quick succession of shoots and throw off the disease. Proper drainage to the infected gardens is also attended to. As a result of this, treated gardens show some temporary improvement, but the improvement has been found to be only temporary.

*Work to be done.*—The following are the lines on which future investigation is to be carried out.

1. Determination of the casual organisms.
  - (a) Isolation.
  - (b) Inoculation.
2. Study of the conditions favouring the disease.
  - (a) Soil—physical features, drainage, mineral deficiency.
  - (b) Weather.
3. Means by which the disease spreads from one locality to another.

## 4. Control measures.

(a) Fungicidal.

(b) Manurial.

(c) Study of the possibilities of improvement of the physical condition of the soil by providing adequate drainage facilities.

(d) Resistant varieties—observation on the incidence of the disease in relation to varieties.

*Magnitude of the Disease.*—The disease is assuming serious proportions and it is high time to tackle it on systematic lines. It has spread over one *Taluk* in the Cochin State and it has spread over a much larger area in the neighbouring State of Travancore. Dr. E. J. Butler, who conducted an enquiry into the "Root Disease" of coconuts in Travancore in 1908, does not mention of a single instance of leaf disease in Travancore at the time of his investigations. (Reference Pusa Bulletin\* No. 9 on the Coconut Palm Disease in Travancore by Dr. E. J. Butler 1908). But, at present, there are thousands of trees affected by the disease in the very areas investigated by Dr. Butler. There are also gardens affected by this disease in British Cochin, though to a limited number.

The coconut is a crop of All-India importance and this is a disease which has already affected three territories, Cochin, Travancore and British Cochin. Next to paddy, the coconut is the most important crop of the West Coast and several lakhs of the population are dependent on the growing of coconuts or industries connected with the coconut for their livelihood. Added to the recent abnormal fall in prices which has hit everyone connected with the industry hard, this disease is another menace which is threatening the coconut industry.

The limited staff of the State Agricultural Department is fully occupied and is quite inadequate to deal with a problem of this magnitude and the appointment of a special full-time staff is necessary to carry out this work.

*Financial.*—The following is the cost of a scheme for Research on this disease, to be spread over a period of five years. The total cost comes to Rs. 40,580.

*Statement showing details of the cost of the scheme for Research on the Coconuts Leaf Disease.*

|   | I<br>year. | II<br>year. | III<br>year. | IV<br>year. | V<br>year. | Remarks.     |
|---|------------|-------------|--------------|-------------|------------|--------------|
| 1. Mycologist Rs. 300—25—<br>400 per mensem . . . . .   | 3,600      | 3,900       | 4,200        | 4,500       | 4,800      |              |
| 2. Graduate Assistant Rs.<br>50—5—70 . . . . .  | 600        | 660         | 720          | 780         | 840        |              |
| 3. Fieldmen Rs. 25—3—40 . . . . .   | 300        | 336         | 372          | 408         | 444        |              |
| 4. Climber Rs. 15 . . . . .   | 180        | 180         | 180          | 180         | 180        |              |
| 5. Peon Rs. 12 . . . . .  | 144        | 144         | 144          | 144         | 144        |              |
| 6. Travelling allowance . . . . .   | 900        | 900         | 900          | 900         | 900        |              |
| 7. Laboratory equipment . . . . .   | 2,000      | 250         | 250          | 250         | 250        |              |
| 8. Contingencies—Rent for<br>building (Office and<br>Store) Spraying, Manu-<br>ring and Drainage ex-<br>periments, Photographs,<br>casual labour charges,<br>and sundries . . . . . | 1,000      | 1,000       | 1,000        | 1,000       | 1,000      |              |
| Total . . . . .   | 8,724      | 7,370       | 7,760        | 8,162       | 8,558      | = Rs. 40,580 |

\*Not put up.

## ENCLOSURE II.

EXTRACT FROM THE REPORT OF THE OIL SEEDS SUB-COMMITTEE, JULY 1935.

*Proposal for research on coconut leaf disease in Cochin. (Subject No. 51).*

It appeared to the Sub-Committee that this disease is also known in Madras and Travancore. But there is a little uncertainty about its identity and economic importance. It appears that there is scope for a co-ordinated scheme of work on coconut diseases in South India. The Sub-Committee recommends that an official reference should be made by the Council to the Madras, Travancore and Cochin Governments as to the necessity for and the best method of arranging for co-ordinated work on this disease as well as on the other diseases of the coconut palm. The Sub-Committee considers that the possibility of a centrally situated laboratory which would be convenient to the coconut growing areas of all these three Governments, might be explored.

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EXTRACT FROM THE PROCEEDINGS OF THE ADVISORY BOARD, JULY 1935.

25. *Application from the Government of Cochin for a grant of Rs. 40,580 spread over a period of five years for a scheme of investigation of the coconut leaf disease in Cochin State (Subject No. 51 of the Agenda).*

Mr. Warriar accepted the report of the Committee which was adopted.

## ENCLOSURE III.

COPY OF LETTER No. 3888-III/35-2, DATED THE 26TH SEPTEMBER 1935, FROM THE SECRETARY TO THE GOVERNMENT OF MADRAS, DEVELOPMENT DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

*Application from the Government of Cochin for a grant for a scheme of investigation of the coconut leaf disease—Ref. Your letter No. F-120/III-35-A., dated the 23rd August 1935.*

I am directed to state that the disease is not important so far as the Madras Presidency is concerned except in British Cochin. Ernakulam is considered to be a central place where a laboratory can be conveniently situated. A copy of the remarks of the Government Mycologist is enclosed.

*Remarks of the Government Mycologist.*

The leaf disease of coconut palm, a description of which appeared in the Madras Agricultural Department Year Book for 1924, was first reported about the year 1915 from Mattancherry in Cochin State. Dr. McBae who was then Mycologist at Coimbatore investigated the disease and found that the disease was prevalent in Mattancherry, Ernakulam and British Cochin which borders on Mattancherry.



2. The fungus was isolated in Coimbatore and its characters studied. It was not identified, but from its characters it was called a "Panicillium—lie fungus" and the disease was called "Cochin disease" of coconut palm. One important point discovered during the study of the fungus at Coimbatore was that it is a weak parasite which flourishes on tender shoots only during heavy monsoon.

3. With this knowledge, a series of experiments was suggested to the State authorities to be laid out in a heavily infected locality. The summary of the experiments is given below:—

| Plot No.       | No. of trees. | Treatment.  |
|----------------|---------------|---|
| A              | 100           | Control.  |
| B <sub>1</sub> | 50            | Trees to be sprayed with 10-10-50 Bordeaux mixture with resin.  |
| B <sub>2</sub> | 50            | Trees to be sprayed with 5-5-50 Bordeaux mixture with resin.  |
| C <sub>1</sub> | 50            | Manuring with Mixture A—<br>Cattle manure . . . . . 5,000 lbs.<br>Potassium sulphate . . . . . 100 „<br>Basic super-phosphate . . . . . 3 cwts.<br>Finely ground shells . . . . . 60 lbs. } per acre. |
| C <sub>2</sub> | 50            | Manuring with Mixture B -<br>Fish manure . . . . . 500 lbs.<br>Potassium sulphate . . . . . 100 „<br>Basic super-phosphate . . . . . 3 cwts.<br>Finely ground shells . . . . . 60 lbs. } per acre.    |
| D <sub>1</sub> | 50            | Manured with Mixture A and sprayed with 10-10-50 Bordeaux mixture.  |
| D <sub>2</sub> | 50            | Manured with Mixture B and sprayed with full strength.  |

Some months later, the Superintendent of Agriculture under whose charge these experiments were, wrote as follows in the course of a letter:—

"Last year's spraying work done in Mettancherry appears to have done some good. A good many of the trees are looking better and a few are free from disease."

It may be recalled in this connection that the technique of spraying trees had not advanced beyond what was then known as "Mahali spraying" or spraying of arecanuts against Mahali disease.

4. Since the disease was confined to a narrow strip of land between the back water at Ernakulam and the sea, and the Cochin Department of Agriculture was more advantageously situated than the Madras Department to conduct experiments on measures of control, the subject has not subsequently received much attention from this Department.

5. The studies made at Coimbatore are by no means complete and several points both academical and economic remain to be investigated. Now that the disease is common both in Cochin and Travancore States and has assumed economic importance, the sanction of a grant for research into this disease may be recommended. The scheme submitted by the Cochin Department was unofficially shown to me and approved by me.

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COPY OF LETTER No. D. Dis.-1010/1111, DATED THE 30TH SEPTEMBER 1935, FROM THE DIWAN OF COCHIN, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

*Scheme of investigation of the Coconut Leaf Disease in the Cochin State.*

*Reference:—*(1) My letter D. Dis.-15352/10, dated 6th June 1935. (2) Your letter No. F.-120/III/35-A., dated 23rd August 1935.

The suggestions of the Darbar are already contained in my letter under reference. What I have further to add on the points mentioned in the report of the Sub-Committee is that Cochin State occupies a central place in the coconut producing areas of the West Coast and the Laboratory proposed for combating coconut diseases may be located in this State, say at Ernakulam.

As regards research on coconut diseases two schemes have been placed before the Imperial Council of Agricultural Research, one on the Root Diseases of coconuts by the Travancore Darbar and the other on the Leaf Diseases of coconuts by the Cochin Darbar. The Root Disease is rampant in Travancore and stray cases are seen in the adjoining Cochin Kanayannur Taluk. The Leaf Disease had its origin in the Cochin State, and although prevalent in Travancore and British Cochin its worse aspects are seen in this State. It has therefore to be tackled in the Cochin State itself.

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COPY OF LETTER No. D. Dis.-2525/35/DEVPT., DATED THE 6TH NOVEMBER 1935, FROM THE CHIEF SECRETARY TO THE GOVERNMENT OF TRAVANCORE TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

With reference to your letter No. F.-120/111/35-A., dated the 23rd August 1935, regarding the application from the Government of Cochin for a grant of Rs. 40,500 spread over a period of five years for a scheme of investigation of the coconut leaf disease in Cochin State, I have the

honour to inform you that, as stated in the Cochin scheme itself, this leaf disease occurs in Travancore also, and is even more wide-spread here than in Cochin. The Council has already considered a scheme submitted by this Government and sanctioned a grant for the investigation of the so-called root disease of coconut palms, a disease which occurs very often in company with the leaf disease and many other affections of the palm. All these diseases will thoroughly be investigated under the Travancore Scheme and the Travancore Research Stations will be set up in an area which is more widely and severely infected than any other part of the Malabar Coast. Travancore may therefore be looked upon as a central research station for the whole of Malabar. The work proposed by the Cochin State is only a duplication of a part of the work which will be done in Travancore under the grant from the Imperial Council. It is therefore the considered view of the Travancore Government that it is unnecessary to take up the Cochin Scheme separately.

## APPENDIX XLVII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 27th December 1935, on Subject No. 25:—Application from the Government of Madras for a grant of Rs. 74,705 spread over five years for a scheme of Research on Coconuts in the Madras Presidency.**

Attention is invited to the attached copy of a letter (Enclosure) from the Government of Madras, No. 1723, dated the 6th December 1935, forwarding a scheme of research on coconuts in the Madras Presidency which involves, as far as the Council is concerned, recurring expenditure of Rs. 74,705 spread over a period of five years. The scheme is for the consideration of the Advisory Board.

2. The Vice-Chairman to the Council considers that it will be an advantage if the scheme is first examined by a Sub-Committee consisting of:—

The Vice-Chairman, Imperial Council of Agricultural Research,  
Chairman, *Ex-Officio*.

The Agricultural Expert, Imperial Council of Agricultural Research.

The Director of Agriculture, Madras.

The Director of Agriculture, Bombay.

The Director of Agriculture, Mysore.

The Director of Agriculture, Travancore.

The Superintendent of Agriculture, Cochin.

Professor T. Ekambaram.

The Imperial Mycologist (subject to the approval of the Government of India).

The Secretary, Imperial Council of Agricultural Research, Secretary,  
*Ex-Officio*.

This Sub-Committee will meet on a convenient day between the 10th and 15th February 1936 and its report (Appx. XLVIII) will be submitted to the Advisory Board in due course.

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 ENCLOSURE.

*Copy of a letter No. 1723, dated the 6th December 1935 from the Secretary to the Government of Madras, Development Department, to the Secretary, Imperial Council of Agricultural Research, New Delhi.*

I am directed to enclose a scheme of research (Annexure) on coconuts proposed by the Director of Agriculture, Madras, for consideration of the Council. As regards the pay of the staff, though the average of the different scales for the gazetted and non-gazetted staff has been adopted for

purposes of the estimates, the actual pay drawn from time to time by the incumbents will alone be debited to the grant.

2. The Provincial Research Committee has by a majority recommended the scheme.

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### ANNEXURE.

#### A SCHEME FOR RESEARCH ON COCONUTS.

*Work done on the coconut.*—Before dealing with the problems which require research it is but appropriate that the results of the researches carried out in Madras are briefly summarized so as to enable proper appreciation of the work that is ahead.

The study of the floral biology of the palm has revealed that (a) the cross-pollination in the coconut is not so widely prevalent as is largely presumed and that (b) as much as 80 to 90 per cent. of the female flowers are shed, and of these about 70 to 80 per cent. are shed after the female flowers have become receptive; neither drought nor rainfall is correlated with the shedding of female flowers—"buttons."

The copra content of the nut is related to both the volume and the weight of the nut; but the medium-sized round nuts contain proportionately more copra than the oval nuts of the same volume. The medium-sized round nuts germinate earlier than the other types of nuts. The seedlings from the early germinated nuts are more vigorous, i.e., produce more leaves and roots. A large number of the leaves on the palm is positively and significantly correlated with the early flowering and heavy yields.

Light orange nuts contain more of copra than the other types of nuts. Very early harvest leads to a loss in the yield of both the copra and oil.

Clean cultivation of the coconut gardens increases the yield by about 100 per cent., over the unweeded plots. A mixture of three pounds of ammonium sulphate and 20 pounds of ashes per tree is found to be the best manure for the coconuts on the West Coast. The trees which yield heavily do not appear to respond to the systems of cultivation and manuring which have been tried. This type of trees may be the ecotypes for this region.

About 1,000 nuts obtained by cross, self and natural pollination of desirable trees have been planted. Pruning of roots during trenching appears to increase the setting percentage, while manuring appears to increase the production of female flowers. Pruning of roots of vigorous one-year old seedlings before transplanting, appears to be harmful to the seedling. In most of the localities where the water table is low, deep planting of seedlings is found better than the system of surface planting. Some trees are found to be entirely free from the attack of rhinoceros beetle (*Oryctes rhinoceros*).

*Work on hand.*—The following problems are under experimentation:—

- (a) The determination of the best method of applying the manures to the coconut. In the experiments carried out so far, the manures were broadcasted, but the common practice on the West Coast is to apply them in trenches.

- (b) The testing of different doses of manures found most economical.
- (c) An investigation into the factors which lead to the shedding of "buttons" (female flowers).
- (d) The biometrical measurements on the seedlings from cross, self and naturally pollinated seed nuts of the desirable types of trees. The study will include the measurements of the rate of production of leaves and the rate of the growth of the stem with a view to correlate the observation on the offspring with the parents. In spite of the fact that there is considerable cross-pollination, in the coconut some progenies show hybrid vigour, and it would be possible to utilize this in the production of seed material.

*The work that will be pursued from the Provincial funds.*—The research on the abovementioned problems will be financed from Provincial funds, and the pursuit of these problems will at least require a period of five years. In addition to this work, research will be financed from the Provincial budget for the following two problems:—

- (e) The determination of the manurial requirements of the heavy bearers.
- (f) The evaluation of the efficiency of different methods of cultivation.

*The research proposed to be carried out with the financial aid of the Imperial Council of Agricultural Research.*—There are four Agricultural Research Stations in Madras, which are entirely devoted to research on the coconut. The work done and the work on hand on these stations has just been stated. Some of the recommendations arising out of researches carried out in Madras are applicable to the States and Provinces other than Madras. It may be said that to that extent Madras has already contributed to the solution of problems of all-India character. The problem (d) dealing with the study of the seedlings from cross, self and naturally pollinated nuts, that is on hand is also of an all-India character.

The Government of Madras spends annually about Rs. 24,000 on the research on coconut, and a capital outlay of about one lakh of rupees on the existing stations has already been incurred. With the commitments already on hand it will not be possible to undertake research on the problems outlined below, and the application, is therefore made to the Imperial Council of Agricultural Research, to finance the scheme.

#### *Problems.*

(a) *Determination of the criteria for selection*—(i) *Yield of nuts.*—In a crop like the coconut which stands on the plantation for a period of 60 to 80 years at least, the need for the careful selection of the seed nut and the seedlings for planting is obvious. For efficient selection of seed nuts and seedlings, however, it must be known that certain characters in the parental palms, in the seed nuts and in the seedlings represent to a large extent the desirable qualities in the palm. Preliminary work has shown that the period required for germination, rate of production

of leaves and girth, and the height of the stem may form suitable criteria for the selection of seedlings with reference to the yield of nuts. This, however, has to be confirmed from the study of the large number of first and second generation and parental seedlings. Suitable material is available for this investigation.

(ii) *Yield of copra*.—Since the major portion of the crop on the West Coast is converted into copra and then into oil, the yield of copra and oil per palm are important considerations for the producer. "On an average about 6,250 nuts will yield a ton of copra on the West Coast, while in Ceylon about 4,800 nuts are required to yield a ton of copra." This remark of the Coconut Enquiry Officer (paragraph 49 of his report) calls for some action. No systematic study of the variation in the yield of copra per nut has so far been conducted in India. It is, therefore, proposed to study the variation in the copra content of the nuts of heavy bearers, and to determine the correlations, if any, between the copra content and the characters of the nut and the palm.

(iii) *Yield of oil*.—"Generally 62½ per cent. oil is obtained from local copra and 60 per cent. of oil from Ceylon copra" (paragraph 74 of the Coconut Enquiry report). This is an advantage in favour of our producers. It would, however, be still worth while to explore the possibilities of raising the percentage of oil in our copra. The study of the variation in the oil content of copra from different types of trees with a view to ascertain the correlation between the oil content and the characters of the nut and the palm is therefore proposed.

(b) For the manufacture of high-grade coir, nuts have to be harvested before they are fully ripe. After examining the question whether the loss sustained by the production of comparatively low grade copra is adequately compensated for by the gain in the sale of green husk for the manufacture of coir, the Enquiry Officer came to the conclusion that "the whole question needs to be examined fully by a series of experiments" (paragraph 122 of the report). The investigation of the problem along the following lines would answer the question raised above:—

(iv) The suitability of the husks at different stages of maturity for the manufacture of coir.

(v) The study of the different commercial grades of coir fibre, with reference to their colour, length, tensile strength and resistance to decay under moist conditions. Similar data obtained from item (iv) will have to be compared with the data from the commercial grades.

(vi) The quantity and the quality (physical) of copra from the nuts harvested at different stages of maturity.

(vii) The quantity and quality (free fatty acid) of oil from the copra made from the nuts at different stages of maturity.

(c) The nuts harvested during the rainy season are largely sent from the West Coast to up-country merchants and these are not converted into copra.

(viii) The variations in the copra and the oil content of the nuts from the harvests of different months. It may be possible for the producers to sell as whole nuts, the nuts which are not so rich in oil and copra.

*The cost of the scheme.*—It is proposed that there should be a Superintendent in charge of the four stations who will control and co-ordinate the work. A fieldman is required to assist each assistant.

| Particulars.   | Average pay. | First year. | Second year. | Third year. | Fourth year. | Fifth year. | Total. |
|--|--------------|-------------|--------------|-------------|--------------|-------------|--------|
|  | Rs.          | Rs.         | Rs.          | Rs.         | Rs.          | Rs.         | Rs.    |
| <b>Recurring expenditure—</b>                            |              |             |              |             |              |             |        |
| One Superintendent on Rs. 200—30/2                       | 422 2/9      | 5,067       | 5,067        | 5,067       | 5,067        | 5,067       | 25,335 |
| —250—40/2—500—30/2—700.                                  | ...          | 633         | 633          | 633         | 633          | 633         | 3,165  |
| Leave contribution at 12½ per cent. . .                  |              |             |              |             |              |             |        |
| Total—Provincial Service . . .                           |              | 5,700       | 5,700        | 5,700       | 5,700        | 5,700       | 28,500 |
| Two Botany Assistants, third grade—<br>Rs. 75—7½/2—105.  | 93 2/3       | 2,248       | 2,248        | 2,248       | 2,248        | 2,248       | 11,240 |
| One Chemistry Assistant third grade—<br>Rs. 75—7½/2—105. | 93 2/3       | 1,124       | 1,124        | 1,124       | 1,124        | 1,124       | 5,620  |
| Three fieldmen Rs. 30—3/2—48                             | 40 2/5       | 1,455       | 1,455        | 1,455       | 1,455        | 1,455       | 7,272  |
| One clerk Rs. 30—3/2—45—2/2—55                           | 42 1/12      | 505         | 505          | 505         | 505          | 505         | 2,525  |
| One laboratory attendant Rs. 19—2/2—33.                  | 26 7/9       | 322         | 322          | 322         | 322          | 322         | 1,610  |
| Total pay—Subordinate Service . . .                      |              | 5,653       | 5,654        | 5,653       | 5,654        | 5,653       | 28,267 |
| Leave contribution at 12½ per cent. . .                  |              | 706         | 707          | 706         | 707          | 707         | 3,533  |
| Total—Subordinate service . . .                          |              | 6,359       | 6,361        | 6,359       | 6,361        | 6,360       | 31,800 |
| Two peons Rs. 12—17 . . .                                | 14.7         | 352         | 352          | 352         | 352          | 352         | 1,760  |
| Leave contribution and pension at 1/12.                  |              | 29          | 29           | 29          | 29           | 29          | 145    |
| Total inferior service . . .                             |              | 381         | 381          | 381         | 381          | 381         | 1,905  |
| Grand total . . .  |              | 12,440      | 12,442       | 12,440      | 12,442       | 12,441      | 62,205 |
| Travelling allowance . . .                               |              | 3,000*      | 400          | 400         | 400          | 400         | 4,600  |
| Laboratory apparatus and materials . . .                 |              | 2,000       | 600          | 600         | 600          | 600         | 4,400  |
| Working expenses . . .                                   |              | 400         | 400          | 400         | 400          | 400         | 2,000  |
| Contingencies . . .                                      |              | 300         | 300          | 300         | 300          | 300         | 1,500  |
| Total cost of the scheme . . .                           |              | 18,140      | 14,142       | 14,140      | 14,142       | 14,141      | 74,705 |

\* Provides for the expenses of the tour of the officer to acquaint himself with the research on the account that is being carried out in Ceylon, Malaya, and the Philippines.

No application has been made for the non-recurring expenditure which will be borne by the Madras Government. Since in calculating the cost of the scheme average salaries are taken into consideration, the actual cost of the scheme will be less than the estimated amounts of about Rs. 15,000 per annum or a total of about Rs. 75,000 for the five-year period. The contribution to the scheme from Madras is the recurring expenditure of about Rs. 24,000 per annum and the capital outlay of about a lakh of rupees.

#### Appendix No. 1.

*The division of work between the assistants.*—Since the assistants will be working in collaboration with one another, it is well nigh impossible to have clear-cut division of work among them.

Botany Assistants.—2—Problems (i), (ii), (iv), (v), (vi) and partly problems (iii) and (viii).

Chemistry Assistant.—2—Problems (iii), (vii) and (viii).



## APPENDIX 2.

| Details regarding laboratory apparatus and materials—                            | First year. | Subsequent years. |
|--|-------------|-------------------|
|  | Rs.         | Rs.               |
| Hydraulic oil press . . . . .  | 800         | ..                |
| Oil extraction apparatus . . . . .   | 400         | ..                |
| Cloth bags . . . . .   | 200         | ..                |
| Ether, alcohol, other chemicals, commercial coir-fibre and incidentals . . . . . | 600         | 600               |
| Total . . . . .  | 2,000       | 600               |

## APPENDIX 3.

|   | Rs.                        |
|---|----------------------------|
| (i) Recurring expenditure of Rs. 24,000—Actual expenditure in 1934-35 for four coconut stations—                                      |                            |
| Pay of establishment (four Agricultural graduates, one Agricultural Diploma holder, two clerks, one fieldman and two peons) . . . . . | Rs. 9,577 + 1,272 = 10,849 |
| Travelling allowance . . . . .  | 491                        |
| Working expenses . . . . .  | 7,235                      |
| Other contingencies . . . . .   | 680                        |
| Petty construction and repairs . . . . .  | 683                        |
| Repairs to residential buildings . . . . .  | 200                        |
| Capital outlay (livestock and dead stock) . . . . .   | 150                        |
| Other petty supplies . . . . .  | 203                        |
| Total for the four coconut stations . . . . .   | 20,491                     |
| Add one-third share of the expenditure on Oil Seeds Specialist's headquarters at Coimbatore debitable to coconut research—            |                            |
| Pay of staff . . . . .  | Rs. 2,820                  |
| Laboratory apparatus, travelling allowance and contingencies . . . . .  | 1,080                      |
|   | 3,900                      |
| Grand total—Expenditure incurred by the Madras Government in connexion with coconut research . . . . .                                | 24,391                     |
|   | Rs.                        |
| (ii) Non-recurring expenditure—Capital outlay—Cost of land—   |                            |
| Agricultural Research Station, Pilicode, 0.74 acres at Rs. 490 per acre . . . . .   | 28,300 *                   |
| Agricultural Research Station, Nileshwar II, 26.67 acres at Rs. 300 per acre . . . . .  | 7,980 *                    |
| Agricultural Research Station, Nileshwar III, 43.02 acres at Rs. 300 per acre . . . . .   | 12,900 *                   |
| Agricultural Research Station, Kasaragod, 30.98 acre. at Rs. 600 per acre . . . . .   | 18,600 *                   |
| Implements, stores, furniture, etc. (lump sum estimate) . . . . .   | 3,000 *                    |
| Work bullocks—five pairs at Rs. 250 per pair . . . . .  | 1,250                      |
| Capital cost of residential buildings . . . . .   | 13,692                     |
| Capital cost of non-residential buildings . . . . .   | 14,574                     |
| Total, non-recurring expenditure . . . . .  | 1,00,296                   |

\* Estimated present valuation.

## APPENDIX XLVIII.

Report of the coconut Committee held at New Delhi on 12th February 1936  
at 12-0 noon.

## PRESENT:

Dr. F. J. F. SHAW, (Chairman). |

Rao Bahadur D. ANANDA RAO. |

Dr. W. BURNS. |

Mr. L. D. GALLOWAY. |

Mr. K. RAMIAH. |

*Application from the Government of Cochin for a grant of Rs. 40,580 spread over a period of five years for a scheme of investigation of the coconut leaf disease in the Cochin State, (item 24 of the Agenda). (Appendix XLVI).—*The Committee considered the application from the Government of Cochin for the above scheme and came to the conclusion that, in view of the fact that the scheme for the investigation of coconut disease in Travancore had already been approved by the Advisory Board, it was unnecessary to establish a separate scheme in Cochin. The Committee therefore suggest that the investigation of the Cochin coconut leaf disease be carried out at the laboratory in the Travancore State and that to deal with this increased work the staff under the Travancore scheme be strengthened by the addition of one routine graduate Assistant on Rs. 75—5—85 and that an increased provision of Rs. 500 per annum under travelling allowance should be made in order to enable him to tour in the Cochin State. The Committee came to the conclusion that, since both of these diseases are of obscure origin and both seem to occur in the Travancore State, a preliminary investigation in both cases would be of a similar nature.

*Application from the Government of Madras for a grant of Rs. 74,705 spread over a period of five years for a scheme of research work on coconuts in the Madras Presidency (item 25 of the Agenda). (Appendix XLVII).—*The Committee consider that this coconut problem is one of all-India importance affecting the provinces of Madras, Bombay, the Travancore State and Cochin. The problems which it is proposed to investigate are of a practical nature which are likely to yield results of economic importance. The Committee suggest the following modifications in the cost of the scheme:—

|   |                 |
|---|-----------------|
|   | Rs.             |
| One Superintendent starting on Rs. 260 per mensem . . . . .                                 | 17,520          |
| Two Botanical Assistants . . . . .  | 10,080          |
| One Chemical Assistant . . . . .  | 5,040           |
| <b>Two fieldmen . . . . .</b>   | <b>3,888</b>    |
| One Laboratory Attendant . . . . .  | 1,236           |
| One peon . . . . .  | 750             |
|   | <hr/>           |
| Travelling allowance Laboratory apparatus, Working expenses,<br>and Contingencies . . . . . | 38,514<br>9,900 |
|   | <hr/>           |
|   | 48,414          |
|   | <hr/>           |
| or say Rs. . . . .  | 48,400          |

The Committee called attention to the fact that the provision of travelling allowance in the first year is Rs. 3,000 in order to allow the tour of some officer selected by the Madras Government to Ceylon and the Philippines. The Committee has deleted Rs. 2,600 from the travelling allowance provision of the first year and considered that if it is desired the Research Council should bear the expense of this tour a separate proposal with a definite nomination of the officer should be submitted. The Committee understand from the Director of Agriculture, Madras, that the scheme will be under the guidance of the Oilseeds Specialist, Madras, Dr. Patel. The Committee recommend the scheme as revised at a total cost of Rs. 48,400 to the Board.

F. J. F. SHAW.

**APPENDIX XLIX.**

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 12th September 1935 on Subject No. 16 (a):—Report by Dr. B. P. Pal, Second Economic Botanist on the scheme for breeding rust-resistant wheats.**

In September 1934, the Advisory Board recommended a continuation grant of Rs. 1,35,000 spread over three years to the Government of the United Provinces for investigations on cereal rusts by Dr. K. C. Mehta (pages 46, 496-497 and 499-514 of the printed proceedings). This recommendation was approved by the Governing Body and effect was given to it from the 1st April 1935.

2. As the Board is aware, the extension scheme provided for co-operation with the Imperial Economic Botanist in the breeding of rust-resistant wheats. The Director, Imperial Institute of Agricultural Research, Delhi, has now forwarded the enclosed preliminary report (not printed) by Dr. B. P. Pal, Second Economic Botanist on the breeding of rust-resistant wheats at the Botanical Section, Pusa.

The report is for the consideration of the Advisory Board.

## APPENDIX L.

Report of the Wheat Breeding and Potato Committee, held at New Delhi, on the 14th February at 10-30 a.m.

## PRESENT:

Dr. F. J. F. SHAW. (*Chairman*).  
 Rao Bahadur D. ANANDA RAO.  
 Dr. W. BURNS.  
 Mr. L. D. GALLOWAY.  
 Dr. K. C. MEHTA.  
 Mr. J. C. MCDUGAL.  
 Dr. B. P. PAL.  
 Mr. J. H. RITCHIE.  
 Mr. D. R. SETHI.  
 Mr. B. S. KADAM attended as visitor.

*Report by Dr. B. P. Pal, Second Economic Botanist, Imperial Institute of Agricultural Research, on the scheme for breeding rust-resistant wheats [item 16 (a) of the Agenda]. (Appendix XLIX).—This scheme is under the Director of the Imperial Institute of Agricultural Research and the work is carried out by the Second Economic Botanist, Dr. B. P. Pal. The scheme started in April with the appointment of an Assistant, who is paid by the Imperial Council of Agricultural Research, at the Rust Research Station, Simla. The work had been carried out at Pusa during the preceding cold weather where the Assistant who was subsequently appointed to Simla, was an honorary research worker in the laboratory. The report gives the detail of 112 crosses which were carried out at Simla. This large number of crosses was made because at the time when the hybridisation work was in progress, Dr. Mehta's experiment on the resistance of parental types was still in progress. As the crosses were easy to make, a large number were made and from among these crosses a few will be selected for further study, the selection being based on the results obtained by Dr. Mehta on the resistance of parental types. In this way a year has been saved in the progress of the work. The Committee would point out that this scheme has not the sole object of producing a rust-resistant wheat but that due attention must be paid to the production of varieties which in addition to rust-resistance, possess desirable economic qualities. The Committee would request that the workers of the scheme should give adequate attention to the needs of the Central Provinces, Bombay, and other areas which require short season wheats. The Committee recognise that Durum crossing will be a problem for the Local Agricultural Department in Bombay.*

*Progress report for the year 1934-35 on the investigations on "Cereals" by Dr. K. C. Mehta, Agra College, Agra [item 16 (b) of the Agenda].—The Committee note that the report gives a summarised account of the work of the past year up to June 1935 and that detailed tables connected with the incidence and dissemination of rust, maps and the illustrations of samples studied will be published in the final report of the investigations.*

Dr. Mehta brought with him these tables and they were available and were studied by the Committee during the meeting. The Committee wish to commend this method of presenting an annual report which results in a considerable saving in the bulk of papers submitted to the Board.

The report deals with the progress of the work during the past year and the Committee note that the work was extended in six directions which are described on the first page of the report. A more intensive study of the location of foci of infection and more detailed information on the course of wind currents which serve for the dissemination of infection was made during the year under review. The study of wind trajectory commenced in 1932-33 and during the year under review supplementary wind curves have been prepared for two other altitudes. The Committee approved the report.

*Application from the Government of Assam for a grant of Rs. 30,688 spread over a period of four years for mycological research on potatoes (item 17 of the Agenda).* (Appendix LI).—The Committee reject the Assam scheme and do not recommend it to the Board because they consider that potato diseases should be investigated by the Imperial Mycologist in close collaboration with the potato-breeding research. Moreover, the Committee would draw attention to the fact that the most abstruse problems of potato disease are those of virus diseases and that there is a scheme for the investigation of virus diseases already sanctioned by the Board. The Committee would like to call the attention of the Board to the urgency for the investigation of the storage rot of potatoes.

*Report on the co-operative trials conducted in connection with the potato breeding scheme for Northern India in 1935 by the Second Economic Botanist, Imperial Institute of Agricultural Research [item 18 (a) of the Agenda].*—Dr. Pal explained that it was necessary to have a potato station in the hills where crossing work could be done. A standard set of varieties was grown at Shillong, Simla, Chaubattia the Kulu Valley and the Murree hills in order to find the best site for a sub-station. The Farm Manager at each of these stations was given a schedule of the information required and he visited all the stations during the course of the summer. The conclusions that have been arrived at are set forth on page 5 of the report. Berry formation was very satisfactory at Chaubattia, Simla and the Kulu Valley but as Kulu was inaccessible, it was ruled out as a site for the sub-station. The choice therefore lay between Chaubattia and Simla. In this connection Dr. Pal had visited a number of sites at Simla and a note on this subject had been submitted.

*Report on the non-recurring grant for the hills portion of the potato breeding scheme for Northern India [item 18 (b) of the Agenda].*—The Committee came to the conclusion that Simla is the best place for the proposed potato-breeding sub-station and the site which is described in Dr. Pal's note to the Committee is the best which can be obtained in Simla. This question had been considered at a previous meeting of the Board when it was stated that non-recurring expenditure given at the foot of page 2 the cost of land and buildings would have to be added. The main work so far has been firstly the collection of samples of potatoes from different parts of India with a view to finding out how many distinct varieties there are in India and which of them are useful as breeding material. Side by side with this a large amount of the new South American species—those discovered by the Russian and other expeditions—

has been obtained and efforts are being made to maintain this material. It is rather difficult material to maintain because some of the species require very special conditions. Some species form tubers under short day conditions only. At present the material is so little that Dr. Pal has not been able to test it and is trying to multiply it as rapidly as possible. Tests will be carried out to determine the value of this material. Some of the species are immune to Phytophthora and some are able to stand a high degree of frost. As soon as the tests are carried out, these species will be hybridised with the best of the Indian varieties and it is hoped to produce disease resistant strains of economic value.

The Committee considered carefully the capital expenditure involved in this scheme in the erection of buildings and came to the conclusion that, as the scheme had been initiated by the Imperial Council of Agricultural Research, the cost of the buildings should be defrayed by the Research Council. The Committee would draw attention to the fact that it may be necessary at a later date to extend the area at the hill station. Subject to this suggestion the Committee recommend the scheme to the Board. The matter is very urgent as valuable exotic material may be lost if the scheme is not immediately proceeded with.

## APPENDIX LI.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 28th December 1935, on Subject No. 17:—Application from the Government of Assam for a grant of Rs. 30,688 spread over a period of four years for Mycological Research on Potatoes.**

Attention is invited to the attached letter (Annexure) from the Government of Assam, No. 4463-E., dated the 25th November, 1935, forwarding a scheme for mycological research on potatoes. The scheme would involve, as far as the Council is concerned, a non-recurring expenditure of Rs. 10,250 and a recurring expenditure of Rs. 20,438 or a total expenditure of Rs. 30,688 spread over a period of four years. The previous scheme mentioned in the note by the Director of Agriculture, Assam, will be found in the printed proceedings of the meetings of the Advisory Board, February 1934, pages 526-534.

2. The subject is for the consideration of the Advisory Board. It may be stated that investigations on potato diseases are being undertaken by the Imperial Mycologist, Imperial Institute of Agricultural Research at Pusa, in connection with the potato breeding scheme for Northern India already sanctioned by the Council.

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 ANNEXURE.

LETTER FROM H. G. DENNEHY, Esq., I.C.S., SECRETARY TO THE GOVERNMENT OF ASSAM, IN THE TRANSFERRED DEPARTMENTS TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NO. 4463-E., DATED 25TH NOVEMBER 1935.

SUBJECT:—*Mycological Research on potatoes.*

I am directed by the Government of Assam to refer to the correspondence ending with this Department letter No. 2575-E, of the 1st December 1933. The scheme has been held up pending decision as to the location of a central potato breeding research station, *vide* your letter No. F.-92/I/34/A., of the 6th February 1935, and connected correspondence. The Assam proposals however included mycological enquiries distinct from the matter of breeding research, and the condition of potato culture in Assam (and, it is believed, elsewhere in India) is such as to make some action for the solution of problems concerning storage and transport urgently necessary. The Assam Government have therefore decided to send up the mycological section of their proposals for consideration separately. They are fully explained in the prefatory note of the Director of Agriculture enclosed and differ from the original scheme in providing for a laboratory, quarters for the mycologist, and quarters for the laboratory assistant and menials on a better scale, at the cost of provincial revenues. The cost of land and the recurring charges against the provincial revenues are shown *pro forma*, as it will not be necessary to expand the existing scope of the farm in these respects.

If the scheme is accepted by the Council, it will be placed before the legislature for sanction.



## POTATO RESEARCH SCHEME FOR ASSAM.

Mention was made in the note on the Potato Research Scheme submitted to the Imperial Council of Agricultural Research in 1933 that it was necessary to carry out investigations into the causes of the various potato diseases and the best methods of control. Apart from *Phytophthora Infestans* various other diseases are now causing losses in an increasing degree and the whole potato crop in Eastern India is faced with a serious situation. It is therefore necessary that apart from any breeding experiments this problem should be investigated on the spot without further delay. The best suitable station for the purpose on this side of India is undoubtedly the Upper Shillong Farm. Shillong potatoes are now being sent for seeds not only to all parts of Assam and Bengal, but also to Behar, United Provinces, Central Provinces and Punjab and the quantity is steadily increasing. The results obtained would be applicable to all other Hill areas, particularly in North Eastern India, where considerable quantities of potatoes are grown and exported for seed throughout the plains. The question is, therefore, of an all-India importance and of a very urgent nature. The actual details of work can only be drawn up by the Mycologist after he is appointed in consultation with the Imperial Mycologist at Pusa. But it will be necessary to carry out storage as well as manurial experiments. It is proposed to carry on the work for four years in the first instance after which some definite results may be expected. The local Government will supply the non-recurring expenditure for land, staff quarters and all the recurring expenditure for cultivation and labour. The Imperial Council of Agricultural Research is requested to provide funds for building and equipping a small laboratory, a storage godown, and for the recurring expenditure for the staff and contingencies.

J. N. CHAKRAVARTY,

*Director of Agriculture, Assam.*

## MYCOLOGICAL EXPERIMENT.

| Details.  | 1st year.           |                 | 2nd year.           |                 | 3rd year.           |                 | 4th year.           |                 | Total.              |                 |
|---|---------------------|-----------------|---------------------|-----------------|---------------------|-----------------|---------------------|-----------------|---------------------|-----------------|
|   | Non-recur-<br>ring. | Recur-<br>ring. | Non-recur-<br>ring. | Recur-<br>ring. | Non-recur-<br>ring. | Recur-<br>ring. | Non-recur-<br>ring. | Recur-<br>ring. | Non-recur-<br>ring. | Recur-<br>ring. |
| I   | 2                   | 3               | 4                   | 5               | 6                   | 7               | 8                   | 9               | 10                  | 11              |
|   | Rs.                 | Rs.             | Rs.                 | Rs.             | Rs.                 | Rs.             | Rs.                 | Rs.             | Rs.                 | Rs.             |
| Mycoologist on Rs. 250—260—20—300                                   | ..                  | 3,000           | ..                  | 3,120           | ..                  | 3,360           | ..                  | 3,600           | ..                  | 13,080          |
| Laboratory Assistant on Rs. 50—21—100                               | ..                  | 600             | ..                  | 630             | ..                  | 660             | ..                  | 690             | ..                  | 2,580           |
| One peon at Rs. 14—17—1—19  | ..                  | 168             | ..                  | 180             | ..                  | 168             | ..                  | 180             | ..                  | 684             |
| Laboratory Servant Rs. 15—1—20                                      | ..                  | 180             | ..                  | 180             | ..                  | 192             | ..                  | 210             | ..                  | 744             |
| Travelling allowance  | ..                  | 300             | ..                  | 300             | ..                  | 300             | ..                  | 300             | ..                  | 1,200           |
| Contingencies—  |                     |                 |                     |                 |                     |                 |                     |                 |                     |                 |
| Instruments and appliances  | 4,000               | ..              | ..                  | ..              | ..                  | ..              | ..                  | ..              | 4,000               | ..              |
| Laboratory Equipment  | 1,000               | ..              | ..                  | ..              | ..                  | ..              | ..                  | ..              | 1,000               | ..              |
| Chemicals, etc.   | ..                  | 250             | ..                  | 250             | ..                  | 250             | ..                  | 250             | ..                  | 1,000           |
| Miscellaneous contingencies (office expenses<br>and miscellaneous). | ..                  | 250             | ..                  | 250             | ..                  | 250             | ..                  | 250             | ..                  | 1,000           |
| Books   | 250                 | ..              | ..                  | 50              | ..                  | 50              | ..                  | 50              | ..                  | 150             |
| N. Works—   |                     |                 |                     |                 |                     |                 |                     |                 |                     |                 |
| Construction of a laboratory  | 2,500               | ..              | ..                  | ..              | ..                  | ..              | ..                  | ..              | 2,500               | ..              |
| Storage Godown  | 2,500               | ..              | ..                  | ..              | ..                  | ..              | ..                  | ..              | 2,500               | ..              |
| Total   | 10,250              | 4,748           | ..                  | 4,948           | ..                  | 5,230           | ..                  | 5,512           | 10,250              | 20,438          |

*Value of land, Buildings, Labour, etc.*

To be provided by the Local Government:

| Non-recurring :—                             |                      | Rs.                   |
|--|----------------------|-----------------------|
| Land . . . . .                               |                      | 2,500                 |
| Quarters for Mycologist . . . . .            |                      | 3,500                 |
| Ditto for Laboratory Assistant . . . . .     |                      | 1,500                 |
| Ditto for Menials . . . . .                  |                      | 500                   |
|  | Total                | 8,000                 |
| Recurring :—                                 |                      |                       |
| Proportionate share of supervision . . . . . |                      | 1,000 per an-<br>num. |
| Seeds, manures, etc. . . . .                 |                      | 500                   |
| Labour . . . . .                             |                      | 1,500                 |
| Miscellaneous . . . . .                      |                      | 250                   |
|  | Total                | 3,250                 |
|  | Total for four years | 13,000                |

*Actual expenditure to be incurred by the Local Government.*

| Non-recurring :—               |       | Rs.   |
|--------------------------------|-------|-------|
| Quarters—Mycologist . . . . .  |       | 3,500 |
| Laboratory Assistant . . . . . |       | 1,500 |
| Menials . . . . .              |       | 500   |
|                                | Total | 5,500 |

## APPENDIX LII.

*For the use of members only.*

**Imperial Council of Agricultural Research, Advisory Board, Thirteenth Meeting, February 1936, Subject No. 18 (b):—Report on the non-recurring grant for the hills portion of the potato breeding scheme for Northern India.**

The results of preliminary experiments conducted at a number of hill stations in Northern India to determine the most suitable place for potato breeding work have been set forth in a previous report. It was concluded from these that either Simla or Chaubattia would be very suitable for the purpose. Enquiries were instituted accordingly to find a site at either of these stations which would fulfil the necessary requirements. The Director of Agriculture, United Provinces, stated that no such site was available at Chaubattia although uncleared forest land could be had. At Simla I personally inspected a number of sites and eventually discovered one which in my opinion would be suitable. The details are as follows:—

*Location.*—Kanlogh, about 2 miles from Lady Reading Hospital.

*Area.*—About 8 acres; the terraces are comparatively large and level.

*Aspect.*—Faces south.

*Elevation.*—About 6,200 feet.

*Irrigation.*—The present owner has diverted a small channel of water from a perennial spring about  $\frac{1}{4}$  mile away on to the land. The water would have to be lifted to the higher terraces.

*Buildings.*—No buildings are available on the site.

*Electricity, etc.*—As the area is within the municipal limits the rates for electricity and filtered water will be considerably lower than those prevailing outside municipal limits.

The lack of laboratory accommodation and quarters is a disadvantage but buildings are only a question of time and money. The other sites inspected were not suitable as although several of them possessed buildings, no facilities for irrigation (which are essential for a breeding station) were available.

I suggest therefore that the site described above may be acquired by purchase or on long lease and the necessary buildings constructed thereon. In view of the fact that the present scheme will have to be continued for a total period of probably not less than 10 years before definite results can be expected, it is recommended that the former alternative be adopted as it will probably prove to be cheaper in the long run.

The cost of land, buildings and pumping equipment is estimated to be as follows:—

|                                      |   |
|--------------------------------------|---|
|                                      | Rs.   |
| Cost of land . . . . .               | 8,000 (If rented, about Rs. 800 a year. For 4 years — $800 \times 4 = 3,200$ ). |
| Laboratory and Office . . . . .      | 5,000   |
| Quarters and bullock shed . . . . .  | 5,000   |
| Seed and implement godowns . . . . . | 2,000   |
| Pumping Equipment . . . . .          | 5,000   |
|                                      | 25,000 or 20,200.   |

The other non-recurring expenditure will be as indicated in the original scheme, *viz.*—

|   | Rs.    |        |
|---|--------|--------|
| Fencing . . . . .                                   | 2,000  |        |
| Office furniture . . . . .                          | 500    |        |
| Insect proof cage and controlled Illumination House | 6,000  |        |
| Laboratory apparatus . . . . .                      | 1,500  |        |
| Racks for storing potatoes . . . . .                | 500    |        |
| Containers for keeping samples separate . . . . .   | 250    |        |
| Implements . . . . .                                | 300    |        |
| Pots . . . . .                                      | 300    |        |
| Sprayers . . . . .                                  | 200    |        |
| Pollination bags . . . . .                          | 100    |        |
| Gunny bags . . . . .                                | 50     |        |
| Books . . . . .                                     | 100    |        |
| Bullocks . . . . .                                  | 500    |        |
| Additional grant to meet certain in 1935-36*        | 1,000  |        |
|   | 13,300 |        |
|   | 25,000 | 20,200 |
|   | 13,300 | 13,300 |
| Total . . . . .                                     | 38,300 | 33,500 |

\*This was made necessary by the receipt of a large amount of new material which required arrangements for protection from possible disease-carrying insects, and, in certain cases, curtailed day-light. In sanctioning the grant the Vice-Chairman instructed that the amount should be included in the estimates for non-recurring expenditure on the hills portion of the scheme.

A sum of Rs. 700 will also have to be provided for renting a building for use as a temporary laboratory and office until such time as the buildings on the site are completed. The total figures for non-recurring expenditure on the hills portion of the scheme will therefore amount to Rs. 89,000 if land is bought and Rs. 34,200 if land is leased.

As considerable potato material has been obtained from abroad it is requested that early steps may be taken to establish the sub-station in order that this valuable material may not be lost.

B. P. PAI,

Second Economic Botanist.

## APPENDIX LIII.

Note by the Secretary, Imperial Council of Agricultural Research, dated the 24th December 1935, on Subject No. 20:—Application from the Government of Bombay for a Grant of Rs. 49,360 spread over five years for a scheme for investigation into the attack on Jowar by the Parasite *Striga*, by the Economic Botanist to the Government of Bombay.

Attention is invited to the attached copy of a note dated the 26th January 1935 (Enclosure I not printed. See proceeding of the Advisory Board held in February 1935, pages 205-209), circulated to the Advisory Board. The Board recommended that there should be a further examination of the literature on the subject and that Directors of Agriculture should be invited to supply any information available regarding extent methods of control. Relevant extracts from the report of the Sub-Committee (adopted by the Board) which examined the Scheme in the first instance are attached (Enclosure II).

2. Enclosure III contains the replies which have been received from some of the Directors of Agriculture and the Director, Imperial Institute of Agricultural Research. The Directors of Agriculture, Bengal, United Provinces, Assam, Hyderabad and Bhopal, the Agricultural Officer, Baluchistan and the Superintendent of Agriculture, Cochin State, have no information on the subject.

3. The subject is now for the consideration of the Advisory Board. It will first be examined by a Sub-Committee of the Board consisting of:—

The Vice-Chairman, Imperial Council of Agricultural Research,  
Chairman, *Ex-officio*.

The Agricultural Expert, Imperial Council of Agricultural  
Research.

The Director of Agriculture, Bombay.

The Director of Agriculture, Punjab.

The Director of Agriculture, Madras.

The Director of Agriculture, Bihar and Orissa.

Professor T. Ekanbaram.

Professor L. S. S. Kumar, Economic Botanist to the Government  
of Bombay (subject to the approval of the Government of  
Bombay).

Professor S. P. Agharkar, Calcutta University, (Subject to the  
approval of the Calcutta University).

Secretary, Imperial Council of Agricultural Research, Secretary,  
*Ex-officio*.

This Sub-Committee is to meet between the 10th and 15th February 1936 and its report will be submitted to the Advisory Board in due course.

## ENCLOSURE II.

EXTRACT FROM THE REPORT OF THE PLANT DISEASES SUB-COMMITTEE.  
FEBRUARY 1935.

Subject 25 (a)—Application from the Government of Bombay for a grant of Rs. 49,360 for a scheme for investigation into the attack on jowar by the parasite 'Striga'.

This is a similar scheme to 25 (b). The parasite is perhaps somewhat less important but is more widespread. In the opinion of the sub-committee there should be a similar further study of the literature on 'Striga' and a circular letter should be issued inviting Directors of Agriculture to supply any information available as to methods of control in use at present.

It is desirable that Professor Kumar, Acting Economic Botanist, Bombay Presidency should be invited to attend the next meeting of the sub-committee appointed to discuss these two schemes.

## ENCLOSURE III.

## (1) Madras.

LETTER FROM THE DIRECTOR OF AGRICULTURE, MADRAS, No. D-1095-35,  
DATED 29TH AUGUST 1935.

The remedial measures consisted in the growing of a continuous trap crop of maize and frequent ploughing of the field before the striga plants began to flower. This has been tried by the Government Mycologist in the Agricultural Research Station, Palakuppam and it has been reported there was no incidence of striga in the infected field of Jowar in the succeeding years.

## (2) Bombay.

SUMMARY OF THE WORK DONE BY THE ECONOMIC BOTANIST TO GOVERNMENT,  
BOMBAY PRESIDENCY, POONA.

*Striga*.

Experiments have been conducted on the parasitism of three species of *Striga*, viz., *S. lutea*, *S. densiflora*, and *S. euphrasiodes*. It is found that these three species show certain differences in regard to the germination of their seed. Of the three species, the seed of *S. lutea* and *densiflora* require the host stimulus for germination in the absence of which failure of germination results while *S. euphrasiodes* germinates in the absence of such stimulus only to the extent of production of the two cotyledonary leaves. For further development it has been ascertained that contact with host (Sorghum) roots is essential.

The seeds of the parasite which lie well removed from the host roots obtain their stimulus through the medium of the moisture in which it is carried. The stimulus is of a chemical nature apparently by means of a substance soluble in water.

The maximum distance from the host root at which germination of *Striga* seed has so far obtained is 50 m.m., while the normal distance is from 2 to 4 m.m.

*Striga* seeds have been successfully germinated on artificial agar media containing an extract of sorghum roots, leaves and stem. Apparently the chemical substance which acts as a stimulus for the germination of the *Striga* seed is not necessarily confined to the roots but is generally diffuse throughout the plant.

Seeds of *Striga* kept continuously soaked in water for several months germinated up to the 3rd month in one trial and to the sixth in another. This shows that the viability of *Striga* seeds is not easily impaired by the action of water over a long period and that it can tide over water-logged conditions in fields for a fairly long time without being affected. A similar experiment of soaking the seed of sorghum showed that the percentage of germination became very low after a fortnight and total failure resulted after 19 days.

The terminal death point of the host and the parasite was 77°—78°C and 68°—69°C., respectively.

In pot cultures it was found that *Striga* seeds could germinate up to a depth of six inches. Trials of further depths are being carried out.

In regard to the most susceptible age of the host plant, it has been found that the parasite attacks easily at any stage of the growth of the host up to maturity which fact confirms observations made in the field.

The relation of temperature to the germination of parasite's seed shows that at 35°C. no germination takes place while at 30°C. and below satisfactory germination is available.

Fairly high humidity is necessary for the germination of the parasite's seed but the optimum moisture required has not been accurately determined owing to the difficulty of having to grow parasite and host together.

In the matter of susceptibility of different varieties of *Jowars* grown in the Bombay Presidency it has been shown that all without any exception are susceptible. Of these the variety "Bilichigan" shows more resistance to attack than others. Under certain controlled laboratory conditions, resistant varieties of *jowar* have been selected from some of the Bombay varieties. In two instances these selections have proved to be resistant in the second generation. Further testing of these lines is in progress.

From a study of the literature on *Striga* and experience gained from experiments it appears to be clear that the only way to combat the attack of the pest is by evolving resistant lines of sorghums from the important varieties grown in different tracts.

#### SHORT NOTE ON WORK DONE IN OTHER COUNTRIES ON STRIGA.

##### *Striga*.

The only work of importance done on *Striga* in other countries is that by Saunders in South Africa. He worked on a single species, viz., *S. lutea* and has conclusively proved the necessity of the host stimulus for germination and subsequent development of *Striga*. After trying weeding, trap cropping, cover crops, chemical treatment of soil, etc., Saunders is of the opinion that "no panacea for witchweed (*Striga*) is at hand and that the farmer must recognize the struggle against this parasite to be one which demands the utmost resourcefulness. No single agronomic



practice will achieve the desired aim when once the soil is heavily infested and it is only by a combination of practices that success can be achieved". How far this dictum applies to India remains to be seen.

Saunders has been able to develop certain *Striga*-resistant varieties of sorghums. He finds that in these resistant varieties the parasite establishes its haustorial connection with the host and penetrates into the tissue of the root to some distance after which the host cuts off all further progress of the haustoria by means of a barrier probably of protoplasm of different composition to that found in the susceptible cells. In the case of resistant types from the Bombay varieties of sorghums the seed of the parasite does not even germinate. Saunders has worked out the inheritance of the character of partial resistance to *Striga* attack in *Sorghum* and finds that it is of a highly complex and non-Mendelian type. The work in Bombay has not progressed far enough to take up the study of the inheritance of the resistance character.

*List of references to publications on Striga.*

1. DASTUR, J. F.—  
Control of *Striga* app. on sugarcane in the Central Provinces.  
Bull. Int. Soc. Sug. Tech. 1932: No. 25, p. I.
2. SAUNDERS, A. R.—  
The Witchweed: a dangerous pest on summer cereals.  
Farming in S. Africa 1930-31: 5: 267-71.
3. SAUNDERS, A. R.—  
Studies in phanerogamic parasitism with particular reference to  
*Striga lutea* Lour. Part I. The economic importance,  
distribution, life history and parasitism of *Striga lutea*.  
Part II. Experiments on the control of the parasite in the field.  
Part III. The breeding of resistant host varieties.  
Sci. Bull. Dep. Agric. S. Afr. 1933: No. 128: pp. 56.
4. SAUNDERS, A. R.—  
Witchweed-resistant Kaffir corn.  
Fmg. S. Afr. 1934: 9: p. 215.

(3) PUNJAB.

LETTER FROM THE DIRECTOR OF AGRICULTURE, PUNJAB, No. 983-S., DATED  
THE 8TH JULY 1935.

With reference to your letter No. 88/35/A, dated 26th June 1935, I have the honour to forward copy of a note supplied by the Professor of Botany, Punjab Agricultural College, Lyallpur, who has been working on *Striga* in the Punjab. His investigations show that an effective method of controlling the pest is to prevent the germination of seed by weeding out the parasite before it flowers, coupled with a proper rotation of crops. In recent experiments conducted by the Professor of Botany a field infected with the parasite was sown with jowar (*Sorghum*) early in May. The parasite appeared to some extent and the crop was ploughed up before the parasite came into flowering. During the current summer

jowar will be sown in the same field four times and will be repeatedly ploughed up with a view to exhaust the infection.

#### *Striga.*

This parasite has been recorded in the Punjab on jowar sugarcane, bajra and Sudan grass. It has also been reported on maize and rice in other countries. It is very badly prevalent on maize and some fodder grasses in South Africa. I first observed it on sugarcane in 1921 and published an article in the Agricultural Journal of India, Vol. XVI, part V, September 1921. A copy of the Reprint is sent herewith for your reference. Investigations on this parasite have been carried out in South Africa and an exhaustive note was reproduced in the Agricultural Journal of India, Vol. XVII, Part II, 1922. With regard to control measures satisfactory methods for its eradication are as follows:—

(i) If the field is sown with the susceptible crop and ploughed up a month later all the parasite (*Striga*) which has germinated in the meantime is destroyed. If this process is repeated several times, the soil will be cleared of its seed. Four or five such crops during two successive years would probably reduce the parasite in even a very badly infected field.

(ii) This parasite like others of the same habit reproduces itself from seed. The effective method of controlling the pest is to prevent the formation of seed. Weeding out of the parasite before flowering is necessary for this purpose. Experiments on these lines have been laid out on the Mona Remount Depot where the parasite has been prevalent seriously in jowar fields.

A plan of the experiments is herewith enclosed for reference.

In connection with the control measures I made the following remarks in my note when I sent the proposal for starting the experiments at Mona to you:—

(a) The seed of *Striga* which is lying in the soil germinates only when the host crop is sown. It does not germinate by itself and from independent plant. There is a certain amount of affinity between the seedling of the host and the seed of the parasite. Both must be present together for the germination of the seed of the parasite. The seed is very minute in size like dust particles. The capsules which contain the seed in large quantities burst open on maturity and throw it out in the air to be scattered about by wind. In order to check the growth of the parasite it is evidently necessary that seed formation should be stopped. The parasite should be cut at an early stage before flowering, so that seed is not produced. Repeated weeding of the parasite is necessary, because fresh shoots continue to appear so long as the crop lasts and roots and the stumps are not killed. This method however is very laborious and expensive. It should be adopted in all cases where the infection is small. Further infection of the soil by addition of fresh seed will be prevented.

(b) Where the crop is badly infected it should be ploughed before the parasite flowers. It might be said that the crop should not be grown at all on such an infected field but a certain amount of good results from raising the host crop as most of the seed in the soil will have germinated and thus the field would become free of the parasite to a certain extent.

No doubt on the one hand there is a loss of labour and seed incurred for growing the host crop but there is an advantage of reducing infection. If the host crop is grown repeatedly, the infection would ultimately be altogether exhausted.

(c) A rotation of crops is the proper and effective treatment. The susceptible crop should not be grown on infected soil. Instead of this crop leguminous crops such as berseem, shaftal, senji, cowpeas, lucerne, etc., should be grown. I was told that usually Imphee jowar comes in the same field in the 3rd year. This interval does not seem to be sufficient to kill the seed in the soil. I would, therefore, suggest that for the present 6 years' rotation should be tried. In other words, in whatever fields, jowar whether Imphee or Desi occurs, it should be substituted by leguminous crop. In this connection, I would further recommend that the fields should be ploughed by an iron plough, such as Rajah, so that the seed is buried deep in the soil.

(2) With regard to the proposed scheme for investigation in my opinion there is a great deal of room for adding to our knowledge on this parasite. But in view of what has already been done some of the items do not appear to be of immediate necessity. They are more of academic interest than of utility in the matter of control of the pest.

(I) Physiological. Considerable work on root parasitism has been published in Memoirs of the Department of Agriculture in India, Botanical Series, Vol. I and II by C. A. Barber. Although it relates to Sandal Parasite (*Santalum album*) yet the findings apply equally to other root parasites. There is hardly any need for repeating the same investigation.

(II) Agronomical. This is a matter for the Department to take up.

(III). Histological and (IV) Cytological. I do not consider these investigations necessary. An article on "the structure and development of *Striga Lutea*" by Stephens Annals of Botany Vol. XVI, page 1067 furnishes information on this aspect.

(V) Breeding. There is no likelihood of any thing useful coming out of breeding work. I have found three species of *Striga* attacking sugarcane and jowar and their total number is four. They are all of the same habit and identical in the mode of parasitism.

Any experiment which would be desirable to undertake would be in the direction of control measures. In considering the Scheme attention should be focussed on this aspect of the proposal more than on any other of pure scientific nature.

*Striga* as a pest of valuable farm crops calls for action almost in the whole of India. It occurs widely in Bombay, Central Provinces, United Provinces and the Punjab.

#### (4) BURMA.

LETTER FROM THE DIRECTOR OF AGRICULTURE, BURMA, No. 5381/1A-12-Pr., DATED 3RD JULY 1935.

With reference to your letter No. F. 98/35/A., dated the 26th June 1935, on the subject, I have the honour to forward herewith for your information a copy of this department bulletin No. 18 of 1931 (not printed) and to request that its receipt may kindly be acknowledged.

## (5) BIHAR AND ORISSA.

LETTER FROM THE DIRECTOR OF AGRICULTURE, BIHAR AND ORISSA, No. 8738-1-61-35, DATED 12TH JULY 1935.

I have the honour to reply to your letter No. F.-89/35/A., dated the 26th June 1935 on the subject and to say that the Assistant Economic Botanist of this province has had no occasion to deal with the pest. Haines (Botany of Bihar and Orissa) reports three species from Bihar and Orissa, but none of them seems to attack jwar with any severity.

## (6) CENTRAL PROVINCES.

LETTER FROM THE DIRECTOR OF AGRICULTURE, C. P., No. 8264, DATED 8TH JULY 1935.

With reference to your letter No. F.-89/35/A., dated the 26th June 1935, I have the honour to say that experiments for the control of *Striga* on Jowar are being carried out by this Department. We have found that certain varieties of Jowar, like Agia Kodal, Lamkansi, Haraswada, etc., are very much resistant to *Striga*, whereas varieties like Motichura and Dukri are very susceptible. Further we have found that certain varieties like Detha, Saoner and Nilwa even though attacked by *Striga* do not show any marked ill effects, there being not much difference in growth between the infected plants and healthy plants just as there is between diseased plants and healthy plants of Motichura and Amneri.

As regards the direct method of control, we find that burning trash on an infected field in May, especially after the field has been ploughed, considerably reduces the incidence of *Striga* and this good effect has been observed to last at least the following season as well. Sprinkling powdered Copper Sulphate on the ground as soon as *Striga* plants appear above ground surface has been found to control considerably the growth of the parasite and to help the jowar plants to make a good growth.

A histological study of the haustoria of *Striga* plants has been commenced since the last year.

## (7) N. W. F. P.

MEMORANDUM FROM THE DIRECTOR OF AGRICULTURE AND ALLIED DEPARTMENTS, N. W. F. P., No. 5492/D. A., DATED 13TH JULY 1935.

The only control methods practised in this Province is the cutting out of all shoots of the parasite before flowering.

Other remedies such as a change in the rotation are scarcely practicable as there is no other crop that can be grown under the conditions in which Bajra thrives.

## (8) SIND.

COPY OF LETTER No. 774, DATED 17TH APRIL 1935, FROM THE BOTANIST, AGRICULTURAL RESEARCH STATION, SAHRAND, TO THE CHIEF AGRICULTURAL OFFICER IN SIND, KARACHI, REGARDING INFORMATION RE. STRIGA.

"I have the honour to state that the phanerogamic parasite *Striga* is known in this province. The extent of area in which the prevalence has been noticed has not been definitely ascertained but seem to be small. This parasite locally known as 'Angari' causes poor growth of the crop and grain formation does not take place.

2. The parasite is found in Larkana, Dadu and Nawabshah districts.
3. The rotation of crops is found to be the only means to escape this parasite.
4. White flowered *Striga* has been noticed.
5. No Literature is available."

## (9) IMPERIAL INSTITUTE OF AGRICULTURAL RESEARCH.

LETTER No. 1932-D., DATED THE 16TH JULY 1935, FROM THE DIRECTOR, IMPERIAL INSTITUTE OF AGRICULTURAL RESEARCH, DELHI.

With reference to your letter No. F-88/35-A., dated the 26th June 1935, I have the honour to enclose a brief note on the subject referred to therein together with a see below list of literature dealing with the same.

*Note on the control of the Phanerogamic Parasites—Striga and Orobanche.*

Earlier records suggest that clean cultivation and weeding to prevent seed formation prevents *Striga* from becoming a serious pest. It is said only to thrive on poor soil.

From the summaries of references given in Sorauer's Handbuch etc., there seems little reason to anticipate any better means of eradication of *Striga* and *Orobanche* than weeding.

A list of references is attached.

## REFERENCES.

*Striga.*

Dastur, F. J.—Control of *Strigga* spp. on sugarcane in the Central Provinces. (Internat Soc. Sugarcane Technol. Cong. (San. Joan.) Proc. 4, Bull. 25, pp. 186, 1932).

Buuren, H. Van.—Poona Agri. Coll. Mag. 5, 1914, No 3, pp. 198-196. The Author describes the attack of *S. lutea* on durra, pearl millet, maize, and other grasses in India.

Walters, J. A. T.—Witchweed (*Striga lutea*): A new pest of the maize crop in [Rhodesia Agri. Jour. 13 (1916), No. 2, pp. 284-296]. Relations of this plant to maize cultures are discussed and a control method is suggested.

Mackenna, J.—(Rept. Prog. Agri. India, 1916-17, pp. 64-72). *Striga lutea*, a pest of millet which germinates only in the presence of a host, can be counteracted in large part by the method of trap crops. *Striga* appears to be controllable in case of Eleusine coracana by employment of early maturing varieties.

Palm, B. T. and Heusser, C.—*Striga lutea* on rice in Sumatra (Trans. title) [Ztschr. Planz 34, (1924), No. 1-2, pp. 11-18]. Its root relation with rice also as to its relations with numerous other hosts named.

Sawyer, A. M.—Results of investigations made by the Dept. of Agri. Burma, into the extent of damage caused by *S. lutea*. [Burma Dept. Agri. Bul. 18 (1921) pp. 7]. Summary of information obtained during an investigation (1913-20) regarding the prevalence, habits and characteristics of *S. lutea* in plains of Burma is given, the object of the investigation being to discover a simple and inexpensive but effective means for reducing the losses caused by this parasite in connection with millet. Direct killings with chemicals injured the host rather than the parasite. Decoy cropping of the host after giving promise in preliminary trials, proved disappointing when employed on a field scale. Sowing in row 18" apart followed by occasional intercultivation with a wheat have resulted in vigorous crops despite dense infestation. Thorough cultivation, drainage, manuring and early sowing which tend to produce tall, vigorous and steady crops early in the season, minimize the loss. The burning of stubble and rubbish on this field after harvest destroys the seed of the pest lying on and near the surface of the ground. Rotation of crops and destruction of alternative hosts are suggested.

Narsimhan, M. J.—Report of work done in the Mycological Section. (Mysore Dept. Agri. Report 1919-20, pp. 62-63). *Striga* seed did not germinate alone or along with ragi. (Crow-foot millet) seedlings.

Luthra, J. C.—*Striga* as a root parasite of sugarcane. (Agri. Journ. India. 16, 1921 No. 5, pp. 519-523). The spp. attacking cane were identified as *S. densiflora* and *S. euphrasioides*. The canes attacked may make very poor growth, resembling drought stricken plants. They may be killed completely or may be little affected by attack. Method of attachment and attack is described. Cotton is not susceptible.

Narasimhan, M. J.—Parasitic plants as enemies to crops. (Jour. Mysore Agri. & Expt. Union, 2, 1920, No. 1, pp. 18-20). Mention is made among root-parasites, of *Striga lutea* on ragi, jola and sugarcane.

Timson, S. D.—Witch weed (*Striga lutea*). Methods of control, Rhodesia Agri. Dept. Bull. No. 750.

Timson, S. D.—Witch weed (*Striga lutea*). Rhodesia Agri. Bull. No. 802.

Timson, S. D.—Witch weed Progress Repts. and a warning Agri. Bull. No. 838.

Timson, S. D.—Witch weed Progress Repts. and a warning, Agri. Bull. No. 906.

- Pearson, H. H. W.—Agri. Journ. of India, Vol. XVII (1922), pp. 166.  
208 (a reprint)
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- Pearson, H. H. W.—Rhodesia Agri. J. (1933) 30 14-25.
- Pearson, H. H. W.—Zeitsch. F. Pflanzenkr. (1924) 34 11.

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(10) MYSORE.

COPY OF NOTE NO. M.-675, DATED 4TH DECEMBER 1935, FROM THE  
MYCOLOGIST, DEPARTMENT OF AGRICULTURE, MYSORE, BANGALORE.

Striga is a serious pest on Jowar in the Chitaldrug District in Mysore, and in the same area it has been observed to attack sugarcane. In the Tumkur District it has often been found parasitising irrigated ragi. In view of the fact that jowar is a poor man's crop, any combative measure involving much expense is not likely to be taken up by the ryot.

Weeding out the parasite before it sets seed, no doubt, mitigates infection to some extent. Since weeding is never seriously taken up after the harvest, the parasite comes up once again and sets seed. Some success has been obtained by spraying with cheap chemicals such as iron sulphate, but even this is not likely to be taken up by ryots. We are at present carrying out experiments to see how far rotation with other crops can be of any help in suppressing Striga. Search for a resistant variety is also being made.

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(11) TRAVANCORE.

LETTER FROM THE DIRECTOR OF AGRICULTURE AND FISHERIES, TRAVANCORE,  
No. 2666-131/11, DATED 18TH NOVEMBER 1935.

I have the honour to inform you that Jowar is not being cultivated in Travancore except in some parts of the Shencotta Taluq. Even there it is a crop of only secondary importance. Enquiries made in that taluq show that Striga is not known there as a pest. This department had therefore, no occasion to study the problem.

Some work on Striga on hill paddy has however been done and the note herein enclosed contains details of the experiments conducted.

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Marom and Marom infection (*Striga Lutea*, Lour)

BY

N. K. B. KURUPP, B.A., M.Sc.,

Economic Botanist to the Government of Travancore.

In the year 1107 M. E./1932-A. D., complaints were received from several cultivators in the northern hilly tracts of Travancore about a very injurious weed popularly called 'Maroin'. A careful study was therefore started in the course of the same year.

During my observation it struck me that the presence of this obnoxious weed is certainly determined by the chemical nature of the soil. Samples of the two types of soil, one from the area where it is found in abundance and the other from an area where it does not thrive at all, were taken for analysis. The results of the analyses conducted in the chemical laboratory are shown below:—

TABLE 1.  
*Samples from soil infected with Striga.*

|                              | Soil.  | Sub-soil. |
|------------------------------|--------|-----------|
| 1. Moisture . . . . .        | 4.4 %  | 2.9 %     |
| 2. Organic Matter . . . . .  | 8.45 % | 4.9 %     |
| 3. Phosphoric acid . . . . . | 0.10 % | 0.06 %    |
| 4. Potash . . . . .          | 0.31 % | 0.10 %    |
| 5. Lime . . . . .            | 0.31 % | Trace.    |
| 6. Nitrogen . . . . .        | 0.10 % | 0.60      |

From the above table it will be clear that the soil is deficient in lime. This lime requirement may be expressed as 1,400 lbs. per acre.

TABLE 2.  
*Sample from soil free from Striga.*

|                              | Soil.  | Sub-soil. |
|------------------------------|--------|-----------|
| 1. Moisture . . . . .        | 3.24 % | 2.6 %     |
| 2. Organic matter . . . . .  | 9.85 % | 5.32 %    |
| 3. Phosphoric acid . . . . . | 0.12 % | 0.07 %    |
| 4. Potash . . . . .          | 0.29 % | 0.12 %    |
| 5. Lime . . . . .            | 0.53 % | 0.30 %    |
| 6. Nitrogen . . . . .        | 0.13 % | 0.67 %    |

The lime requirement of the soil may be expressed as 450 lbs. per acre. A careful study of the tables 1 and 2 leads to the conclusion that *Striga* thrives well in soils that are deficient in lime.

The life history of the *Striga* plant is a very interesting one, but since it is almost completely worked out, I do not wish to waste any time in recounting the whole story.

A few seeds of the plant were taken for germination trials in the laboratory. A good portion of the seeds were then soaked for germination. The seeds did not germinate. They were then mixed with the garden soil and exposed for some time when they germinated. When



once the germination is started, the roots go in search of host plants, into the root tissues of which they send the specially developed organs called *Haustoria*, and snatch away nourishment at the expense of the host plant. When the plant has thus established absolute connection with a host plant, it begins to grow upward very vigorously. This is why we see the withering of rice plants in the *Striga*-infected cherikal lands, often synchronising with the appearance of the *Striga* plants above ground.

#### *Local methods of eradication.*

Application of cattle manure, and the hand picking of weeds are the two exclusive methods adopted by the ryots. Weeding as practised by the ryots in the cherikal lands is a very interesting process. The weeding is of two kinds.

1. *Poovandankila*. In this instance the owner of the field gives information to his friends on the previous evening that they should come for weeding. They generally begin weeding after a light breakfast, at about seven A.M. After breakfast they walk to the field each with a special instrument in his hand for rooting out the *Striga* plant. To remove the shrubs that happen to grow here and there in the fields they generally engage one man for every ten weeders.

To remove the tedium of work weeding is generally conducted with the accompaniment of music. When there are more than fifty people to weed, the musicians do not take part in the weeding process. Just at noon the weeders are refreshed with some liquid food and are wound up with a key in the shape of chew composed of betel leaf, arecanut, chunam and often tobacco. Now they re-enter the field and work on till 5 P.M. After 5 P.M., they take their bath and go to the land owner's house where they are given a very sumptuous feast. The whole affair is generally a labour of love and not a wage work. Where however they think of some remuneration as a matter of courtesy the ordinary weeders are allowed two pukas of paddy each and the experienced weeders and the musicians get each about two pukas and a half.

The magic of a music, which is reserved for such occasions, efficiently does away with the tedium of work, for the sole attention of the weeders is stealthily focussed upon music and weeding thus becomes almost automatic. How they achieve this end is really very interesting to note. The two musicians divide the weeders between themselves, thus forming two parties so far as the music alone is concerned. Several technical tricks are played to make the function very beguilingly interesting. According to the set up rules, no party is allowed to sing songs that have already been ear-marked by the other party with a cunning recitation of an initial line or two during the day. Insinuating songs are also very often sung and they frequently lead to quarrels. Another interesting method is to sing songs to the effect that the tongues of the opponents are locked and the keys thrown into the ocean. The opponents in their turn have to sing songs purporting the reclamation of the key and the ultimate redemption of their tongues; after which only they could begin the ordinary songs.

Weeding is conducted with the help of professional coolies also. This may be on a large scale. In the small-scale weeding about seven to twelve female coolies and to musicians are engaged. The music is accompanied with drum-beating done by the musicians themselves.

When these people reach the fields that are to be weeded the first thing they are to do is to sing a song purporting to fix the sun to a definite spot in the heavens. The main idea in this is that no moment should be wasted in the course of the operation. For the purpose of weeding the coolies arrange themselves in a regular line. When the operation has commenced, the coolies if they want to leave the line at all, would step back without disturbing the line and then only on out for any purpose. The experienced weeders here get higher wages.

For the large scale weeding, generally, five kinds of musical instruments are used. The other details are more or less like those mentioned in connection with the small scale weeding. The custom is to close the function by two females dancing with characteristic shaking of heads, and these females are entitled to get comparatively high wages.

This is in short how weeding is conducted in charikal lands. Generally during the course of the season three weeding are conducted.

Cultural experiments were conducted in the fields for two consecutive years, and the results obtained confirm the view that the following methods could be safely resorted to for eradicating Striga plants from the Striga infected fields—

1. Application of cattle manure well preserved with urine,
2. Application of about one ton of common salt per acre of cultivated field;
3. Application of Nitre at the rate of about one cwt. per acre;
4. Application of about 1,400 lbs. of lime per acre in the affected area.

*The following mechanical means may also be recommended.*

1. To hand-pick the weeds before their flowering time and then to destroy them;
2. The sowing may be conducted and the seeds be allowed to sprout up, and they are then ploughed in the soil. This is certainly impracticable in a poor country, where the farmers cannot afford to waste any paddy.
3. The whole area may be covered with rubbish to a depth of about one inch and the rubbish then set fire to. This would almost completely burn the seeds shed during the season.

#### *Bibliography.*

1. Striga Lutea—Tour. A root parasite of paddy in Malabar Agricultural Journal of India, Volume 1, 1906.
2. Striga as a root parasite of sugar cane by J. C. Kuthra, M.Sc., XVI & V. P. 517—The Agricultural Journal of India, 1921.
3. The problem of witchweed by H. W. H. Peascon Sc.D., F.L.S. Department of Agricultural Union of South Africa, Bulletin No. 40.
4. Marom and Marom infection by N. K. B. Kurup, Leaflet No. 143, (Malayalam).

## \* APPENDIX LV.

**Note by the Secretary, Imperial Council of Agricultural Research dated the 13th November 1935, on Subject No. 21:—Application from the Government of Bombay for a Grant of Rs. 37,510 spread over five years for the Investigation of the attack on Tobacco by the Phasero-gamic Parasite: *Orobanche*.**

Attention is invited to the attached copy of a letter (Enclosure) of January 1935 (Enclosure I, not printed); (See proceedings of the Advisory Board held in February 1935, pages 200-204) on the subject mentioned above, which was circulated to the Advisory Board at its meeting held in February 1935. The Board recommended that the consideration of the scheme should be postponed and that in the meantime (i) a further study of the literature on the work carried out in other countries should be made by the authors of the scheme and (ii) that Directors of Agriculture should be invited to send memoranda on methods of Orobanche control at present in use in the various provinces. It was also agreed that the Director of Agriculture, Bombay should be asked to supply a memorandum giving all available data regarding the field experiments already carried out in the Bombay Presidency. Relevant extracts from the proceedings of the Board and of the report of the sub-committee which examined the scheme in the first instance, are enclosed (Enclosure II).

2. Enclosure III contains the replies which have been received from some of the provincial Directors of Agriculture and constituent states of the Council and the Director, Imperial Institute of Agricultural Research; to enquiries made by the Secretariat of the Council in pursuance of the Advisory Board's recommendations. The other Directors of Agriculture including the Chief Agricultural Officer in Sind and the Agricultural Officer, Baluchistan have no information to furnish.

3. The Imperial Bureau of Plant Genetics, is unable to give any information beyond that referred to in the reply from the Director of Agriculture, Bombay (Serial No. 7 of Enclosure III). On a request made by the Agricultural Expert to the Council, the attached letter (Enclosure IV) has been received from Mr. L. F. Cocks, the Agricultural Officer of the Indian Leaf Tobacco Development Company at Chirala (M. S. M. Rly.), regarding the methods of control adopted in the Guntur District of the Madras Presidency and the work done by the Company.

4. The subject is now for the consideration of the Advisory Board. It will first be examined by a sub-committee of the Board consisting of:—

The Vice-Chairman, Imperial Council of Agricultural Research.  
Chairman *ex-officio*.

The Agricultural Expert, Imperial Council of Agricultural Research.

The Director of Agriculture, Bombay.

The Director of Agriculture, Punjab.

Professor S. P. Agharkar, Calcutta University.

Professor T. Ekambaram.

The Director of Agriculture, Madras.

The Director of Agriculture, Bihar.

Either Imperial Agriculturist, or

Offg. Imperial Economic Botanist. (Subject to the approval of the Government of India.)

Professor L. S. S. Kumar, Economic Botanist to Government, Bombay. (Subject to the approval of the Government of Bombay.)

Secretary, Imperial Council of Agricultural Research—Secretary, *ex-officio*.

This sub-committee will meet on an afternoon between the 10th and 15th February 1936, and its report will be submitted to the Board in due course.

N. C. MEHTA,  
Secretary.

The 13th November 1935.

#### ENCLOSURE II.

EXTRACT FROM THE PROCEEDINGS OF THE PLANT DISEASES SUB-COMMITTEE, FEBRUARY 1935.

SUBJECT: 25 (b).—*Application from the Government of Bombay for a grant of Rs. 37,510 for a scheme for the investigation of the attack on tobacco by the Phanerogamic Parasite 'Orobanche'.*

The Director of Agriculture, Bombay, informed the sub-committee that in Gujerat this parasitic plant is more damaging to cigarette tobacco than to other tobaccos because the finer types are planted early and irrigated. The sub-committee considered that there is some doubt as to whether the proposed programme of research work would lead to more satisfactory methods of dealing with this parasitic weed than those already in use. The plant is a comparatively large one so that its eradication by mechanical means is not very difficult. The sub-committee recommends that the scheme be postponed until the next meeting of the Advisory Board and that in the interim a further study of the literature on work carried out in other countries should be made by the authors of the scheme. The Agricultural Expert undertook to write to the Imperial Bureau of Plant Genetics and to give any further assistance possible in regard to literature. It was also agreed that the Director of Agriculture should supply a memorandum giving all available data on the field experiments already carried out in the Bombay Presidency on the removal of this weed. It was further agreed that all Directors of Agriculture should be invited by the Council to send in a memorandum on methods of Orobanche control at present in use in various provinces.

EXTRACTS FROM THE PROCEEDINGS OF THE ADVISORY BOARD, FEBRUARY 1935.

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8. *Application from the Government of Bombay for a grant of Rs. 37,510 spread over five years for a scheme for the investigation of the attack on tobacco by the Phanerogamic Parasite 'Orobanche'.*—[Subject No. 25 (b) of the Agenda.]

Mr. Patel introduced the scheme and said that he had nothing to add to what the sub-committee had stated in its report. Mr. Stewart enquired

whether the committee considered the point that much of the work proposed in the scheme as very largely of academic interest and of no economic importance. He suggested that when information in regard to the work already carried out in other countries had been obtained as recommended by the sub-committee the scheme would very probably not be necessary at all. Mr. Burt referred to the second sentence of the sub-committee's report in which the Committee had expressed a doubt as to whether the proposed programme of research work would lead to more satisfactory methods of dealing with this parasitic weed than those already in use. The recommendation of the committee to postpone the scheme till the next meeting of the Advisory Board and to obtain further information on the subject was approved.

### ENCLOSURE III.

Serial No. I.—LETTER FROM THE DIRECTOR OF AGRICULTURE, PUNJAB, No. 962-S., DATED THE 8TH JULY 1935.

With reference to your letter No. 66/III/35/A., dated 24th June 1935 I have the honour to say that all the three species of Orobanche, namely, *O. Cernua*, *O. Nicotianæ* and *O. Indica* have been met with in the Punjab. *O. Nicotianæ* causes serious damage to tobacco at Hazro in the Attock district. The other two species are found on Sarson in certain parts of the province. Experience here has shown that the best method of control is to prevent the formation of seed. For this purpose the removal of the parasite at an early stage before flowering is imperative. This method has been practised at Hazro by the Deputy Director of Agriculture, Rawalpindi, who has been carrying out a vigorous campaign for eradicating this parasite. His experience has shown clearly that it can be controlled simply by pulling off the parasite from the host plant above ground level and destroying it before it seeds. It is not considered that there is any necessity for the Imperial Council of Agricultural Research to finance the proposed Bombay Scheme on this parasite.

A copy of this Department's leaflet No. 38 on Broomrape is attached for information.

### DEPARTMENT OF AGRICULTURE, PUNJAB.

#### LEAFLET No. 38.

#### *Broomrape and its eradication.*

Several kinds of Broomrape occur in the Punjab. Of these *O. Nicotianæ* is of great agricultural importance. It grows on the roots of tobacco and is the cause of heavy damage to this crop in the Attock district, where it is widely prevalent in Hazro and the "Chhachh" tract and has become a serious pest. It is locally known as "Khumb". Broomrape has also been found on egg plants and rape plants.

*Description.*—It is a small parasitic flowering plant of whitish colour and devoid of green leaves. There are no roots, but the underground portion of the stem sends out root-like organs called Hauhtoria by means of which the parasite attaches itself to the roots of its host plant. The stem is unbranched and 8 to 14 inches in height. It is thick and succulent at the base. The greater part of it bears white flowers tinged with blue.

Its seeds are very small, like dust particles and are produced in large quantities from a single plant.

The parasite reproduces by seeds and grows only in the presence of the tobacco plant. The seedlings on becoming united with the host plant draw nourishment from it through Haustoria. The host plant being thus deprived of its food is left to starve and in cases of severe attack the affected tobacco plants are killed. Generally the produce of tobacco in affected fields is reduced by about 50 per cent. also the stuff prepared from the leaves of affected plants is of inferior quality and fetches a lower price.

*Preventive measures.*—Ever since Broomrape has appeared on tobacco plants, the farmers have left it alone, and the numerous seeds it has produced every year have fallen in the fields and have been scattered by wind. The seeds can remain dormant in the soil for a long time, and when tobacco is planted they germinate and produce the parasite. The following methods are suggested to control the parasite and check its further spread :—

- (1) The parasite should be prevented from maturing its seed. For this purpose the plants should be pulled out, as soon as they come above ground, and should be burnt at once.
- (2) Fields badly infested with the parasite should be well manured in order to make the tobacco plants grow vigorously and strong enough to resist the attack. But to cope with the parasite, the fields have to be heavily manured and frequently watered. The cost of cultivation, however, is much increased in this way and there is no proportionate rise in income. In the "Chhachh" tract cost of manure amounts to Rs. 250 per acre.
- (3) Tobacco should not be grown in successive years on the same land. Two or three years' rotation with wheat or other crops not attacked by the parasite will be helpful in controlling the pest.
- (4) As already mentioned, the seeds of the parasite are very tiny and are easily carried away by wind. They would be carried from one field to another. Therefore it is necessary for complete control of the pest that all farmers of a locality where parasite is found, take it out of their fields by adopting the measures suggested above under (1). If, however, only a few of them attend to it and others leave the parasite in their fields, its seeds will again get blown to places cleared of it.
- (5) It has often been noticed that seeds of the parasite are found in nursery beds also and when tobacco is sown there, they germinate and affect the seedlings.

Young plants of the parasite are thus carried to the fields in contact with the tobacco seedlings when the latter are transplanted. To check this source of infection the seed bed should be changed from season to season.

*Serial No. 2.—LETTER FROM THE DIRECTOR OF AGRICULTURE, BENGAL, No. 10997, DATED 8TH JULY 1935.*

With reference to your letter No. F-66/III/35-A., dated 24th June 1935, I have the honour to say that the only remedial method adopted is the uprooting of the parasite and burning it. In case of severe attacks, tobacco is not grown in the particular land for a few years.

Serial No. 3.—LETTER FROM THE DIRECTOR OF AGRICULTURE, BIHAR AND ORISSA, No. 8796/I-60-35, DATED 15TH JULY 1935.

I have the honour to reply to your letter No. F.-66/III/35/A., dated the 24th June 1935.

2. The controls adopted in this province are,

- (1) Uprooting of the pest,
- (2) Rotation of crops.

3. The pest is uprooted as soon as it emerges from the soil and before flowering time. It is important to remove the plant as soon as it is noticed as the seed is very light and is easily transported by the wind.

4. Solanaceæ and cruciferae for which the parasite has a distinct preference should not be planted in an infected area. Seedlings perish readily when they are unable to reach a suitable host.

Serial No. 4.—LETTER FROM THE DIRECTOR, IMPERIAL INSTITUTE OF AGRICULTURAL RESEARCH, No. 1933-D., DATED 16TH JULY 1935.

With reference to your letter No. F.-66 III/35-A., dated 24th June 1935, I have the honour to enclose a brief note on the subjects referred to therein together with a list of literature dealing with the same.

NOTE ON THE CONTROL OF THE PHANEROGAMIC PARASITES—STRIGA AND OROBANCHE.

Earlier records suggest that clean cultivation and weeding to prevent seed formation prevents *Striga* from becoming a serious pest. It is said only to thrive on poor soil.

From the summaries of references given in Sorauer's *Handbuch*, etc., there seems little reason to anticipate any better means of eradication of *Striga* and *Orobanche* than weeding.

A list\* of references is attached.

Orobanche.

BIFFIN, R. H.—

Jour. Roy Soc. England, 74, 1913, pp. 376. Notes on the method of eradication are given.

Broom rape, Jour. Bd. Agri. (London), 23 (1916), No. 5 pp. 478-481. *Orobanche* minor on clover fields in England. The life history of the plant is briefly outlined, together with preventive and control measures.

\* (Orobanche only.)

BUTLER, E. J.—

(Ann. Rept. Bd. Sci. Advice India, 1915-16, pp. 103—113). The work of the past two seasons has established the view that the parasitic spp. of Bihar are *O. indica* and *O. cernua*.

MORETTINI, A.—

On a special cultural practice for control of Orobanche on beans. (Staz. sper. Agri. Ital., 45, 1912, No. 8, pp. 598—614.) Deep planting of beans neither diminished the attack per cent. nor decreased the severity of the injury. Late planting seems to have increased the yield by limiting germination of the seeds of the parasite.

SHAW, F. J. F.—

(Ann. Rept. Bd. Sci. Advice India, 1914-15, pp. 104—109.) Field experiments with tokra of tobacco have already yielded some results. *O. cernua* and *O. indica* occur on tobacco, the latter being much more serious to crops and the former causing more damage to crucifers. The effects of chemical manures on the influence of tokra are being tested.

MACKENNA, J.—

(Rept. Prog. Agri. India, 1916-17, pp. 64—72). Tokras (*O. sp.*) were not controlled by the use of Sod. nitrate.

BUTLER, E. J.—

(Ann. Rept. Bd. Sci. Advice India, 1916-17, pp. 47—56). Plant pests and diseases dealt with include amongst other things Orobanche spp. on tobacco and other plants.

TATE, P.—

On the anatomy of *O. hederæ* Duby, and its attachment to the host. [New Phytol., 24 (1925), No. 5, pp. 284—293]. Seeds of *O. hederæ* do not germinate in the absence of the host. The results of its activity in connection with the host are discussed.

SHAW, F. J. F.—

Orobanche as a parasite in Bihar. [Memoir, Dept. Agri. India, Bot. Ser., 9 (1917), No. 3, pp. 107—130].

*O. indica* on mustard was not much lessened by the use of Sod-nitrate. The results in case of *O. cernua*, were not convincing. Weeding out the parasites before they have time to ripen seeds appears to be more practicable in a region where labour is cheap. The slight climatic differences between two cold seasons may powerfully influence the development of *O. indica*. It is stated that this species contains at least two races, one parasitic on tobacco, the other on crucifers.

Serial No. 5.—LETTER FROM THE DIRECTOR OF AGRICULTURE, MADRAS, No. D.-1094-35, DATED 22ND JULY 1935.

I have the honour to enclose an extract from the report of the Government Mycologist. A copy of the leaflet No. 69 is also enclosed.

Reference is also invited to the Bulletin No. 2 of this Department "The Tobacco Parasite *Bodu* or *Orobanch Micotisum*".



COPY OF LETTER B. O. C. No. 299/34, DATED 10TH AUGUST 1934, FROM THE GOVERNMENT MYCOLOGIST, COIMBATORE, TO THE DIRECTOR OF AGRICULTURE, MADRAS.

Generally the attack is severe in seasons which are dry either before or during the period of growth of the crop in the case of dry tobacco and when, though raised under irrigation, the number of waterings or the quantities of water supplied are inadequate. Where rotation is carefully followed as in parts of Madura, Ramnad and Tinnevely the disease has been reduced in intensity. An extreme case of attack to the extent of 75 per cent. is found in the Lankas of the Godavari delta where there are no facilities for irrigating the crop. Ordinarily the percentage of attack varies on dry tobacco from 30 to 75 per cent. and on irrigated tobacco the attack varies from *nil* to 25 per cent. Climatic conditions in the different soil tracts seem to exercise their influence also, but what share soil, and climatic conditions, seasons and cultural practices contribute have not been determined.

2. Only one species of *Orobanche* has so far been recorded in South India, *viz.*, *Orobanche cernua* (Loeff) var. *desertorum* (Beck). This is synonymous with *Orobanche nicotianæ* (Wt.) which is a parasite on tobacco. There is another species—*Orobanche Indica* (Hem.) and it has been recorded only from Bihar.

3. Bulletin No. 2, an old publication of the Madras Agricultural Department, on Bodu (*Orobanche*) on tobacco is now out of print.

4. To check the spread of 'Bodu' parasite, the following measures have been recommended:

- (1) Persistent removal of the parasite as soon as it appears above ground and before it seeds.
- (2) Regular interculturing and suitable crop rotation.

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#### DEPARTMENT OF AGRICULTURE, MADRAS.

[LEAFLET No. 69.]

*Tokra (Orobanche Sp.)—A pest on tobacco.*

(Tl: Malli or Bodu; Tam: Poga Elai Kalan.)

*Orobanche* is a parasite pest which causes much loss to growers of tobacco. If the attack is severe it may result in the total failure of the crop. Ryots should therefore be in a position to recognize this pest and know how to deal with it when it does appear. The life-history of this pest is described below.

The pest in question is a parasite plant which grows from the roots of the tobacco plant. In some cases as many as twelve of these parasite plants have been observed growing round a single tobacco plant. The parasite appears generally as a succulent stem with scale-like leaves and yellow to blue coloured flowers. It grows about six inches in height and produces seed capsules which contain myriads of small dark-coloured seeds. If the parasites are not removed before the seed

capsules are formed the capsules burst and the seed is carried like dust by the wind and scattered all over the fields. The seed which can remain viable for about three years is responsible for raising the pest in the succeeding tobacco crop. If in the next season the roots of the tobacco plant come in contact with the seed of the parasite plant the latter germinates, enters the roots of the tobacco plant and comes up as the stem described above. As it is a parasite plant it does not absorb its food direct from the soil but obtains its supplies through the roots of the tobacco plant, thereby affecting the growth and yield of the tobacco plant. This pest may also attack other plants like chillies and tomatoes.

The loss referred to can be easily prevented if tobacco growers will see that these parasites are removed and burnt before they have time to seed. Ryots must realize that all growers must co-operate in this work as a single plant or even a portion left to seed can pollute a very large area. It is therefore necessary that eradication must be complete and thorough and all plants removed and burnt. Goats should not be allowed to graze such plants as viable seeds are likely to pass through these animals in their manure and thus cause infection. In cases of severe infection it is better to avoid growing crops like chillies, tomatoes, brinjals or tobacco on infected lands for two or three years.

Ryots are requested to give the remedial measures suggested their attention and by doing so to minimise the loss now arising through the prevalence of this pest.

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*Serial No. 6.*—LETTER FROM THE DIRECTOR OF AGRICULTURE, BARODA, No. 672 OF 1935-36, DATED THE 26TH AUGUST 1935.

I have the honour to state as follows.

The parasite *Orobanche* on tobacco and some other plants is cosmopolitan. Immense work can be found done in America, France, England, Germany, Russia, Roumania, Greece, Bulgaria, Turkey, etc. It occurs more on irrigated crop than on dry one. A summary of all the work will lead one to the conclusion that there is no remedy for this parasite except of up-rooting the fleshy stems before they come to flower. The only point that remains to be worked out is possibly the viability of the seed in soil.

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*Serial No. 7.*—LETTER FROM THE DIRECTOR OF AGRICULTURE, BOMBAY PRESIDENCY, No. 493-G./8493, DATED THE 12TH OCTOBER 1935.

I have the honour to forward herewith copies of the undernoted papers.

- (1) A note on the field experiments on the removal of the *Orobanche* weed already carried out in the Bombay Presidency.
- (2) A note on work done on *Orobanche* in India and abroad by L. S. S. Kumar, Esquire, Economic Botanist, Bombay, Poona.

A NOTE ON THE FIELD EXPERIMENTS ON THE REMOVAL OF  
THE OROBANCHE WEED ALREADY CARRIED OUT IN THE  
BOMBAY PRESIDENCY.

METHODS OF CONTROL.

(A) *Hand picking*.—The method of control followed at the Government Tobacco Research Station, Nadiad, consisted till 1933-34 of only hand picking by labourers going round the field once a week when they could collect large quantities. The method, however, was not effective. The Orobanche shoots develop at least 25 per cent. of its body weight at a very conservative estimate, before it makes its appearance above the soil surface when it can be hand picked and although when one is pulled out many small ones in close attachment with it are also pulled out, there is no dearth of more, and the tobacco plants have been observed to suffer. It remains to be seen if picking of all apparent shoots, say twice or thrice a week, is more effective way of controlling the parasite or not. Besides study on the rapidity and habit of growth of the parasite will be necessary before any proper plan of control can be devised.

(B) *Interculturing supplemented by hand picking every fourth day*.—In 1934-35 the month of October was a dry and a hot one and September and November were not much better. The cigarette tobacco crop had to be irrigated on 28th October 1934, 3rd November 1934 and 3rd December 1934. Following each irrigation, however, interculturing crossways was done using the local interculturing implement drawn by a pair of bullocks. Subsequently hand picking also was done once in three days particularly to remove the shoots from the very neighbourhood of the plant stalk to which the implement cannot be made safely to reach. The interculturing did some slight damage to the leaves of the plants.

The double plan of interculturing after irrigation and hand picking every fourth day, however, seemed to preserve the crop in full health and vigour till 13th January when the frost destroyed the same.

The cost of interculturing and hand picking together works up at Rs. 5 per acre for the actual period for which it was followed and would have been about Rs. 10 per acre had it been followed to the end of the season.

The prevailing labour charges at Nadiad are Re. 0-5-0 a day for a female labour to hand pick the Orobanche and Rs. 2-0-0 per day for a man and a pair of bullocks to work at interculturing.

Interculturing reduces the growth of Orobanche but interculturing is not possible up to the end of the crop as the crop grows and particularly when the crop is planted closely.

In 1922-23 some study on this parasite was taken up on the Association farm and the only new point that was found was that the parasite attacked the roots of the tobacco plant at varying depths, the maximum depth to which the attack could be traced being four inches below the soil surface.

## NOTE ON WORK DONE ON OROBANCHE IN INDIA AND ABROAD.

Much of the early work done on *Orobanche* pertains to the systematic aspect of botany while some of them refer to the biology of this parasite which is compared with other phanerogamic parasites.

Shaw who refers to work done by Koch states that heavy application of manure although diminished the attack of *O. ramosa* for a time the tobacco crop became diseased and succeeding crops showed more infection. The experiments of Peter and Schwantz who used various chemicals for checking *Orobanche* resulted in failure. Shaw who conducted a detailed experiment on the effect of Nitrate of Soda also came to the conclusion that even a very heavy dose of manuring did not materially reduce the attack.

The most important works on *Orobanche* has been done in Russia which primarily consists in the developing of sunflower resistant to *Orobanche*. This parasite seems to cause considerable damage to Sunflower crop. In regard to *Orobanche cumana* which attacks sunflower two different varieties have been isolated. One of these is capable of attacking certain varieties of sunflower and not others while the second type attacks varieties immune to the attack of the first. The reasons which have led the Russian to develop resistant lines of sunflower in preference to cultural and weeding methods of destroying the parasite seems to point out that such eradication is not easily practicable when fields are highly infected.

*Ternovsky* working in Russia has come to the following conclusion: He observes that *Petunioides* are more susceptible to attack by *Orobanche*. Of the *Nicotiana's* the *rustica* types are less susceptible as compared with the *tobacum* types which are not immune at all.

In many of the provinces in India where the attack of *Orobanche* on tobacco is a serious problem recourse to hand weeding must have been had. Yet from no province in which *Orobanche* occurs has complete success in total eradication of this parasite been reported. It is therefore, presumable that hand weeding and burning the parasite is not a complete solution to the problem of eradication of the pest. As in the case of *Striga*, so here it appears that if a permanent solution is to be arrived at, it will be the adoption of the idea of going in for resistant lines of tobacco as suited to the different affected tracts.

L. S. S. KUMAR.

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*List of references to publications on Orobanche.*

PUSHKAREVA, K. V.—

[To the characteristic of the seeds of different biological races of broom-rape (*Orobanche*).]

Wks. Agric. Exp. Inst. Rostow a. Don 1930:31:5:12—20.

PARIEVSKALA, A. P.—

(On the resistance of Russian and foreign sorts of hemp to *Orobanche ramosa*.)

Bull. Plant Protection Leningrad 1932:5:73—84.

IDANOW, L. A.—

[Results of works on sunflower selection in connection with the resistance of this plant to "malign" Doabroom-rape (*Orobanche cumana* b) infection.]

Wks. Agric. Exp. Inst. Rostow a Don, 1931:5:229—54.

ZHDANOV, L. A.—

(A contribution to the question of the immunity of the sunflower to *Orobanche*.)

Proc. U. S. S. R. Congr. Genet. Plant. and Animal-Breed, 1930:4:135-36.

UKRAINSKII, V. T.—

(On the question of breeding and seed production of sunflower resistant to *Orobanche*.)

Semenovodstvo (Seed Growing) 1934: No. 3:43—47.

PUSHKAREVA, K. V.—

[To the characteristic of the seeds of different biological races of broom-rape (*Orobanche*).]

Wks. Agric. Exp. Inst. Rostowa Don 1930:31:2:Pp. 12.

IDANOW, L. A.—

[Results of works on sunflower selection in connexion with the resistance of this plant to Malign Doadroom-rape (*Orobanche cumana* B) infection.]

Wks. Agric. Exp. Inst. Rostowa Don, 1931:1931:3:Pp. 229.

ZHDANOV, L. A.—

(A contribution to the question of the immunity of the sunflower to *Orobanche*.)

Proc. U. S. S. R. Congr. Genet. Plant and Animal-Breeding, 1930:4:135-36.

UKRAINSKII, V. T.—

(On the question of breeding and seed production on sunflower resistant to *Orobanche*.)

Semenovodstvo (Seed Growing) 1934: No. 3:43—47.

PARIEVSKALA, A. P.—

(On the resistance of Russian and foreign sorts of hemp to *Orobanche ramosa*.)

Bull. Plant Protection Leningrad 1932:5:73—84.

TERNOVSKY, M. F.—

Die Fragen der Immunität bei Vertretern der Gattung *Nicotiana*, (The problems of immunity in representatives of the genus *Nicotiana*.)

Zuchter 1934:6:140—44.

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Flora of British India, Vol. IV, 1885.

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Bengal plants, 1903.

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“Monographie der gastering Orobanche”.

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Die anfecht, und Kultur der Parasitischen Samen-pflanzen, Jena, 1910.

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Die Entwicklungsgeschichte des Orobanches.

Heidelberg, 1887.

PETERS, L. AND SCHUDARTZ, M.—

“Krankheiten und Beschädigungen des Tabocks. Milt. Kais. Biol. Austral. Land U. Fortwirtschafft, Heft 13, Berlin, 1912.

SHAW, F. J. F.—

Orobanche as a parasite in Bihar. Memoir. Dept. Agri. in India, Bot. Ser. Vol. IX, No. 3, Aug. 1917.

Serial No. 5.—LETTER FROM THE DIRECTOR OF AGRICULTURE IN MYSORE, No. Roc. 3226-Sc. 376 34-35, DATED 11TH OCTOBER 1935.

With reference to your letter No. F-66/III/35-A., dated 24th June 1935, I have the honour to state that this is reported to occur in Mysore only sporadically. The parasite spends most of its life underground attacking the tobacco roots. The flower spike which comes above ground is the only visible symptom of the presence of the parasite. If these are removed before they set seed, the parasite can be controlled to a large extent.

Enclosure IV.

LETTER FROM MR. L. F. COCKS, INDIAN LEAF TOBACCO DEVELOPMENT CO. LTD., CHIRALA, No. Misc. C. 172, DATED THE 15TH JULY 1935.

It is very welcome news indeed to hear that the Research Council is considering a scheme of work on the Orobanche Parasite, the increasing incidence of which in recent years has given us cause for grave concern. Undoubtedly, the damage done in the Guntur District runs into several lakhs of rupees annually, and we fear that in a few years' time a large area of good land will become so liable to Tokra attack that the cropping of tobacco on it will become uneconomical. Here this parasite is observable on both “Deshi” and Virginian tobaccos, but the latter seem to be more affected by its presence. It is also to be found on brinjals, tomatoes and chillies.

In this District it is remarkable that very serious damage, i.e., to the extent of the crop having to be ploughed in) only occurs when the attack is an early one on plants which have not "got into their stride" as regards growth. This was particularly noticeable in the last crop. Dry unseasonable weather was experienced at planting time so that plants made very slow growth giving the parasite the chance of overwhelming the plant before it had made any strength. We have also observed here that if early growth be rapid, however serious the attack may be, the plant seems to acquire sufficient strength both to maintain the parasite and to mature a fair crop of leaf; even so, both quality and yield are undoubtedly affected.

The only satisfactory methods of control in use in this District are hand pulling and crop rotation. With regard to the former, the "spikes" of the parasites are collected usually by children and old people, are dried out on waste land, and afterwards burnt. By word of mouth through our field supervisors, and in recent years, by simply worded posters displayed on flue curing barns and in conspicuous places in villages in the tobacco growing belt, we have strongly advocated the above method of control. For your information, I am enclosing two of the posters (not printed) in present use which have special reference to Tokras; as you will observe they are printed both in English and in Vernacular. We also issue free of charge to the more educated ryots a general pamphlet on tobacco cultivation; this contains a section on Tokras and their control.

With reference to crop rotation, we are experiencing considerable opposition and our propaganda is having very little effect. Ryots do not seem to realise the seriousness of the heavy incidence of Tokras and are very averse to cutting out for any length of time tobacco from their rotation. Recently tobacco has been their only good "Money" crop; both chillies and groundnuts having been a poor market for some years.

It is a common occurrence here for a serious attack of Tokras to be noticed in a field that has not grown tobacco for a number of years. Last season my attention was drawn to a field in which tobacco or allied crops had not been grown for ten years, but Tokras were causing as much damage as in other fields where tobacco had been grown frequently. This points to the fact that Tokra seed, retains its vitality in the soil for long periods. However, it is our experience that if land be covered by flood water for several weeks Tokras disappear for some years. The re-introduction of the parasite is then probably made by means of farmyard manure or folding stock, etc. In this District, Tokras are frequently fed to cattle, sheep and goats. Undoubtedly, what is actually required is the complete resting of Tokra infested land from the growing of tobacco and other susceptible crops for a long period of say, at least ten years. However, I feel sure that this is impracticable and we could never expect ryots to agree to it. At present we are only trying to persuade ryots to rest their land from the cultivation of tobacco every alternative year. This is not nearly sufficient, but is a small step in the right direction.

## APPENDIX LV.

Report of the Committee appointed to examine schemes regarding attack on (a) Jowar by the parasite *Striga* and (b) tobacco by the phanerogamic parasite *Orobanche* held at New Delhi at 12 noon on the 14th February 1936.

## PRESENT:

Dr. F. J. F. SHAW (*Chairman*).  
 Prof. AGHARKAR.  
 Rao Bahadur D. ANANDA RAO.  
 Dr. W. BURNS.  
 Dr. L. S. S. KUMAR.  
 Mr. V. N. LIKHITE.  
 Dr. B. P. PAL.  
 Mr. K. RAMIAH.  
 Mr. D. R. SETHI.

*Application from the Government of Bombay for a grant of Rs. 49,360 spread over five years for a scheme for investigation into the attack on jowar by the parasite Striga, by the Economic Botanist to the Government of Bombay, Item 20 of the agenda.*

The Committee considered the scheme and approved of the work outlined under section I—Physiological Section III.—Historical and under section V.—Breeding. The Committee considered that the work under section II.—Agronomical and section IV.—Cytological need not be included in the scheme. Mr. Kumar explained that some of the lines of work suggested by Dr. Shaw at page 7 of the supplementary note were already in progress. He had already obtained resistant types of Sorghum from South Africa and had sent to South Africa Indian material of Sorghum. With regard to items 3 and 4 in Dr. Shaw's note, *viz.*, the testing of Indian *Striga* in South Africa and the testing of South African *Striga* in India, the Committee came to the conclusion that the danger of introducing South African *Striga* to India was such that this item had better not be carried out. The Committee desire to emphasise that the lines of work under 'Breeding' appear to offer the most promising solution of the *Striga* problem and that they should be given prominence in the investigation.

Professor Kumar explained that the expenditure on soil temperature tanks was necessary for the success of the breeding work as it would be desirable to test the resistance of varieties under optimum conditions of infection. Under 'Expenditure' Prof. Kumar explained to the Committee that the shed which it was proposed to build, was a structure of a special nature to contain the soil temperature tanks and not a building of an ordinary type. The cost of the electric installation included the service line from the main. This was estimated at Rs. 400 and the Committee decided that this amount should be deleted from the estimate. The Committee considered that a sum of Rs. 2,000 should be sufficient to make good the deficiencies in an apparatus not available in existing equipment. The Committee decided that the item of Rs. 500 for the purchase of furniture should be deleted. The Committee deleted one Assistant and



three Fieldmen from the scheme and made various minor cuts. The Committee approved of the scheme as revised:—

*Non-recurring expenditure.*

|  | Rs.   |
|--|-------|
| 1. Purchase of expenditure not available with the existing equipment at Poona . . . . .      | 2,000 |
| 2. Purchase of soil temperature tank, electric installation, and shed for the tank . . . . . | 4,600 |
| Total . . . . .  | 6,600 |

*Recurring expenditure.*

|   |        |
|---|--------|
| 3. Investigator on Rs. 1'0—10—260 . . . . .                     | 10,800 |
| 4. One fieldman on Rs. 35—5/2—60—4—100 . . . . .                | 2,340  |
| 5. Laboratory boy on Rs. 20—1—25 . . . . .                      | 1,320  |
| 6. Travelling allowance for Investigator and fieldman . . . . . | 3,600  |
| 7. Apparatus and chemicals . . . . .                            | 1,500  |
| 8. Miscellaneous . . . . .                                      | 1,500  |
| Grand Total . . . . .   | 27,060 |

*Application from the Government of Bombay for a grant of Rs. 37,516 spread over five years for the investigation of the attack on tobacco by the Phanerogamic Parasite Orobanche. Subject 21 of the agenda.*

The Committee considered that the proposal for the investigation of Orobanche was not of such urgency and importance as the former proposal on Striga and they consider that in view of the fact that they have recommended the scheme on Striga to the Advisory Board, it would be advisable to see what progress and success are achieved in this investigation before embarking upon a precisely similar scheme with another crop.

## APPENDIX LVI.

Note by the Secretary, Imperial Council of Agricultural Research, dated the 25th January 1936, on Subject No. 31:--Application from the Government of the Punjab for a grant of Rs. 29,286, spread over a period of five years for a scheme for the study of the effects of Phosphatic Manuring on grass land in an area of low rainfall.

The scheme (Enclosure I), involves an expenditure of Rs. 36,586 spread over five years. Of this the local Government have offered to contribute Rs. 7,300 towards the supply of conveyance (pony) to the Plant Ecologist, the carting and spreading super-phosphates and the labour for harvesting and carting grass. The grass produced will be consumed by the Government cattle farm livestock. Further details in respect of the scheme have been obtained from the local Government *vide* enclosures II and III.

The scheme will, in the first instance, be considered by the Standing Animal Nutrition Committee whose report (Appendix LVII) will be circulated to the Advisory Board in due course.

## ENCLOSURE I.

A SCHEME TO STUDY THE EFFECTS OF PHOSPHATIC MANURING ON GRASSLAND IN AN AREA OF LOW RAINFALL. BY W. S. READ, P.S.V., ASSISTANT SUPERINTENDENT, FODDER, GOVERNMENT CATTLE FARM, HISSAR.

The "barani" grazing area of the Government Cattle Farm, Hissar, Punjab, is some 35,000 acres in extent, and is probably the largest controlled natural grazing area in the country.

In the past, the development of the resources of the Farm, has been mostly in the form of improving the irrigated cultivated area. Nothing much has been done, until recently, to develop the "natural" resources of the Farm, such as, improving the quantity or quality of the indigenous grasses found on the "barani" area of the Farm.

The development of the irrigated cultivated area having now been reduced almost to routine, more time is available for attention to the needs of the "barani" area of the Farm, and I have recently submitted to the Local Government, a scheme for the provision of a "watbandi" system (consisting of a grid of *bands*) on the whole of the *barani* grazing area of the Farm.

This scheme was scrutinised before submission to Government, by Dr. E. McKenzie-Taylor, M.B.E., Ph.D., D.Sc., F.I.C., I.S.E., Director, Irrigation Research, Punjab, who is also a member of the Soil Research Committee of the Imperial Council of Agricultural Research. This officer suggested that an additional scheme should be drafted for some research work, to try and improve (on an economic basis) the grass on the "barani" grazing area of the Farm, by manurial treatment.

The average annual rainfall of Hissar is 14 inches, most of which falls during the *monsoon* season. A feature of the rainfall here is its extreme patchiness, and the irregularity of the intervals between the showers. The quality and quantity of the grazing which becomes available each year is considerably affected by these variations. Sometimes in a year when the actual rainfall recorded is above average, the grass crop is short; and yet in other years, when the rainfall is low, a much better crop of grass for grazing and haymaking is obtained, simply because the distribution of the showers has been more suitable.

The Rainfall Statistics show that there appears to be a certain critical period between the first and second instalments of the *monsoon*. If this interval is long, then no matter how good the rains following this break may be, the yield of grass appears to be on the low side. If this critical period is short, then the yields may be good, even with a quite moderate rainfall.

It is, therefore, suggested that steps should be taken to determine measures which may enable the grass to be carried alive over this critical period, and the method proposed, depends upon the effect of phosphatic manures on root development. By encouraging the development of roots, the plant is enabled to draw water from both a greater depth in the soil and from a greater volume of soil. The dressings of phosphatic manures thus have the same effect in practice as an increase in rainfall.

The most active of the phosphatic manures is "superphosphate". It is, therefore, proposed that an experiment be laid down, to investigate the effect of dressings of this manure on the yield of grass on the "barani" area of this Farm. The benefit of dressings of superphosphates under conditions similar to those found in Hissar has been demonstrated in connection with wheat production in the low rainfall areas of Australia. In India, preliminary experiments have indicated the value of phosphatic dressings in assisting in the establishment of grasses in the Pubbi Hills of the Punjab. These hills are of course situated in an area of fairly high rainfall, but the "run off" is so high that from the pedological point of view, they are dry.

It seems possible, that phosphatic dressing of the grass on the "barani" area of this Farm, should assist in carrying the grass over the dry periods between the stages of the *monsoon*, and result in an increased yield for grazing and haymaking. Should the experiment in its early stages show signs of giving useful results, and additional scheme could then be added, to carry out feeding experiments with grass and hay from the manured and unmanured areas. Such a scheme cannot be put in hand simultaneously, as the manuring scheme would first have to be producing results to ensure a continuous supply of material for the feeding experiment.

This experiment should be carried out over a period of 5 years at least, in order to embrace most of the usual variations in climate and rainfall. It should be in the charge of the Assistant Superintendent (Fodder), Government Cattle Farm, Hissar, and should consist of laying out different areas, sites to be chosen at random, in the "barani" grassland of the Farm area. Each area so laid out will be 50 acres in extent, divided into plots of 2 acres each. Of these, ten acres, in 2-acre plots,

chosen at random, will be treated with four different rates of super phosphate. Five such areas will be laid out, one each year, on sites chosen at random. These areas will be furnished with *bands* to conserve rainfall, and will be fenced in with dry thorn and a chowkidar provided. Soil samples will be taken from every plot prior to the phosphatic dressings and be sent to the Agricultural Chemist to Government, Punjab, for mechanical and chemical analysis. Samples of grass from every plot will also be sent each year to that officer for analysis. Dr. Lander kindly agreed to do this work at a recent conference with me regarding this scheme. In this connection, provision has been made in the financial aspect of the scheme, for an analyst on Rs. 100 per mensem, to be employed as required by Dr. Lander, to cope with the extra work.

A record of the experiment will be kept as follows:—

- (a) Mechanical and chemical analysis of the soil of each plot.
- (b) Growth history of the grass on each plot.
- (c) Systematic botanical analysis of the treated and untreated areas, to determine the effect of the treatment both on the numbers and types of the plant population of the plots.
- (d) Weight and comparative statistics of the grass crop harvested each year.
- (e) Analysis of the grasses obtained from the plots.
- (f) Observations as to the number of seasons in which improvement is seen from an original phosphatic dressing.
- (g) Observations to determine the economic quantity of phosphatic manure required per acre.

It is obvious that the value of this investigation will not be confined to Hissar alone, but will undoubtedly find an application to all "barani" areas of low rainfall in India in some form. This is, therefore, a suitable scheme for submission to the Imperial Council of Agricultural Research, for the provision of a grant-in-aid to carry out the same.

The Government Cattle Farm, Hissar, is undoubtedly an ideal place for the experiment. There is plenty of land available, and the indigenous grasses found here in years when rainfall is favourable are probably the best in the country. The Meteorological Station is situated on the Farm, and there are three other rain gauges at different places on the Farm. Provision has been made in the financial aspect for a rain-gauge at each experimental area also.

Both Dr. Lander and Dr. McKenzie-Taylor have expressed their willingness to help and advise as necessary during the progress of the experiment. The Fodder Specialist of the Agricultural Department, Punjab, who is stationed only 60 miles from Hissar, will be given every facility for following and observing the course of the experiment.

The financial implications of this scheme, as affecting the Imperial Council of Agricultural Research, and the Punjab Government, respectively, are given in the statements attached.

A Table showing the annual variation in Rainfall for the past twenty-one years, and the amount of hay harvested in each of those years.

| Year.          | Rainfall. | Departure from normal. | Hay made maunds. |
|----------------|-----------|------------------------|------------------|
|                | Inches.   | Inches.                |                  |
| 1914 . . . . . | 17-23     | Plus 3-23              | 10,262           |
| 1915 . . . . . | 10-55     | Minus 3-47             | Nil              |
| 1916 . . . . . | 21-88     | Plus 7-88              | 24,439           |
| 1917 . . . . . | 48-26     | Plus 27-26             | 15,223           |
| 1918 . . . . . | 7-85      | Minus 6-15             | 5,087            |
| 1919 . . . . . | 11-85     | Minus 2-15             | 13,974           |
| 1920 . . . . . | 6-53      | Minus 7-47             | Nil              |
| 1921 . . . . . | 12-64     | Minus 1-36             | 11,232           |
| 1922 . . . . . | 16-86     | Plus 2-86              | 7,068            |
| 1923 . . . . . | 24-40     | Plus 10-40             | 62,302           |
| 1924 . . . . . | 14-40     | Plus 0-40              | 2,487            |
| 1925 . . . . . | 11-71     | Minus 2-29             | 16,287           |
| 1926 . . . . . | 33-92     | Plus 19-92             | 32,566           |
| 1927 . . . . . | 17-84     | Plus 3-84              | 11,401           |
| 1928 . . . . . | 16-10     | Plus 2-10              | 17,979           |
| 1929 . . . . . | 12-16     | Minus 1-84             | 3,085            |
| 1930 . . . . . | 21-46     | Plus 7-46              | 38,758           |
| 1931 . . . . . | 16-47     | Plus 2-47              | 43,476           |
| 1932 . . . . . | 10-97     | Minus 3-03             | 16,230           |
| 1933 . . . . . | 24-94     | Plus 10-94             | 39,234           |
| 1934 . . . . . | 16-24     | Plus 2-24              | Nil              |

This Table illustrates the point, that it is not the amount of rainfall, but its distribution that governs the growth of the grass. Compare 1914 with 1919 and 1921. Also note that 1922, 1924 and 1934 were above normal years and yet the amount of hay was poor. See also 1932 with a shortage of 3" and yet a good lot of hay was made, 1925 was a similar year.

*Some Examples of long breaks in the monsoon referred to in this Scheme, from which the grass never seems to recover, even though the rain is above average in total quantity for the year.*

- Year.
1922. Rainfall plus 2'86" yet only 7,068 maunds of hay made. There was a break of 31 days without rain in the middle of the monsoon.
1924. Rainfall plus 0'40" yet only 2,487 maunds of hay made. There was a break of 26 days without rain during the monsoon followed by 1'04" on one day, followed by another break of 25 days.
1927. Rainfall plus 3'84" yet only 11,401 maunds of hay made. There was a break of 15 days without rain in the middle of the monsoon.
1929. Rainfall minus 1'84" which is not much below average, yet only 3,058 maunds of hay was made. There was a break of 25 days in the middle of the monsoon without rain.
1934. Rainfall plus 2'24" yet no hay at all was made. There was a break in the monsoon of 22 days in July, followed by a break of 17 days in August in which there were a few insignificant precipitations.

*Lay-out and treatment of the plots.*

|    |    |    |    |    |
|----|----|----|----|----|
| A. | D. | B. | E. | C. |
| E. | C. | A. | D. | B. |
| C. | D. | B. | E. | A. |
| D. | C. | B. | A. | E. |
| B. | A. | E. | C. | D. |

*Legend*

A. Control.

B. 50 lbs. superphosphate per acre.

C. 100 " " " "

D. 150 " " " "

E. 200 " " " "

Total area annually—50 acres.

Area of each plot—2 acres.

*Chemical requirements.*

|                    | Control. | Acres,<br>treated. | Total.        | Superphosphate<br>lbs. |
|--------------------|----------|--------------------|---------------|------------------------|
| 1st year . . . . . | 10       | 40                 | 50            | 5,000                  |
| 2nd " . . . . .    | 10       | 40                 | 50            | 5,000                  |
| 3rd " . . . . .    | 10       | 40                 | 50            | 5,000                  |
| 4th " . . . . .    | 10       | 40                 | 50            | 5,000                  |
| 5th " . . . . .    | 10       | 40                 | 50            | 5,000                  |
| Total . . . . .    | 50       | 200                | 250<br>acres. | 25,000 lbs.            |

## Statement of Expenditure to be borne by the Imperial Council of Agricultural Research.

| Item No. | Particulars.  | 1st year. | 2nd year. | 3rd year. | 4th year. | 5th year. | REMARKS.  |
|----------|---|-----------|-----------|-----------|-----------|-----------|---|
|          |   | Rs.       | Rs.       | Rs.       | Rs.       | Rs.       |   |
| 1        | 1 qualified Plant Ecologist (Rs. 200—200—250) 25 less 15 per cent.)   | 2,040     | 2,040     | 2,040     | 2,940     | 3,240     | To keep own records for first 2 years.            |
| 2        | 1 Analyst (Rs. 100—10—140 less 15 per cent.)  | 1,020     | 1,140     | 1,260     | 1,380     | 1,500     | To be employed by Agricultural Chemist, Lyallpur. |
| 3        | 1 Record-keeper (Rs. 40—2—80 less 15 per cent.)   | ..        | ..        | 408       | 432       | 456       | } To be employed as required.                     |
| 4        | 1 Literate Labourer (Rs. 25 per mensem)   | 75        | 75        | 100       | 125       | 150       |   |
| 5        | 5 Chowkidars (Rs. 13 per mensem each)   | 156       | 312       | 468       | 624       | 780       |   |
| 6        | Miscellaneous expenses, including the preparation of graphs, diagrams, tables, sketches, Railway freight on samples, etc. | 250       | 275       | 300       | 325       | 450       |   |
| 7        | Marking and laying out of plots   | 120       | 120       | 120       | 120       | 120       |   |
| 8        | Provision of rain-gauges  | 25        | 25        | 25        | 25        | 25        |   |
| 9        | Fencing plots   | 500       | 500       | 500       | 500       | 500       |   |
| 10       | Purchase of Superphosphates at Rs. 95 per ton   | 250       | 250       | 250       | 220       | 220       |   |
|          | Total   | 4,406     | 4,707     | 6,041     | 6,691     | 7,441     | = Rs. 20,286 spread over 5 years.                 |

*Statement of Expenditure to be borne by the Punjab Government.*

| Item No. | Particulars.   | REMARKS.  |           |           |           |           |
|----------|--|-----------|-----------|-----------|-----------|-----------|
|          |  | 1st year. | 2nd year. | 3rd year. | 4th year. | 5th year. |
|          |  | Rs.       | Rs.       | Rs.       | Rs.       | Rs.       |
| 1        | Conveyance for Plant Ecologist   | 300       | 300       | 300       | 300       | 300       |
| 2        | Caring and spreading Superphosphates                                     | 200       | 200       | 200       | 200       | 200       |
| 3        | Labour for harvesting and carting grass at approximately Rs. 4 per acre. | 320       | 640       | 960       | 1,280     | 1,600     |
|          | Total  | 820       | 1,140     | 1,460     | 1,780     | 2,100     |

A pony will be supplied by Government Cattle Farm, Hissar.

Labour, carts, etc. will be provided by Government Cattle Farm, as the grass produced will be consumed by the Farm livestock.

Rs. = 7,300 spread over 5 years.

*Summary.*

|   |       |       |       |       |       |
|---|-------|-------|-------|-------|-------|
| Liability of the Imperial Council of Agricultural Research. | 4,406 | 4,707 | 6,041 | 6,691 | 7,441 |
| Liability of the Punjab Government                          | 820   | 1,140 | 1,460 | 1,780 | 2,100 |
| Total   | 5,226 | 5,847 | 7,501 | 8,471 | 9,541 |

Rs. = 29,286.  
= 7,300.  
= 36,586, spread over a period of 5 years.



## (ENCLOSURE II.)

COPY OF A LETTER No. F. 155/35-AGRI., DATED THE 14TH SEPTEMBER 1935, FROM THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, TO THE SECRETARY TO THE GOVERNMENT OF THE PUNJAB, DEVELOPMENT DEPARTMENT.

SUBJECT:—*Scheme for the study of the effects of phosphatic manuring on grass land in an area of low rainfall.*

I am directed to refer to Mr. Bourne's letter No. 784-D. (S), dated the 28th June 1935, on the subject mentioned above, and to say that the scheme will be placed before the Animal Nutrition Committee at the time of the next cold weather meeting of the Advisory Board of the Council. In the meantime I am to point out that the scheme does not state what the system of management of the grass land will be. It is presumed that the general method of management at the Hissar farm is to lay out the land for hay during the monsoon and to allow regulated grazing during the cold weather.

In this connection it may be pointed out that it would make the experiment much simpler to carry out, if it were limited to hay, as there is then no question of damage to the pasture by accidental overstocking, for in pasture experiments there is the difficulty of accumulation of dung in the better plots. On the other hand if grazing is entirely eliminated, the composition of the grasses may be adversely affected. It is, therefore, requested that these points may be further considered, and this Department may kindly be informed whether, in the event of the plots being used for grazing, only cattle will be grazed or both cattle and sheep.

## (ENCLOSURE III.)

COPY OF A LETTER No. 184-D., DATED THE 22ND JANUARY 1936 FROM THE JOINT SECRETARY TO GOVERNMENT, PUNJAB, DEVELOPMENT DEPARTMENT, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

SUBJECT:—*Scheme for the study of the effects of phosphatic manuring on grass land in an area of low rainfall.*

In reply to your letter No. F. 155/35-Agri., dated 14th September 1934, and subsequent reminder, I am directed by the Punjab Government (Ministry of Agriculture) to intimate that no grazing will be done on the experimental plots. Provision has been made in the scheme for fencing the plots and providing each with a chowkidar to prevent unauthorised grazing. The grass crop will be harvested by cutting and weighed carefully each year. It was recognised, when preparing the scheme, that grazing would destroy the value of the results obtained. It is felt that the possibility of the composition of the grasses being perhaps adversely affected by the elimination of grazing is of minor importance, since the main object of the experiment is to ascertain the value of superphosphates with regard to root development. The dung dropped by grazing animals would cause uneven results which would detract from the value of the observations and of the data collected.

## APPENDIX LVII.

Report of the Standing Animal Nutrition Committee of the Imperial Council of Agricultural Research, held at New Delhi, on the 14th February 1936.

## PRESENT:—

1. Col. A. OLVER (*Chairman*).
2. Dr. W. R. Aykroyd.
3. Dr. W. BURNS.
4. Mr. M. CARRERY.
5. Dr. J. K. DUBEY.
6. Mr. E. S. FARRROTHER.
7. Mr. INDU BHUSAN CHATTERJEE.
8. Mr. P. J. KERR.
9. Mr. ZAL R. KOTHAVALA.
10. Dr. P. E. LANDER.
11. Mr. C. H. PERR.
12. Mr. T. F. QUIRKE.
13. Dr. K. C. SEN.
14. Mr. S. M. A. SHAH.
15. Rao Bahadur B. VISWANATH.
16. Mr. F. WARE.
17. Rao Bahadur M. VAIDYANATHAN.

1. *Application from the Government of the Punjab for a grant of Rs. 29,286 spread over a period of five years for a scheme for the study of the effects of phosphatic manuring on grass land in an area of low rainfall. (Item No. 31 on the Agenda of the Advisory Board). (Appendix LVI).*

This scheme was considered in detail and in answer to a question by Dr. Burns it was explained that there were to be 5 randomised areas of 50 acres each divided into plots of 2 acres. This was considered satisfactory for the purpose of the scheme and it was suggested that more than one sort of phosphate should be tried but after discussion it was agreed that it would be advisable to confine the work under the scheme to one phosphatic manure. Dr. Burns suggested that the study of root development should be added to the table of records which were to be kept under the scheme on page 3 of the printed scheme. In dealing with the staff required and the statement of expenditure to be borne by the Imperial Council of Agricultural Research, it was agreed that throughout the cut of 15 per cent. shown in the original scheme should be omitted and it was decided that to carry out the work satisfactorily it would be necessary to have a second Analyst on the scale of Rs. 100—10—140 instead of one. It was also agreed that the price of phosphate had better not be stated in the scheme as it was impossible to say what that might be when the work was started. With these changes the liability of the Imperial Council of Agricultural Research would be increased from Rs. 29,280 to

Rs. 35,640, but it was considered that the scheme could not be satisfactorily carried out otherwise. The Committee considered the work to be important and recommended its adoption with the above modifications.

2. *Proposal for the extension of the Bengal Animal Nutrition scheme, for a further period of 5 years from January 1937 (total cost of scheme Rs. 99,276). (Subject No. 15 on the Agenda of the Advisory Board).*

*Annual reports for the years 1931-32, 1932-33, 1933-34 and 1934-35 on the scheme for the appointment of a Physiological Chemist to study animal nutrition problems at Dacca. (Subject No. 14 on the Agenda of the Advisory Board).*

It was agreed that the work which is being done at Dacca was valuable but that it had extended beyond its original purpose into problems of method which needed to be completed but it was considered that further work on methods should be dealt with at a Central Institute. It was recommended that the work should be confined to Items 1 and 4 on pages 6 and 7 of the printed proposal and as much of item 3 as was necessary to obtain a complete picture. Item 5 would be incidental to this work. To carry out the work on this restricted scale it was agreed that the Assistant Physiological Chemist's pay should be fixed at a flat rate of Rs. 200 a month and that the second Assistant Physiological Chemist, the Junior Assistant and the 2 stall watchmen should be deleted and that provision for travelling could be reduced to Rs. 1,000 a year, Chemical and apparatus to 800 a year, contingencies to Rs. 600 a year and books and periodicals to Rs. 500 in the first year and Rs. 200 in subsequent years. With these modifications the liability of the Imperial Council of Agricultural Research under the scheme would be reduced from Rs. 99,276 to Rs. 71,700. It was considered very important that work of this nature in East India should not be stopped at this juncture and with the above modifications the scheme was recommended.

A. OLVER,  
Colonel.

NEW DELHI,  
The 14th February, 1936.

## APPENDIX LVIII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 3rd February 1936, on Subject No. 14:—Annual reports for the years 1931-32, 1932-33, 1933-34 and 1934-35 on the scheme for the appointment of a Physiological Chemist to study animal nutrition problems at Dacca.**

These reports were circulated to the members of the Advisory Board and Standing Animal Nutrition Committee for consideration at the meetings held in July 1935 [compare notes dated the 25th June 1935 and 9th July 1935 on subjects Nos. 55 and 55 (Supplementary) respectively]. As the members had no time to go through them thoroughly, the consideration of the reports was postponed for a subsequent meeting. The reports will now be considered by the Animal Nutrition Committee at its meeting to be held during February 1936 and its report (App. LVII) will be circulated to the Board in due course.

## APPENDIX LIX.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 1st January 1936, on Subject No. 15:—Application from the Government of Bengal for the extension of the Bengal Animal Nutrition Scheme for a period of 5 years at a cost of Rs. 99,276.**

Attention is invited to the attached letter (Annexure I) from the Government of Bengal, No. 7038, dated the 7th December 1935, forwarding the scheme. In July 1935 the Animal Nutrition Committee and the Advisory Board considered a scheme for the extension of the Bengal Nutrition Scheme costing Rs. 1,08,615 (Rupees 1,06,050 recurring and Rupees 2,565 non-recurring) spread over a period of 5 years. The Animal Nutrition Committee recommended (*vide* Annexure II) that the Government of Bengal be asked to submit a smaller scheme and their recommendation was accepted by the Advisory Board (*vide* Annexure III). The Government of Bengal have accordingly submitted the scheme in a revised form costing Rs. 99,276 spread over 5 years. The scheme will be examined in the first instance by the Animal Nutrition Committee of the Council whose report will be circulated to the Board in due course.

## ANNEXURE I.

LETTER FROM THE GOVERNMENT OF BENGAL, AGRICULTURE AND INDUSTRIES DEPARTMENT (AGRICULTURE BRANCH). No. 7038. DATED CALCUTTA, THE 7TH DECEMBER 1935.

I am directed to forward herewith, for favour of inclusion in the Proposal for extension agenda of the meeting of the Advisory Board to be of the Bengal Animal held in February, 1936, the marginally noted scheme nutrition scheme. (Enclosure I) which has been approved by the Bengal Provincial Agricultural Research Committee, together with the relevant extract from the minutes of the meeting of the Committee held on 30th November 1935 (Enclosure II). I am to say that Government (Ministry of Agriculture) recommend the scheme subject to the reservation that no financial liability will devolve on them.

## ENCLOSURE II.

EXTRACT FROM MINUTES OF THE TENTH MEETING OF THE BENGAL PROVINCIAL AGRICULTURAL RESEARCH COMMITTEE, HELD AT WRITERS' BUILDINGS, CALCUTTA, ON SATURDAY, THE 30TH NOVEMBER AT 11-30 A.M.

## PRESENT.

- (1) The Hon'ble Nawab K. G. M. Farouqi, Khan Bahadur Minister for Agriculture and Industries—President.
- (2) H. S. E. Stevens, Esq., I.C.S., Secretary to the Government of Bengal, Department of Industries and Agriculture.
- (3) P. J. Kerr, Esq., Veterinary Adviser to the Government of Bengal.
- (4) Professor J. C. Ghosh, D.Sc., Dacca University.

- (5) Professor J. N. Mukherjee, D.Sc., Calcutta University.  
 (6) Professor S. Sinha, Krishnath College, Berhampore.  
 (7) M. Carberry, Esq., M.A., B.Sc., I.A.S., Assistant Director of Agriculture, Bengal.  
 (8) K. Mclean, Esq., B.Sc., I.A.S., Director of Agriculture, Bengal, Secretary.

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(2) The proposal for the extension of the Bengal Animal Nutrition Scheme was next considered. It was explained that the proposal was considered in Committee at the last meeting of the Advisory Board. The Committee referred the scheme back until the return of Mr. Carberry and suggested that it might be curtailed. It was pointed out that the work which had already been done was not a conclusion; and to arrive at positive results it was essential that the scheme should continue and should not be curtailed. This view was accepted by the Committee and it was agreed that the Imperial Council of Agricultural Research should be pressed very strongly to accept the scheme as it was of far reaching value to the whole of North-Eastern India.

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ANNEXURE II.

EXTRACT FROM THE PROCEEDINGS OF THE MEETING OF THE ANIMAL NUTRITION  
 COMMITTEE OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH  
 HELD ON 16TH JULY 1935.

\* \* \* \* \*

**2. Application from the Government of Bengal for the extension of the Bengal Animal Nutrition Scheme for a period of five years at a cost of Rs. 1,08,615 (Subject No. 26 on the agenda of the Board).**

It was pointed out in the Committee that the Bengal Scheme was intended to find out the nutritive value of paddy straw and other grasses and that the work had shown clearly that paddy straw alone was not sufficient for the proper maintenance of cattle and that definite amounts of concentrates were required. It had also definitely shown the nutritive value of the two grasses experimented with. The main object for which the scheme was sanctioned had therefore been fulfilled to a large extent and the Committee was of the opinion that it was not clear for what specific purpose the extension had been asked for. After discussing the matter further the Committee was of the opinion that the Government of Bengal should be asked to put up a smaller scheme for consideration at the next meeting of the Advisory Board to complete the work which had been undertaken to thoroughly test the technique to ascertain digestibility coefficients and for completing the work on mineral studies. The Committee desired that Mr. Carberry should be asked to attend that meeting to explain the scheme.

## ANNEXURE III.

EXTRACT FROM THE PROCEEDINGS OF THE ADVISORY BOARD, DATED THE 19TH  
JULY 1935.

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The recommendation of the Animal Nutrition Committee to the effect that the Government of Bengal should be asked to put up a smaller scheme for consideration at the next meeting of the Advisory Board, on the lines suggested, was approved.

\* \* \* \* \*

## ENCLOSURE.

PROPOSAL BY THE DEPARTMENT OF AGRICULTURE, BENGAL, FOR THE EXTENSION  
OF THE BENGAL ANIMAL NUTRITION SCHEME AFTER THE EXPIRY OF ITS  
PRESENT TERM.

In 1932 the Imperial Council of Agricultural Research provided a five years' grant for a Physiological Chemist and staff to study the problem of animal nutrition as affecting these parts of India. In view of some important development of work the Council at the recommendation of the Standing Committee on Animal Nutrition made a supplementary grant (from July 1935) for additional staff and some necessary apparatus, etc. In making this grant the standing committee remarked that "the work that was being done was of value and much required in India;" and the Board adopted the recommendation. The current grant including the supplementary provision terminates on the 1st January 1937.

It is necessary to give a brief survey of the work.

As soon as the staff and the necessary facilities were ready the first attention was directed to the nutritional values of some of the important fodders and feeds. Paddy straw being a staple fodder used over a large part of India including Bengal, formed one of the first subjects for investigation. Experiments were started with this straw as the sole feed as well as in combination with other feeds.

For this purpose a scheme was drawn up in consultation with Dr. Warth and the work aimed at arriving at an approximate figure for maintenance on one side and the calculation of digestibility coefficients on the other. It was noticed, however, that in the type of paddy straw used the protein content was so poor that when given as a single feed, not only was there an adverse nitrogen balance but even the nitrogen digestion was negative. There was also a general depression of digestibility as the feeding continued. The values were unreliable either as an indication of proper digestibility or as a basis for subsequent calculation of the individual digestibilities in a combined feed with this straw. The use of published standards was also tried but was not found satisfactory. To obviate this difficulty an elaborate experiment was designed and a new method was developed based on graphical representation and multiple regression equation. Details of the method will be found in "A New Method of Experimentation and Computation for directly obtaining the Digestibility

Coefficients of Individual Feed Nutrients in a Mixed Ration" by Carbery, Chatterjee and Hye, published in the December (1934) issue of the Indian Journal of Veterinary Science and Animal Husbandry. This is the first time that a new method of directly obtaining the individual digestibility in a mixed ration has been attempted and the work marks a new stage in this important line of investigation. The work can hardly be said to be complete. The experiments were conducted with straw and cake in three doses of cakes; and although there were 5 replications on each dose, the points in the graph were necessarily concentrated on the three zones and the linear assumption on the basis of what virtually consisted of three points, required confirmation. This part of the work was taken up at the suggestion of Mr. Burt. For this purpose another experiment was designed at Krishnagar providing four points, but while the experiment was in the middle stage of progress some of the animals refused to consume the larger doses of concentrate. The work however, could not be abandoned, but the results when complete are likely to be correspondingly affected. The necessity of working with *more points* requires no emphasis, but it is beset with many practical difficulties besides being tedious and time absorbing. There is no doubt that such work has to be conducted with as large a number of animals as possible. This is a fact felt as much by ourselves as was rightly emphasised by Dr. Lander in his first memoir. As soon therefore as the present work at Krishnagar is completed a retrial of the experiment at Dacca has to be undertaken with more points if possible.

It should be stated that the work referred to in the above paper and in the trial at Krishnagar have both been based on two feeds or two unknowns. No work has been undertaken with three, four or more unknowns. Theoretically the method is applicable to "n" unknowns but it is necessary that work with at least three and four unknowns should be taken up both for confirming the validity of the method as well as to see how far the interaction affect the values under increasing and decreasing doses of concentrate. Here another fact requires to be very carefully considered. In the above method it has been assumed that the digestibility under 1 lb., 2 lbs. and 3 lbs. combinations of cake was the same and constant. The results in so far as these figures are concerned, indicate that this assumption was correct. At the same time it must be stated that the three doses represent three different planes of nutrition. Dr. Warth has noted in his experiments at Karnal that appreciable changes in the digestion of protein and carbohydrate occur when the amount of protein in the ration is varied. The digestibility increases with the amount of protein. To obviate this, one of the procedure might be to put all the animals on the same plane of nutrition and then calculate the values from the data, but the difficulty here has been that the animals are generally of same live weight and hence when the values are worked in the two equations they are so nearly identical that the ordinary procedure of eliminating one unknown often results either in eliminating both or giving absurd values. To obviate this difficulty a new design of experiment has been drawn up with animals of different live weights, say 400, 600, 800 and 1,000 lbs. Their rations will be regulated on the basis of their live weights. Thus by varying the plane of nutrition, different data under the same and under different planes of nutrition will be obtained by which it would be more definitely established how far the digestibility is related to the different planes of nutrition.



It will, however, be self-evident that work on such lines alone requires a considerable period of time. In the first trial with 1 lb., 2 lbs. and 3 lbs. cake, *i.e.*, under three planes of nutrition there were eighteen individual tests with six animals, a pair being allotted to each. At Krishnagar it was done with four points on eight animals and it involved 32 individual trials. Besides some animals refused to eat higher doses of concentrates for which another set of tests had to be conducted although even then the animals could not be persuaded to act as was desired. It is necessary as suggested by Mr. Burt that more points should be worked with, and the next experiment is proposed to be conducted with five doses involving ten animals and necessarily fifty individual tests.

These, however, refer to the estimation with two feeds or two unknowns. The trials with three unknowns and four unknowns require also to be tested. But it will mean prolonged and continuous work extending for four or five years at the least.

The new method of estimating digestibility necessarily involves a very elaborate test and technique. But there are bound to be occasions when the feeding material, animal, etc., might be too limited to permit such an extensive test; and in order to meet such a contingency a shorter method has also been worked out and a paper on the subject under the title "The Estimation and Computation of Digestibility Coefficients from Individual Tests and Their Order of Precision" by Carbery and Chatterjee, is now in the press. The Specialist Referee while scrutinising this paper has remarked that it "constitutes a new and interesting departure" and "furnishes a valuable stimulus for research and criticism." In absence of sufficient tests this method could be worked out only with limited data and that too with respect to two unknowns or two feeds. A formula has been presented for three unknowns and while the mathematical basis has been quite sound as has been remarked by the Specialist Referee, its practical application and validity could not be tested in the absence of requisite data. The design of experiments for testing this method as well as the first one can very well be combined together; and if the life of the present grant is extended, it is intended to take up these in a comprehensive way.

It should be stated that in the trials so far conducted the behaviour of crude fibre with respect to oilcake has presented difficulties. There are some factors at present undetected which seem to operate against a proper assessment of its digestibility. Woodman and Stewart in their investigation on "the mechanism of cellulose digestion in the ruminant organism" have found by bacterial fermentation that the Ether extract fraction of oilcake appears to produce some organic substance which is able "to resist solution by the reagents employed for the estimation of fibre" (Jr. Agr. Sc., 1932, 22/527-547). How far such fermentation is associated with the actual mechanism of digestion in the animal system, is difficult to assess, but important enquiries are suggested and it is intended to pursue this investigation if, with the extension of the scheme some necessary equipment such as a high temperature incubator and accessories are available. Another important aspect is with regard to the maintenance requirement. A method for protein requirement for maintenance (an outline of which has been given in the Annual Report for 1934-35) is being developed which promises to arrive at an evaluation of the minimum quantity for maintenance. The results so far indicate that in the case of the type of animals on this side of

India, a dose of 0.3 lb. of digestible protein per 1,000 lbs. live weight would probably be sufficient for maintenance as compared to 0.6 lbs. found by Continental and American workers as well as by Dr. Warth. It would appear that our animal is probably more thrifty than it was assumed and this finding has a great economic significance when properly established; for after all it is the maintenance requirement which is the fundamental basis on which other requirements for growth, work and lactation can be worked out.

The new lines of developments as narrated in the preceding have naturally enlarged the scope and sphere of the work considerably. The study of nutritional aspects as related to maintenance, work, growth and lactation having regard to soil, rainfall and other factors, have to be taken up, and while some data on feeding values have been obtained more intensive and extensive study is needed.

The investigation on the aspect of work and the efficiency of the animal is a matter of immediate importance for the condition of the physique of the animals in a large part of North-East India is strikingly different as has also been pointed out by the Royal Commission on Indian Agriculture.

The work so far done has been on the digestibility of foodstuffs more or less under the condition of maintenance. Little is known how the digestibility and nutritional values of Indian foodstuffs are related to the output and nature of work. In order to obtain a proper assessment the working efficiency of animal has to be measured on a standardised basis in terms of units of work in relation to the energy requirement as well as on the bearing of protein, fat and carbohydrate. It is proposed to take up this investigation in consultation with Dr. Lander.

No work on the productive requirement for growth and lactation has been undertaken under the conditions prevailing in North-East India. It is necessary to study the requirement of a growing heifer, a cow in milk, a pregnant cow or a dry cow. Similarly the requirements for the development of the fetus and the growth and maturity of new-born are all awaiting study. These enquiries requiring necessarily comprehensive investigations, cannot all be taken up within the limited time at our disposal, but depending in the tenure and stability of the grant the programme can be so framed as to implement a large part of them.

Regarding the investigations on fodder a few words are needed with respect to paddy straw. This straw is used more or less all over India. It has the largest single area covering over 81 million acres of which a little over a quarter falls to the share of Bengal, the next biggest area belongs to Bihar and Orissa followed by Burma, Madras, United Provinces, Central Provinces and Assam. Depending on cultivation, season and position of land the crop is grown under four distinct classes as follows:—

- (1) Transplanted aman or winter paddy grown in water-logged soil
- (2) Broadcasted aman or winter paddy grown in deep and shallow water.
- (3) Aus or autumn paddy grown in high land
- (4) Boro or spring paddy.

These different classes grown in different soils and under different environmental factors not only vary in composition between themselves

but within themselves. Of these, only two classes, viz., transplanted aman and highland aus of Dacca have been done to some extent and some aspects of their variations in nutritive values and composition are set forth in the following:—

|  | Composition.       |                   | Digestibility.     |                   |
|--|--------------------|-------------------|--------------------|-------------------|
|  | Aman.<br>Per cent. | Aus.<br>Per cent. | Aman.<br>Per cent. | Aus.<br>Per cent. |
| Organic matter . . . . .                             | 85.309             | 88.796            | 51.032             | 47.717            |
| Crude protein . . . . .                              | 2.894              | 5.879             | 9.898              | 30.131            |
| Ether extract . . . . .                              | 0.868              | 1.713             | 43.790             | 28.000            |
| Crude fibre . . . . .                                | 34.215             | 32.425            | 61.894             | 58.900            |
| Ash . . . . .  | 14.691             | 11.204            | ..                 | ..                |
| Lime (CaO) . . . . .                                 | 0.401              | 0.635             | ..                 | ..                |
| Magnesia (Mgo) . . . . .                             | 0.290              | 0.400             | ..                 | ..                |
| Potash (K <sub>2</sub> O) . . . . .                  | 1.575              | 2.032             | ..                 | ..                |
| Soda (Na <sub>2</sub> O) . . . . .                   | 0.354              | 0.267             | ..                 | ..                |
| Phosphate (P <sub>2</sub> O <sub>5</sub> ) . . . . . | 0.139              | 0.176             | ..                 | ..                |
| Nutritive ratio (approx.) . . . . .                  | ..                 | ..                | 1.113              | 1.23              |

The most noteworthy feature in these two classes from one single locality, viz., of the red soil area of Dacca, is the marked difference both in general composition and nutritive value, the latter being reflected in better nutritive ratio in favour of aus straw which is besides much richer in phosphate, lime and magnesia. The importance of a comparatively narrow protein ratio and the necessary mineral proportion in a country so scantily supplied in nutritive components requires no special emphasis.

We have found in our experiments as Dr. Warth has found in his that "small differences in the nitrogen content of straw may make all the difference between a positive and negative balance of nitrogen. In fact he has made a pointed reference to this aspect in order that "more emphasis is in future laid on these small differences" (Agricultural Journal of India, 1923, 463). The economic significance of such a vital matter, yet seemingly of minor importance, does not appear to have received the attention it deserves. It will depend entirely on a proper assessment of the feeding values of the main classes of straw under different soil belts to fix up the requirement under local conditions.

It should be stated here that amongst the straws so far studied in the various centres of India there was never quite an appreciable difference in their food values. Thus for instance Dr. Warth has found about 40 lbs. starch equivalent per 100 lbs. of straw for his sample whereas we have got about 24 lbs. at Dacca, which seems to resemble more the Kamra rice straw studied by Dr. Lander. Thus there is "a real and considerable difference" not only with the American data as noted by Dr. Warth but with the samples of different places in India itself. These results strongly suggest the possibility of superior energy values in the same fodders of different localities for which more extensive trials are needed.

With regard to green fodders Napier grass in particular gives wide fluctuations in digestibility mainly associated with the stage of maturity. Besides it appears to be poorer in lime and rich in potash. A field experiment has been started to determine the best stage of maturity compatible with maximum yield and subsequently its value in relation to digestibility will also be tested. The mineral side with special reference to high potash ingestion is proposed to be taken up side by side.

In the case of hyacinth the fodder scarcity has compelled its use in some parts as green food. The few tests done show that it is rich in potash and lime. Its protein content sometimes exceeds that of Napier or Guinea grass, but probably as it is either lacking in the necessary Amino acid make up or due to the mineral imbalance it is not able to produce a positive nitrogen balance. The urine excretion with this food is generally greenish and faeces watery. There are indications that when supplemented with some protein rich feed it is much better utilised; but the effect of continued feeding and the nature of the supplements, require to be studied. This plant as is well known infests Bengal, Assam, Bihar and Orissa and Burma as well as in many other tracts. If it could be suitably utilised as cattle feed it offers a partial solution for its proper tackling. In this respect it has a definite all-India bearing. The work for which the extension is now sought may be summed up as follows:—

(1) Digestibility trials with the four main classes of paddy straw as far as possible from the typical soil belts; similar trials with Napier grass, Guinea grass, water hyacinth, Sorghum, cowpea, khesari, silage, etc., as well as with concentrates and bye-products particularly rice polishings and rice bran; also to trace where possible a co-relation with seasonal and soil factors in reference to the chemical composition and nutritional values.

(2) Experiment to ascertain the most suitable stage of maturity for Napier grass consistent with economic production and feeding values: There might be a seasonable tide in the variation of the constituents as has been noted in the case of spear grass by Mr. Ramiah (Indian Journal of Veterinary Science, 1933, III, page 76).

(3) *Mineral content of feeds and mineral assimilation and metabolism:* At present only limited data are available, but in the few trials that have been done it appears that in the case of hyacinth and Napier grass the potash soda ratio is very high and the lime percentage is high in the former and low in the latter. It has been noted that when fed with hyacinth the gain in weight was negative. Aron (Pfluger's Arch, 1905, 106, 91, referred to in Indian Journal of Veterinary Science, 1933, page 280) considered it possible that such a ratio interfered with the deposit of calcium and bone formation in cattle while Zuntz (Armsby, page 342) has recorded that fodders which cause rickets usually show an excessive proportion of K to Na. Recent work of Richards, Godden and Husband (Bio-chem. J., 1924, 18, 651) shows that an increase in the sodium-potassium ratio in the case of pigs (by the addition of sodium salts in the cereal ratio) led to assimilation of nitrogen, calcium and phosphorus. Dr. K. C. Sen (Indian Journal of Veterinary Science, 1933) has found that a deficiency of calcium in blood causes a large decrease of sugar absorption from the small intestine. Paddy straw has also an appreciable

quantity of potash and Dr. Warth has noted diuresis with this feed. At Dacca high urination has followed the feeding of Napier grass. These matters are intended to be studied side by side in conjunction with other aspects as opportunities will occur.

(4) Utilisation of surplus molasses as cattle feed: The question of utilisation of molasses has been under consideration of the Sugar Committee and the Animal Husbandry Expert. It has been already decided (Imperial Council of Agricultural Research letter No. D. 2934/35-A., dated Simla, the 30th July 1935) that systematic tests shall be carried out at Bangalore and practical feeding trials at different centres. It should be stated here that Bengal might reasonably claim some share of credit as it already initiated this type of investigation. Trials were made at Dacca to mix molasses with some agricultural bye-products such as rice bran and form into a transportable brick (Agricultural Chemist's Annual Report, 1931). The results have been quite promising but more attention could not be devoted on account of shortage of staff and other heavy work. It is now proposed to take it up without delay on the following lines:—

(i) Direct utilisation as a mixture with other cattle food on the lines just stated.

(ii) As a mixture for silage making: Work of this nature has been attempted with success elsewhere. Casolis reports a method (on Hoard's Dairyman, 1934) which seems to be quite suitable and it is proposed to give it a trial. The process is designed specially for the preservation of protein rich crop. It has been found by Dr. Warth and other workers that protein on ensilage deteriorates in digestible fractions. The addition of sugar (in this case from the molasses) helps in the production of fermentation chiefly of the lactic acid type which suppresses organisms responsible for the changes in protein. According to Casolis both in tower and pit silos, lined or unlined there was practically no loss of nutrients. The experiment if successful is likely to provide the equivalent of green crop throughout the year.

(5) Further test to check the validity of longer and shorter methods for the determination of digestibility with more than three points on one side and with animals of varying live weights on the other. The investigation will be conducted with two, three and four feeds or unknowns under the same and different planes of nutrition as already suggested.

(6) Minimum requirement for maintenance: The aspect of protein is already under investigation as has been mentioned in the preceding. The other aspects will also be taken up.

(7) Investigation into the behaviour of crude fibre and fat during the course of digestion with special reference to oilcake: the matter has also been already dealt with.

(8) Amino-acid contents of the feed proteins.

(9) The ration of a bullock in work: This is by far the most important investigation awaiting the section for the work will remain incomplete unless some such test is made with it. Further the method, evolved for digestibility tests under such conditions may at any rate in the presence of a new factor require modifications in the interpretations of results. Unless and until such tests have been thoroughly tried out the section cannot be said to have accomplished the work for which this grant was originally made by the Imperial Council of Agricultural Research.

In conclusion it should be stated that the Dacca staff have been engaged in a particular line of research and have developed their own technique. Their ideas have crystallised into certain definite forms and it would be no exaggeration to state that their work indicates some special aptitude on their part for such types of work. The Royal Commission on Indian Agriculture have also stressed while dealing with animal nutrition work that "full advantage should be taken of special aptitudes" and it would indeed seem abortive if after five years of strenuous work and successful results, the benefit of such experience and aptitude, derived at the expense of the Imperial Council of Agricultural Research should be, for all practical purposes lost and wasted.

It need hardly be stated that the work in the earlier years was more of a preliminary nature. In India this type of work dates only back a short period due mainly to two pioneer workers—Dr. Lander in Northern India and Dr. Warth under the Imperial Department of Agriculture. In fact very few types of work are more tedious, time absorbing and demand such continuity. It is only in years to come that it gathers material for wider benefit. It is therefore for the careful consideration of the Council, that this work started under such favourable auspices should be allowed to grow in such a way that this small nucleus may in course of time develop into a sub-station of the Imperial Institute of Animal Nutrition on this side of India. In fact Bengal provides all the material for such a sub-station. As has been remarked by Dr. Warth, this province "is peculiarly situated as regards animal nutrition problems, as besides the Burdwan Division in Western Bengal where climatic condition resembles those of much of Peninsular India, it includes East Bengal where a moist climate is with adjacent Assam unique in India." Then there are the sub-montane tracts of the Himalayan districts. Further as has been already stated, the work on protein requirement for maintenance indicates that the animals in these parts are probably much more economic than those found by Dr. Warth. This striking characteristic might be equally reflected with respect to the requirement for work, milk production, growth, etc. The study of nutrition problems in such a tract comprising as it does, a varied and representative area on one side, and such interesting features on the other, is as much necessary, as it is, to quote Dr. Warth, "vital not only to North-East India but India as a whole".

The scheme still in force including the supplementary grant from July 1935 provides for one Physiological Chemist on Rs. 250—50—750, one Assistant Chemist on Rs. 160—20—300, another Assistant Chemist on Rs. 160 and one Junior Assistant on Rs. 70. Besides there are one clerk and one byre-overser on Rs. 30—5/2—50. The clerk is virtually the byre-overser of the Krishnagar stall but this has caused great inconvenience as a good deal of clerical work has to wait until the Agricultural

Chemist's staff are able to spare time to do so. An additional byre-overseer has been a crying necessity to relieve the clerk.

With the present pay of byre-overseers at Rs. 30—5/2—50 it has been found impossible to retain the right type of men. Two incumbents after working for a few months left their work for better appointments causing great dislocation as the new recruits had to be trained. It is proposed that their pay should be increased to Rs. 50 the present maximum of their scale.

Amongst the menials there are at present two laboratory bearers on Rs. 20, two laboratory peons on Rs. 15 and two stall watchmen on Rs. 13. For working at two places their number is not sufficient but it is now proposed to increase it in the extension scheme.

There are at present no facilities for cold storage at Dacca and it is suggested that a refrigerator should be provided. Similarly a high temperature incubator for working with thermophilic bacteria for investigation on the mechanism of fibre digestions is needed. A typewriter is also required.

In the scheme which is still in force, the expenditure of the local Government works out as follows up to the end of five years:—

|                                     | Rs.    |
|-------------------------------------|--------|
| Non-recurring expenditure . . . . . | 15,651 |
| Recurring expenditure . . . . .     | 24,500 |
|                                     | <hr/>  |
| Total . . . . .                     | 40,151 |
|                                     | <hr/>  |

Approximate details of these are shown in annexures II and III.

In view of expected increase in the volume of work, if the present scheme is extended, the recurring expenditure from the share of the local Government is not likely, to be less than the amount shown above, viz., Rs. 24,500 while it is impossible at present to say what non-recurring expenditure may be necessary, but as in the past all such requirements will be met.

The expenditure falling to the share of the Imperial Council of Agricultural Research is for a total of Rs. 99,276.

The details have been shown in annexure I. It will be seen from it that the expenditures under the heads "Chemical and apparatus" and "Contingencies" have been reduced. No increased expenditure has been proposed. The only increase is for the accrual of the increments in the pay of the present staff.

It is hoped that in view of the valuable work that is being done, the Imperial Council will provide the grant.

## ANNEXURE I.

Proposed expenditure from the grant of the Imperial Council of  
Agricultural Research.

| Last or<br>5th<br>year's<br>sanction<br>of the<br>current<br>grant.<br>(1) | (2)  | Period of extension— |                  |                  |                  |                   | Total.<br>(8) |
|--|--|----------------------|------------------|------------------|------------------|-------------------|---------------|
|  |  | 6th year.<br>(3)     | 7th year.<br>(4) | 8th year.<br>(5) | 9th year.<br>(6) | 10th year.<br>(7) |               |
| Rs.  |  | Rs.                  | Rs.              | Rs.              | Rs.              | Rs.               | Rs.           |
| 5,400  | Physiological Chemist<br>(Rs. 500—50—750).               | 6,000                | 6,600            | 7,200            | 7,800            | 8,400             |               |
| 2,800  | Assistant Physiological<br>Chemist (Rs. 250—20<br>—300). | 3,120                | 3,360            | 3,600            | 3,600            | 3,600             |               |
| 1,920  | Assistant Physiological<br>Chemist (Rs. 165—<br>250).    | 1,980                | 1,980            | 2,100            | 2,100            | 2,160             |               |
| 840  | Junior Assistant<br>(Rs. 74—110).                        | 888                  | 888              | 960              | 960              | 1,020             |               |
| 720  | 2 Byre-overseers (Rs.<br>50) each.                       | 1,200                | 1,200            | 1,200            | 1,200            | 1,200             |               |
| 480  | 2 Laboratory bearers<br>at Rs. 20 each.                  | 480                  | 480              | 480              | 480              | 480               |               |
| 360  | 2 Laboratory peons at<br>Rs. 15 each.                    | 360                  | 360              | 360              | 360              | 360               |               |
| 312  | 2 Stall watchmen at<br>Rs. 13 each.                      | 312                  | 312              | 312              | 312              | 312               |               |
| 1,500  | Travelling allowance .                                   | 1,500                | 1,500            | 1,500            | 1,500            | 1,500             |               |
| 1,290  | Chemical and ap-<br>paratus.*                            | 1,100                | 1,100            | 1,100            | 1,100            | 1,100             |               |
| 770  | Contingencies* . . .                                     | 700                  | 700              | 700              | 700              | 700               |               |
| 500  | Books and periodicals                                    | 500                  | 500              | 500              | 500              | 500               |               |
| 40   | Stationery . . . .                                       | 40                   | 40               | 40               | 40               | 40                |               |
| 17,014   | Total . . . . .  | 18,180               | 19,020           | 20,052           | 20,652           | 21,372            | 99,276        |

Rs.

Grand Total for 5 years . . . . . 99,276

Recurring expenditure from local Government—(vide Annexure III) . . . . . 24,500

\* Here the amounts under "Chemical and apparatus" and "Contingencies" have been reduced as will be seen from a comparison with the current expenditure for the fifth year (column 1). Leaving the increments in the pay of staff (which does not come under the category of a new expenditure), no increase has been proposed.



## ANNEXURE II.

*Non-recurring expenditure from Local Government.*

|   | Rs.   | Rs.    |
|---|-------|--------|
| Dacca—  |       |        |
| Building—   |       |        |
| Paddock, fencing, etc. . . . .                    | 1,981 |        |
| Addition and alteration in stall . . . . .        | 937   |        |
| Extension to the laboratory building . . . . .    | 2,500 |        |
|   | <hr/> | 5,418  |
| Krishnagar—                                       |       |        |
| Stall, fencing, tube-well—                        |       |        |
| Overhead tank, godown, etc. . . . .               | 2,767 |        |
| Laboratory . . . . .                              | 2,000 |        |
|   | <hr/> | 4,767  |
| Dacca—  |       |        |
| Purchase of animals—                              |       |        |
| Heifers . . . . .                                 | 1,600 |        |
| Bullocks . . . . .                                | 300   |        |
|   | <hr/> | 1,900  |
| Bullocks at Rangpur and Krishnagar . . . . .      |       | 600    |
| Weighbridge at Krishnagar . . . . .               |       | 500    |
| Grant from local Government in (1932-33)—         |       |        |
| For purchase of chemicals and apparatus . . . . . |       | 931    |
| Calculating machine . . . . .                     |       | 975    |
| Platinum basins . . . . .                         |       | 500    |
| Gas burners . . . . .                             |       | 60     |
|   |       | <hr/>  |
| Total non-recurring expenditure . . . . .         |       | 15,651 |
|   |       | <hr/>  |

## ANNEXURE III.

*Recurring expenditure from the Local Government.*

|                                       | Annual.<br>Rs. | For 5<br>years.<br>Rs. |
|---------------------------------------|----------------|------------------------|
| Dacca—                                |                |                        |
| Petty repairs, etc. . . . .           | 100            |                        |
| Cost of grains . . . . .              | 550            |                        |
| Cost of fodder . . . . .              | 450            |                        |
| Cost of labour . . . . .              | 950            |                        |
| Krishnagar and Rangpur—               |                |                        |
| Petty repairs . . . . .               | 100            |                        |
| Cost of grains, etc. . . . .          | 350            |                        |
| Cost of labour . . . . .              | 800            |                        |
| Fodders . . . . .                     | 300            |                        |
| Expenditure for gas . . . . .         | 800            |                        |
| Chemicals and apparatus . . . . .     | 500            |                        |
|                                       | <hr/>          |                        |
|                                       | 4,900          |                        |
|                                       | × 5            | = 24,500               |
| Total non-recurring . . . . .         | 15,651         |                        |
| Total recurring for 5 years . . . . . | 24,500         |                        |
|                                       | <hr/>          |                        |
| Grand Total . . . . .                 | 40,151         |                        |
|                                       | <hr/>          |                        |

## APPENDIX LX.

Note by the Secretary, Imperial Council of Agricultural Research, dated the 18th February 1936, on Subject No. 37 (i):—Report of the Committee of Entomologists on Sugarcane Insect Pests Scheme.

A letter dated the 20th January 1936 which has been received from Mr. Noel Deerr of Messrs. Begg Sutherland & Co., Cawnpore, regarding a sugarcane borer infestation survey at certain sugar factories made at North Bihar and East United Provinces is circulated for the information of the Advisory Board (Enclosure). The report of the Committee of Entomologists on the subject will be circulated in due course.

## ENCLOSURE.

COPY OF A D. O. LETTER, DATED THE 20TH JANUARY 1936, FROM NOEL DEERR, ESQ., C/O MESSRS. BEGG SUTHERLAND & CO., LTD.

I enclose you copy of the results of a borer infestation survey made at the factories managed by Messrs. Begg Sutherland & Co. Ltd.

The infestation appears to be less than was observed last year.

*Results of Borer Infestation Survey at 8 factories in North Bihar and East United Provinces, 1935-36.*

|  | 1     | 2      | 3     | 4     | 5     | 6     | 7     | 8     | Means<br>of<br>Totals. |
|--|-------|--------|-------|-------|-------|-------|-------|-------|------------------------|
| No. of Sticks . . . . .                | 3,200 | 24,357 | 4,000 | 3,200 | 2,800 | 2,727 | 9,600 | 5,220 | 57,134                 |
| Sound . . . . .                        | 4,596 | 17,715 | 3,247 | 2,900 | 2,068 | 2,343 | 7,745 | 4,596 | 45,110                 |
| Infested . . . . .                     | 631   | 7,672  | 753   | 400   | 732   | 384   | 1,855 | 884   | 13,311                 |
| Per cent Sound . . . . .               | 86.0  | 69.8   | 81.2  | 87.5  | 74.0  | 84.7  | 80.5  | 88.5  | 72.0                   |
| Per cent infested . . . . .            | 14.0  | 30.2   | 18.8  | 12.5  | 26.0  | 15.3  | 19.5  | 11.5  | 28.0                   |
| Weight lbs. . . . .                    | 5,326 | 13,062 | 3,157 | 2,120 | 2,229 | 1,967 | 6,089 | 2,862 | 36,512                 |
| Weight Sound lb. . . . .               | 5,208 | 12,054 | 2,796 | 2,042 | 2,108 | 1,687 | 5,612 | 2,557 | 34,064                 |
| Weight Infested lb. . . . .            | 118   | 948    | 361   | 78    | 131   | 280   | 477   | 305   | 2,698                  |
| Per cent Sound . . . . .               | 97.8  | 92.7   | 88.7  | 96.2  | 94.2  | 85.8  | 92.0  | 89.5  | 92.5                   |
| Per cent Infested . . . . .            | 2.2   | 7.3    | 11.3  | 3.8   | 5.8   | 14.2  | 8.0   | 10.5  | 7.5                    |
| Sound Pol Juice . . . . .              | 14.15 | 14.84  | 14.13 | 14.29 | 14.31 | 14.63 | 14.20 | 14.20 | 14.35                  |
| Sound Purity Juice . . . . .           | 81.0  | 80.1   | 80.9  | 80.2  | 78.3  | 80.0  | 81.2  | 80.8  | 80.5                   |
| Infested Pol Juice . . . . .           | 10.27 | 10.85  | 10.22 | 10.71 | 9.50  | 12.69 | 9.79  | 10.21 | 10.52                  |
| Infested Purity Juice . . . . .        | 68.1  | 70.2   | 76.9  | 72.1  | 69.1  | 74.9  | 70.5  | 67.8  | 70.1                   |
| Sound sugar per cent cane              | 11.15 | 11.70  | 11.12 | 11.21 | 11.30 | 11.52 | 11.18 | 11.20 | 11.30                  |
| Infested Sugar per cent Cane . . . . . | 7.70  | 8.15   | 7.62  | 8.03  | 6.97  | 9.53  | 7.32  | 7.55  | 7.88                   |
| Overall Sugar per cent Cane . . . . .  | 11.12 | 11.22  | 10.73 | 11.04 | 11.03 | 11.13 | 11.02 | 10.79 | 11.01                  |
| Sound yield . . . . .                  | 9.20  | 9.55   | 9.09  | 9.24  | 9.05  | 9.43  | 9.22  | 9.25  | 9.25                   |
| Infested yield . . . . .               | 5.20  | 5.83   | 5.30  | 5.92  | 4.92  | 7.25  | 5.17  | 5.32  | 6.62                   |
| Overall yield . . . . .                | 9.13  | 9.27   | 8.67  | 9.17  | 8.80  | 9.15  | 8.90  | 8.92  | 9.09                   |
| Depression of yield . . . . .          | .07   | .88    | .42   | .07   | .25   | .28   | .32   | .33   | .25                    |

## APPENDIX LXI.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 8th February 1936, on Subject No. 37 (i):—Report of the Committee of Entomologists on Sugarcane Insect Pests Scheme.**

In continuation of the note dated the 18th February 1936 on the subject mentioned above (Appx. LX) the following further papers are circulated to the Advisory Board:—

1. Note by the Agricultural Expert to the Council on the Scheme for research on the insect pests of cane. (Enclosure I.)
2. A note by Mr. R. G. Allan, Director of Agriculture, Baroda, on the ratooning of cane. (Enclosure II.)

## ENCLOSURE I.

## NOTE ON SCHEME FOR RESEARCH ON INSECT PESTS OF CANE.

The Sugar Committee of the Imperial Council of Agricultural Research at its sixth meeting held in November 1933, considered and approved a scheme for future research into the insect pests of sugarcane which consisted of two inter-dependent parts, one central and the other provincial, and included an appointment of an all-India Sugarcane Entomologist with staffs in certain important sugarcane growing provinces. The Advisory Board of the Council at its meeting held in February 1934, however, recommended that the central part of the scheme should be started first and its extension into the provinces considered later. Since then, the possibility of the central scheme being worked at the Imperial Institute of Agricultural Research has been considered, and it is thought that, with the transfer of the Institute to Delhi, it will be possible to undertake the work in its entomological section which is proposed to be provided with a parasitological laboratory. The Second Imperial Entomologist can be put in charge of the work and one of the class II posts in the section can be filled by recruiting an officer for systematic work on sugarcane pests. As there is a statistician with two computers on the staff of the Institute, it will not be necessary to have a special statistical assistant for sugarcane work. It will also be unnecessary to have 3 clerks as provided in the scheme. It will be possible to carry on the clerical work with the existing staff of the section if only one extra clerk is provided. A post of insect setter will however be required as the pests will have to be properly set, preserved and stored for study. This post was omitted in the original proposals.

2. The Research Council will thus have to provide funds only for a class I officer for parasitology, two junior assistants, one setter, five fieldmen, and one clerk and for some capital and recurring expenditure on account of equipment and contingencies. The cost of the scheme will

therefore be materially reduced. It is estimated to amount to Rs. 1,50,000 for a five-year period as detailed below:—

*Non-recurring.*

|   | Rs.    |
|---|--------|
| (1) Water, gas and electric fittings for parasitological laboratory . . . . . | 3,000  |
| (2) Apparatus and cages . . . . .   | 15,000 |
| (3) Fencing, shed, etc. . . . .   | 2,600  |
|   | 20,600 |

*Recurring.*

| Details.   | First year. | Second year. | Third year. | Fourth year. | Fifth year. | Total.   |
|--|-------------|--------------|-------------|--------------|-------------|----------|
|  | Rs.         | Rs.          | Rs.         | Rs.          | Rs.         | Rs.      |
| One Parasitologist at Rs. 275—300—325—25—650—35—1,000.                               | 7,800       | 8,220        | 8,640       | 9,060        | 9,480       | 43,200   |
| Two Junior Assistants at Rs. 100—5—120 each . . . . .                                | 2,400       | 2,520        | 2,640       | 2,760        | 2,880       | 13,200   |
| Five Fieldmen at Rs. 40—2 1/2—50 each . . . . .                                      | 2,400       | 2,550        | 2,700       | 2,850        | 3,000       | 13,500   |
| One Setter at Rs. 40—2 1/2—50 . . . . .  | 480         | 510          | 540         | 570          | 600         | 2,700    |
| One clerk at Rs. 40—2—48 . . . . .   | 480         | 504          | 528         | 552          | 576         | 2,640    |
| Provident Fund for Parasitologist and 2 Junior Assistants at 1/16th of pay . . . . . | 638         | 670          | 705         | 740          | 773         | 3,526    |
| Contingencies . . . . .  | 7,000       | 7,000        | 7,000       | 7,000        | 7,000       | 35,000   |
| Travelling allowance . . . . .   | 3,000       | 3,000        | 3,000       | 3,000        | 3,000       | 15,000   |
| Total . . . . .  | 24,198      | 24,974       | 25,753      | 26,532       | 27,309      | 1,28,766 |

|                               |          |
|-------------------------------|----------|
| Total non-recurring . . . . . | 20,600   |
| Total recurring . . . . .     | 1,28,766 |
|                               | 1,49,366 |
| Or say . . . . .              | 1,50,000 |

3. As it will be necessary, to get a man of experience for the post of Parasitologist, he will have to be offered pay according to qualifications within the proposed scale. The initial pay of this post has therefore been put at Rs. 650.

4. The posts proposed above are temporary and no quarters for the incumbents have therefore been provided. They will have to find quarters in Delhi and may be given conveyance allowance. The officers of the Entomological Section who are members of the Institute staff will of course have quarters.

5. The history of this scheme is explained above and the task before the Committee is to suggest methods of co-operation between the central research scheme and the provinces by making the best use of existing resources in the latter. The provinces can obviously co-operate in recording the extent of the damage due to each pest and in the testing of primitive and remedial measures. Varietal resistance is a quality which may vary in different localities. The question of ratooning is also one for provincial co-operation.

6. The position with regard to the central scheme is that Mr. Isaac has done an extensive tour in America (Louisiana), Porto Rico and Hawaii and has acquainted himself with the work on the control of insect pests of cane in these countries. He returns to India only on 6th

February 1936, so it is impossible to include his views in this note. The staff and equipment provided in the scheme have now to be recruited and obtained and it will be possible to establish the scheme in working order at Delhi in November 1936. We might recruit the two Junior Assistants earlier and with these Mr. Isaac could tour the cane-growing areas and collect information regarding the pests in India. Steps should also be taken to recruit the Parasitologist.

An important side to this scheme is that it should co-operate with the cane-breeding work of the Sugarcane Expert at the Karnal sub-station. Arrangements have been made to increase the area of the sugarcane station at Karnal in order to provide more land for the study of varieties of cane as regards their resistance to these pests. Karnal is well suited for this work as it is full of pests (Top borer and Pyrilla) and, if necessary, a portion of the farm at Delhi can be used for this work.

7. The laboratory accommodation for this scheme available in November at Delhi is not really adequate but a start can be made and half the new Parasite laboratory can be given up to this work. It is proposed to establish a much more complete meteorological station at the new site than exists at Pusa and while this will not be under the control of the Imperial Entomologist, instruments and assistance will be available for correlating weather conditions with the incidence of pests if this is desirable and for studying conditions which are favourable to the parasites of these pests. All sections of the Institute will of course co-operate whenever assistance is required.

8. For the details of the lines of work on which the scheme should proceed, it would be advisable to await a report from Mr. Isaac. The parasitic method of control may prove efficacious in the case of Pyrilla. The leaf hopper disease in Hawaii is an encouraging example but in the case of Top stem borer it is unlikely that the parasitic method of control will prove practicable in the case of an insect which lives within the stem of the plant. Here probably the only satisfactory control will be found in the development of resistant varieties. Even in the case of Pyrilla, the breeding of varieties of cane in which the leaf sheath is closely adherent to the stem, offers a possible means of lessening the spread of this pest.

9. During the past six months, the Imperial Council of Agricultural Research has collected information on the question raised regarding the influence of ratooning on the incidence of insect pests. This was referred to at the Sugar Committee meeting in July 1935 and the attached communication (Appendix I), was addressed to all Directors of Agriculture.

The replies of Directors of Agriculture indicate generally that while first ratoons may be allowed, subsequent ratoons should be discouraged. In Bengal, however, the Director of Agriculture is against even first ratoons and most provinces admit that ratooning increases the incidence of pests. In the United Provinces an enquiry is being conducted. Entomologists in the provinces might carry out observations with the object of obtaining some estimate of the influence of ratooning on the occurrence of pests. A copy of a note by Mr. Noel Ferrer on the incidence of borer is attached (Appendix II).

F. J. F. SHAW.

25th January 1936.

COPY OF A LETTER No. F.-32/35/A. DATED THE 28TH NOVEMBER 1935, FROM THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, TO ALL DIRECTORS OF AGRICULTURE (INCLUDING CONSTITUENT STATES).

I am directed to say that in the course of discussions at the last meeting of the Sugar Committee held in July 1935, on a scheme for future research work on the insect pests of sugarcane, it was stated by some of the members that the cane crop became particularly susceptible to attack by diseases and pests on account of the practice of ratooning which was largely prevalent in certain provinces, especially in the United Provinces and the Punjab. It was felt that ratooning made at least apparently cultivation both cheap and easy and some of the members thought that, while there was no risk in the first and the second ratoons, subsequent ratoons were definitely injurious and should be discouraged. On the other hand, some members felt that in view of the fact that in certain tracts ratoon canes were well manured and remained quite healthy, it was not altogether desirable to deprive cultivators of the benefits of ratooning by an active propaganda to discourage it. In other words, it was considered that a reasonable degree of ratooning was advantageous and that cultivators should be taught the proper method of ratooning rather than persuaded to drop the practice altogether.

The Committee eventually recommended that before proceeding with the matter further the views of the Provincial Departments of Agriculture should be invited. A note summarising the existing situation is enclosed and this Department will be glad to have your considered views at an early date on the matters referred to in the note as well as on any other points arising therefrom. In case ratooning is considered to be undesirable, suggestions for dissuading the cultivator from adopting it will be welcomed.

#### *Ratooning*

This consists of allowing the stools of the original plant crop to strike again after the crop has been harvested and to grow into a cane crop for the succeeding year. This process may be repeated upto 4th and 5th ratoons, and I believe that in Cuba certain lands have been known to hold ratoons for 14 and 15 years.

#### *Advantage*

1. In all places where labour is very expensive or very scarce, ratooning is usually practised, because the cost of labour bulks so high on the plant crop that the saving on a ratoon crop easily offsets the loss of tonnage.

2. When cane is being newly introduced into a district or area, and seed has to be railed long distances, ratoons represent heavy saving and enable a larger area to be handled.

3. In all jungle tracts or on land newly reclaimed from forest, where excess nitrogen is usually present and the humus content is very high, ratooning usually pays, as in such places it is possible to give the ratoons the best possible start. This is and has been the case in Cuba.

4. Ratoon cane is earlier ripening than plant cane, and so gives a factory a chance of an earlier start if it is working solely on mid-season varieties.

5. In cases of frost, where it is necessary to pit seed cane at considerable cost or where a lot of seed cane in the standing crop may be damaged ratoons will be kept and the practice in the Punjab is traceable to this.

6. In cases where the plant crop, though heavily manured, has failed to grow through lack of moisture, in such cases a ratoon will use up the manure and probably produce an excellent crop.

In short the advantages may be summed up as a saving in seed, labour, and manure, which in certain areas show a definite profit over the loss in tonnage.

#### *Disadvantages*

1. Ratooning means that a heavy feeding crop is taken for two years running on the same soil, and such treatment usually means that the land under normal treatment cannot carry a heavy feeding crop again for a period of years and the effect of rotation is lost.

2. Insect pests, rats and all known cane diseases are carried on and multiplied by the ratoons which also serve as harbours for diseases to affect the neighbouring plant cane.

3. A general deterioration of the cane crop is to be observed, and as seed is usually drawn from the standing crop, much bad seed is of necessity planted from ratoon cane.

4. It is almost impossible to manure ratoons properly; bulk manure brings white ants, if applied straight to the stools, while all artificials applied have to work in a soil depleted of humus and therefore results are usually unfavourable.

I now deal with the points raised in your letter.

(1) Whether there is any objection to 1st ratoons and subsequent ratoons—

Under advantages I have dealt with cases where first ratoons may prove advantageous. Under no circumstances do I consider second ratoons or any subsequent ratooning advisable.

(2) The economics of ratooning and the relative sucrose content and juice qualities from ratoons of different ages—

The economics of ratooning are given under advantages and are a question of first cost of labour and seed mainly. It is held that ratoons ripen earlier and give a superior juice due to the fact that the cane is usually further advanced and of shorter growth than plant cane, i.e., the shortage of plant food in the soil makes for a less luxuriant growth—more sugar less water. We have not previously ratooned at Pusa, as the borer question and risk to our other experiments has precluded it.

(3) The effect of ratooning on soil—

This year for the first time we have ratooned on a commercial scale in the New Area and on the Farm. In the New Area on a light soil, signs of exhaustion are evident and the land will be unfit for cane for another three years unless very heavily manured. On the Farm, on heavy land it is not so marked, but a comparison of the crop with the neighbouring plant crop is full evidence of the soil deterioration.

Three years ago, we did cane on cane in Bhograsan. Despite heavy manuring and all possible preparation in the time, the second crop was a poor one, showing that the land, which was a good class loam, had been heavily pulled down by the first crop and so was unable to carry the second successfully.

(4) The effect of ratooning on the disease problem--

I have already written a note for the Imperial Council of Agricultural Research on insect pests in which this is stressed. I consider ratooning to be the best way to prevent borer ever being stamped out, while rats and other pests get an opportunity to flourish unchecked.

After the great Bihar Earthquake in 1934 (January) most of the cane in North Bihar was allowed to ratoon, as ryots had no knowledge at the planting time (February) whether any of the local factories would ever work again and no body was willing to spend time and money on first planting under the circumstances. Next year the cane in the North was universally bad and I have little doubt that a further year's ratooning would have sent the crop out.

Ratooning in North Bihar is only done when a man cannot afford seed, is uncertain if his crop will be taken off, or has not enough land to carry two crops of cane. The soil, as a rule, is not strong enough to carry ratoons and the manuring barely sufficient for the plant crop.

Certain factories like Doulatput do cane after cane, *i.e.*, cane-follow-cane with very heavy bulk manuring, and grow an excellent crop, but this allows for complete *kharij* and most of the *rabi* follow to work the land and can not be compared to regular ratooning.

To sum up, the main factor in ratooning is the question of insect pests and their damage, and I consider that this point is of such vital importance as to out-weigh all other considerations whether of soil, manure or economies. A great and concerted effort to control the borer has got to be made at once if the Indian Sugar Industry is ever to be on a sure foundation and ratooning on this account should be forbidden.

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## ENCLOSURE II.

### THE RATOONING OF CANE.

I have at no time been adverse to ratooning, provided it is restricted to one ratoon and provided that the crop is effectively manured, cut very close or even below soil level and well worked in between the rows and if the trash of the virgin crop is effectively removed to the compost pit or even better in this case is burnt on the field. I realise that if this is done, an effective crop upto 80 per cent. or 85 per cent. of the virgin can be secured at comparatively low cost and that there are conditions, as for instance if the virgin cane is for any reason late planted or possibly available water supplies have reacted on full growth in the virgin as in the Terai, when a ratoon will actually give a heavier crop. Further I feel that we must in this matter give some attention to the conditions to which the crop is exposed. Thus as far as I can judge, as we pass on to more tropical areas fungoid disease is likely to be the greatest menace, whereas as we move up the Gangetic valley, the incidence of



insect pests is the greatest danger to which the crop is subjected. Given a disease free cane in the virgin state, ratooning is less likely to be ultimately harmful, provided the agronomic essentials referred to above are attended to than it is, for instance the Western districts of the U. P. where stools left in the ground for the next ratoon or the continuation of green leaf may help the carry over of the pest to the next active season. There is this danger when stem borer in particular and *Pyrilla* attack have to be faced, but I would like to point out that ratoons are by no means the only sources of the carry over; the not uncommon habit of leaving the stubbles to sprout or even to carry on in a dead condition well into the monsoon, when they can be more readily lifted and removed, is just as bad a menace to the oncoming virgin cane or even worse one than is that of a well tended ratoon. Again, as far as *Pyrilla* is concerned there is quite as effective a chance of carry over in the canes standing by for the factory in April on the young virgin planted nearby in February and coming into leaf.

If we demand the suppression of all ratoon then, in as far as borers are concerned, we must demand the entire removal of old stubbles within say by the latest the end of June—a definitely tall order. This without irrigation, free of charge, so as to facilitate ploughing where conditions are slack, as they rarely are once the rains break, would be almost to be impossible of fulfilment.

I am of the opinion that it is not actually the taking of a ratoon which is bad but the taking off of a badly farmed ratoon and that in this sense it should be possible to educate growers to effective technique. The gravest danger lies as much in the disastrous effect on the general level of fertility and on subsequent crop yields (this applies every where) as on the influence of insect pest on the cane crop, as allowed to come up anyhow. The danger is intensified when this crop is carried forward on water only for perhaps 2 or 3 years. Given that, one can inculcate the first and, at any rate in Northern India, restrict ratoon to one year, I do not myself feel that the practice need be considered a menace. It all depends on how far it is possible to insist on a better farming standard of the first ratoon and how far we can stop a recurrence of bad ratoons.

On the State tube wells of the U. P. where the area under cane per well will have for other reasons to be put on a quota basis and where the cropping and handling of each crop can be kept under some supervision, it is quite feasible to insist on a sufficiently high standard of farming of any ratoon included in a man's quota and to refuse any well assistance between say from May 12th and the break of the rains, *i.e.*, the pressure period, to second ratoon, to ratoon outside the quota and to first ratoon which had not been manured to a certain standard, I believe that the irrigation branch would co-operate outside the pressure period by allowing water for stubble removal and plowing at relatively low rates or by some rebate on the water purchased for each area plowed and cleaned by the help of water.

In regard to the canals, I have discussed the matter at great length with irrigation engineers of all ranks. There are difficulties but in the U. P. they see the menace and, as it is possible to know which are 1st and 2nd ratoons, it might be possible to apply a rapidly rising rate to the water charges per acre so as to effect a deterrent on the practice. On some such scales as virgin 10, 1st ratoon 15, 2nd 20, 3rd 30, thus making anything over one ratoon entirely uneconomical or compelling a higher

standard of farming to cope with the higher water rate or to place virgin and 1st ratoon at 10 and the later ones at 20 and 30.

In the Eastern tract of the U. P. it has not been the habit to take at the most more than one ratoon and even so that was not, at any rate in the past, common; but if the first ratoon was found to be badly treated and if the growing of later ratoons gained ground, I doubt if anything except legislation would have any effect, as the necessary water is largely got from wells.

In regard to Baroda, the area under cane is small, the new canes have only just begun to come into use and I think it would be possible to restrict ratoons, grown under good conditions, to one season largely by taking measures now to educate the growers.

R. G. ALLAN,  
Director of Agriculture, Baroda.

## APPENDIX LXII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 12th February 1936 on Subject No. 37 (i):—Note on the scheme for Research on the Insect Pests of Sugarcane by Mr. P. V. Isaac, I.A.C., Second Imperial Entomologist, Pusa.**

In the research on insect pests of cane there has to be two objectives. First the immediate need for the control of the known insect pests affecting the varieties of sugarcane grown at present. Secondly the study of canes in co-operation with the Sugarcane Expert regarding their susceptibility to insects to find canes that are resistant to insect pests.

These two require two different methods of study—For the first investigation of the life histories of the insects including their natural enemies and experiments in biological methods of control are necessary. In America Porto Rico and Hawaii, whereas artificial methods of control have been found unsatisfactory in many instances the introduction of natural enemies has definitely ended for all time the problem of the injurious insects. In Hawaii the Entomologists employed by private bodies have by the introduction of natural enemies succeeded completely in eliminating insect pests of sugarcane. For the second objective trials are required of different varieties and determination of the features that cause them to be unattractive to insects and the search has to be made for varieties that have in them the maximum quantities that will keep insects away from them.

To put it shortly we may consider the first objective as the direct control of pests by biological methods and the second objective as the evolving of pest resistant canes. And when these two objectives are balanced against each other it is plain that while the first is very necessary at the moment the second is the one that should be the ultimate aim of all the research activities that could be brought into being.

It may now be considered what these two lines of enquiry demand in the way of programme and organization.

For the first a survey of the chief insect pests of cane throughout India has to be carried out and close study of the pests made in areas where the infestation is very bad and in others where the infestation is negligible. This will give results that will help in finding out the natural enemies and the range of their distribution.

Artificial methods, like spraying and poison gases, are expensive and their results are only temporary as the insects multiply and become abundant when the campaign is given up. This method is therefore inferior to the introduction of natural enemies which propagate themselves and become a constant check on the increase of the pest. Therefore the study of natural enemies of insect pests and their experimental introduction by human skill in the hope that they will prey on a known insect pest and establish themselves in tracts where they had not spread by unaided natural distribution owing to natural barriers.

If for an existing pest a new natural enemy could be introduced and established we have a permanent force that will bring down the injurious insect from the status of a pest. The search for beneficial creatures that

in this and other countries prey on Indian sugarcane pests as well as on allied insects so that such natural enemies could be introduced into areas in India where they do not exist will be of the greatest benefit to sugar cane cultivation.

The method of breeding parasites and their artificial distribution requires safe and quick transfer of those collected into suitable cages in a place where rearing can be carried on without much difficulty and where facilities can be had for cold storage, air conditioned cages and quarantine possibilities for experiments in parasitization. The utmost care has to be taken that with introduction of parasites other creatures like their hosts or their hyper-parasites or those forms that may be accidentally transported in the material arriving with the parasites, do not get out and become new pests in India. The selected parasites under experiment have to be bred in a place from where they could be quickly and safely sent to areas where their introduction is desired.

In Canada the main insect laboratory for biological control is at Belleville near the port of Quebec and in the United States the two most important parasite laboratories are one at Moorestown near Baltimore on the East-coast and the other at Riverside near Los Angeles on the West-coast. In the United States the mass production and supply of *Trichogramma* for use against the sugarcane borer is to a great extent from the laboratory of Dr. Morrill at Glendale near Los Angeles. All these places have excellent train and aeroplane facilities for the transport of parasites. In Porto Rico and in Hawaii too the aeroplane is used as much as possible for receiving and sending parasites to and from the laboratories. The United States also maintain a parasite laboratory on the South-coast of France at Hyeres for the investigation of a number of European and Egyptian insects and for the shipment of those enemies selected to America.

In India there are several thousand acres of sugarcane under varying zoo-geographical conditions and the task of research into the insect-pests and discovery of remedial measures against the pest is one of great magnitude. Therefore to get results that are desirable it is necessary to have an adequate staff, equipment and facilities for field study, correspondence, discussion and co-operation with other workers.

For over fifteen years the Entomological Section at Pusa had been engaged in the problem of sugarcane pests. The Imperial Entomologist gave part of his time, one Class II Officer, one junior Assistant and a number of subordinate staff have been giving almost all their attention to sugarcane insect work. The results they have achieved lead one to the conclusion that a much larger personnel is required if definite and useful results are to be achieved.

In the State of Louisiana there are for sugarcane work two Entomologists and two laboratories under the Federal Bureau of Entomology, there is a State Agricultural Experimental Station with a staff of Entomologists and also two Entomologists at the University. In Hawaii, the Hawaiian Sugar Planters Association employs five Entomologists. In Porto Rico there are two Entomologists working on sugarcane at the Insular Department of Agriculture and there are four Entomologists employed by the U. S. A. Bureau of Entomology. Dr. F. A. G. Muir of Hawaii who from the year 1905 originated and carried out some of the earliest

schemes of Biological control and had great success in his work over a period of 24 years has said that unless there be proper quarantine quarters to receive the foreign consignment where it can be opened and examined, this work should not be undertaken. Without such the dangers are too great and the probability of doing irreparable damage is too high. The officer at the receiving end should have full knowledge regarding the consignment and should realise that great care is required in handling the consignment.

For selecting an organism for biological control of a pest, the whole life of the pest has to be studied and the relative value of each of its enemies as checks should be determined and this must be done over a considerable period of time. The parasitologist has also to employ a great deal of ingenuity in the matter of suitable caging and transporting and breeding and distributing the selected parasite. Each parasite has to be considered separately for these purposes. Rapid transportation is always necessary.

Biological control requires for its operation the development of special technique, special equipment and special laboratory all of which vary very much from the usual requirements of an entomological institute.

Canada after experience of three small laboratories for the purpose has now completed one at Belleville near Quebec at an expense of dollars 85,000, the equipment to cost 10,000 dollars in addition. This represents an outlay of dollars 95,000 or about Rs. 2,50,000. In California (U. S. A.) there is a laboratory similar to the one at Belleville and at the Moorestown Entomological Centre there are special laboratories for handling parasites.

The second objective, that of evolving insect resistant varieties, requires a survey of the insects that feed on sugarcane and allied plants, the host preference these insects have and morphological and physiological studies of the sugarcane varieties in being and those newly bred. For this purpose close co-operation with the sugar-technologist, Botanists and Sugarcane Breeders is required.

For the study of the pests themselves and experiments in biological control and for observation of the susceptibility of cane to insect enemies we have to consider that the extensive cane growing tracts of India come more or less under three zoo-geographical areas:—The Bengal Bihar area, the Punjab United Provinces area and the West-coast and South India area. It is necessary therefore to study the behaviour of sugarcane pests and their natural enemies separately as far as possible for these three areas.

A Central Research Station with a parasite laboratory at Poona and facilities for observation and experiments at Pusa, Karnal and Coimbatore will meet all these demands. Poona appears to be the most convenient place where parasites could be most conveniently gathered from all parts of India and outside mainly by way of Bombay and studied. A small farm and a quarantine green house would be required there and a special laboratory with cold-storage facilities, incubation chambers having controlled temperature and humidity and a fumigation chamber will have to be provided.

It is hoped that the sub-stations of the Imperial Institute of Agricultural Research at Pusa, Karnal and Coimbatore could each provide the plots and a small building necessary for carrying out experiments and field observations.

While the scheme now provides only for Rs. 1,50,000 spread over five years for the expenses it is desirable that the estimate should be revised as follows:—

*Research Insect pests of sugar cane.*

| I.—Recurring Expenditure   | First year  | Second year | Third year | Fourth year | Fifth year |
|--|---|-------------|------------|-------------|------------|
| 1  | 2   | 3           | 4          | 5           | 6          |
|  | Rs.   | Rs.         | Rs.        | Rs.         | Rs.        |
| All-India Entomologist . . . . .   | Pay met by Imperial Institute of Agricultural Research. |             |            |             |            |
| Parasite Investigation Officer (Poona) at Rs. 650—35—790 . . . . .                           | 7,800   | 8,220       | 8,640      | 9,060       | 9,480      |
| Senior Assistant (Karnal) at Rs. 200—25—300 . . . . .  | Pay met by Imperial Institute of Agricultural Research. |             |            |             |            |
| 3 Junior Assistants at Rs. 100—10—140 . . . . .  | 3,600   | 3,960       | 4,320      | 4,680       | 5,040      |
| 6 Fieldmen at Rs. 50 each . . . . .  | 3,600   | 3,600       | 3,600      | 3,600       | 3,600      |
| 5 Laboratory Attendants (work as setters and laboratory boys) on Rs. 20 each . . . . .       | 1,200   | 1,200       | 1,200      | 1,200       | 1,200      |
| 3 Clerks at Rs. 50 each . . . . .  | 1,800   | 1,800       | 1,800      | 1,800       | 1,800      |
| 5 Chaprasias at Rs. 12 each . . . . .  | 720   | 720         | 720        | 720         | 720        |
| 2 Sweepers (Poona) at Rs. 10 each . . . . .  | 240   | 240         | 240        | 240         | 240        |
| 3 Sweepers (for Pusa, Karnal and Coimbatore) at Rs. 10 each . . . . .                        | 360   | 360         | 360        | 360         | 360        |
| Poona laboratory with grounds to serve as farm all to be hired at Rs. 3,000 a year . . . . . | 3,000   | 3,000       | 3,000      | 3,000       | 3,000      |
| Travelling allowances Rs. 3,000 for Chief, Rs. 2,000 for staff . . . . .                     | 5,000   | 5,000       | 5,000      | 5,000       | 5,000      |
| Contingencies Rs. 10,000 a year . . . . .  | 10,000  | 10,000      | 10,000     | 10,000      | 10,000     |
| Totals . . . . .   | 37,320  | 38,100      | 38,880     | 39,660      | 40,440     |
|  | Total Rs. 1,94,400                                      |             |            |             |            |

II.—Non-recurring expenditure—

|   |          |
|---|----------|
| Alterations to Poona house and land to fit up as Laboratory and Insectary plots . . . . . | 5,000    |
| Cold Storage, air condition room and fumigation chamber . . . . .                         | 20,000   |
| Quarantine green house . . . . .  | 20,000   |
| Laboratory equipment and cages . . . . .  | 15,000   |
| Total . . . . .   | 60,000   |
| Total recurring . . . . .   | 1,94,400 |
| Total non-recurring . . . . .   | 60,000   |
| Grand Total . . . . .   | 2,54,400 |

## APPENDIX LXIII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 17th January 1936 on Subject No. 37 (ii):—Occurrence of the Codling Moth—A serious Pest of Fruit Trees—in the Quetta Valley.**

Attention is invited to the attached Memorandum No. F.-52-XXIII/35-Agri., dated the 18th January 1936, Enclosure to all members of the Committee appointed to consider entomological schemes. The Report of the Committee will be circulated to the Advisory Board in due course.

The subject is for the consideration of the Advisory Board.

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 ENCLOSURE.

**Memorandum, No. F.-52-XXIII/35-Agri., dated the 18th January 1936, to all Members of the Committee appointed to consider Entomological Schemes.**

*SUBJECT:—Occurrence of the Codling Moth—a serious pest of fruit trees—in the Quetta Valley.*

The undersigned is directed to forward herewith (i) a copy of a letter (and enclosure) from the Director, Imperial Institute of Agricultural Research, No. 3728-D., dated the 18th November 1935, regarding the occurrence of Codling Moth—a serious pest of fruit trees—in the Quetta Valley, and (ii) a reprint of the note about the pest which was published in the September 1935 issue of Agriculture and Livestock in India.

The subject will be considered by the Committee appointed to consider entomological schemes and which is to meet at 2 P.M. on 13th February in the Conference Room in the first floor of the South Block, Imperial Secretariat, New Delhi.

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COPY OF A LETTER NO. 3728-D., DATED THE 18TH NOVEMBER 1935, FROM THE DIRECTOR, IMPERIAL INSTITUTE OF AGRICULTURAL RESEARCH.

*Occurrence of the Codling Moth—a serious pest of fruit trees—in the Quetta Valley.*

I have the honour to forward herewith a report by the Imperial Entomologist on the occurrence in the Quetta Valley of the Codling Moth (*Laspheyresia pomonella* Linn.), a notorious pest of fruit trees in several parts of the world.

2. The Imperial Entomologist has suggested in the report certain measures which should be adopted to check the spread of the pest to other parts of India. As, however, the question is of all India importance, I suggest that the report be submitted to the Committee of Entomologists which the Imperial Council of Agricultural Research proposes to convene during the Advisory Board's week in February next to consider the scheme for research on insect pests of sugarcane *vide* Imperial Council of Agricultural Research Office Memorandum No. F.-27.37 A., dated 10th October, 1935, to the Education, Health and Lands Department. This

Committee, with the addition of the Imperial Entomologist, will, I think, be the proper authority to suggest concerted action to be taken for dealing with the Codling Moth.

3. In the meantime, a short note giving a summary of existing information about the pest and suggested methods of control has been published in the September, 1935, issue of Agriculture and Livestock in India.

From

The Imperial Entomologist, Pusa.

To

The Director,

Imperial Institute of Agricultural Research, Delhi.

Memorandum No. 426, dated 16th October, 1935.

I beg to report for the information of Government of India that the Entomological Section, Pusa, as a result of its investigations in Baluchistan during the summers of 1933 and 1934, has discovered that the Codling Moth (*Laspeyresia pomonella* Linn.), the most notorious pest of apple and some other fruits in several parts of the world, occurs in the Quetta Valley. This is the first definite record of this pest in India. The identification of the pest has been confirmed by the Imperial Institute of Entomology, London.

2. In Baluchistan the Codling moth was found infesting chiefly apple and to slight extent pears, quinces, etc., but the damage done by this pest was confused with that by *Spilonota ocellana* Fabr, which is a minor pest of apples in U. S. A. We have, therefore, not yet been able to ascertain as to which of these two pests is more responsible for the damage to various fruits in this area.

3. The Codling moth usually spreads from one country to another in its larval stage inside the infested or 'wormy' fruit. It occurs in almost all the important fruit growing tracts of the world, e.g., America, Europe, Australia, South Africa, Syria, Asiatic Turkey, Mesopotamia, etc., etc. It has not yet been recorded from Persia, Afghanistan, etc. It is likely that it occurs in these areas also but has not been looked for by entomologists. It is feared that the pest has most probably entered Baluchistan from its neighbouring countries on its north and west through the importation of infested fruit.

4. The following lines of action are suggested in this connection:—

- (i) Survey of the various fruit growing tracts of Baluchistan to determine the distribution and status as pests of the Codling Moth and *Spilonota ocellana*.
- (ii) Control of these pests in Baluchistan by the application of remedial measures, e.g., spraying, etc.
- (iii) Examination of imported fruit and nursery stock at the Persian and Afghanistan frontiers of Baluchistan to discover if the above and other exotic insect pests are being introduced into Baluchistan by overland routes. Exact locality or localities



to be selected after consultation with the local Department of Agriculture. Recommendations about the restriction of imports or the treatment of imported fruit will be made after the examination of data thus collected.

- (iv) Examination and destruction of infested fruits at Quetta or other important centres from where fruit is exported to rest of India. This measure should check the spread of the pest to other parts of India.

The work on the lines (i) and (ii) above should be undertaken by the Assistant Entomologist attached to the Department of Agriculture, Baluchistan. I believe he is already doing something in this connection.

The work on the lines (iii) and (iv) is of all India importance. It will involve putting one entomological assistant at the North and West frontiers of Baluchistan and another at Quetta or other suitable place from where fruit is packed and booked for export to rest of India. Two mukaddams will be required by the assistant at the frontiers and one by the assistant at Quetta. The assistants and the mukaddams need be appointed for one year only in the first instance. The salary of the assistant to be posted at the North West Frontiers of Baluchistan should be about Rs. 150 a month, as an experienced man will be required for that place. The Quetta assistant may be recruited at Rs. 100 per month, and the mukaddams at Rs. 30 per month. A sum of Rs. 500 may be sanctioned for contingencies for both stations. The staff will not have to tour much, a sum of Rs. 500 should be enough for this purpose. I shall be able to lend the necessary laboratory apparatus and guide and plan out the work of the staff, if required. The assistants can come to compile and work out the data in my laboratory at Delhi.

5. It need hardly be emphasized that action in this matter should be taken as soon as practicable. The best time for posting the staff would be March or April.

*Estimate of expenditure*

|  | Rs.   |
|--|-------|
| Two Assistants at Rs. 150 and Rs. 100 per month respectively . . . . . | 3,000 |
| Three Mukaddams, each at Rs. 30 per month . . . . .                    | 1,080 |
| Contingencies . . . . .  | 500   |
| Travelling allowance . . . . .   | 500   |
| Total . . . . .  | 5,080 |

H. S. PRUTHI,  
Imperial Entomologist.

## APPENDIX LXIV.

Report of the Entomologists Committee met in New Delhi on the 14th  
February 1936 afternoon at 2-20 P.M.

## PRESENT :

1. Sir BRYCE BURT (*Chairman*).
2. Khan Bahadur M. AFZAL HUSSAIN.
3. Dr. W. BURNS.
4. Mr. M. C. CHERIAN.
5. Mr. M. CARBERY.
6. Rai Sahib G. R. DUTT.
7. Mr. P. V. ISAAC.
8. Mr. A. M. MUSTAFA.
9. Mr. H. S. PRUTHI.
10. Mr. P. B. RICHARDS.
11. Dr. F. J. F. SHAW.
12. Mr. D. R. SETHI.
13. Mr. T. V. SUBRAMANIAM.
14. Mr. R. D. GUPTA (*Visitor*).

*Application from the Director, Imperial Institute of Agricultural Research for a grant of Rs. 1,49,366 spread over a period of five years for a scheme of work on insect pests of sugarcane in accordance with the Sugar Committee's recommendations item 37 (i) of the agenda.*

The Committee considered the note submitted by Mr. Isaac on his return from tour and concluded that the case for the establishment of a sub-station at Poona had not been made out. The Committee decided that the question of the sub-station at Poona should be deferred until the scheme has been in progress for two or three years when information might be available which would show whether the sub-station at Poona was necessary or not.

Mr. Richards pointed out that the cases of successful introduction of parasites of pests were those in countries in which the pest itself was generally not indigenous and that the assumption that success would be achieved in India by introducing the parasite of an indigenous pest had at present no experimental evidence in its support.

The Committee considered the co-operation between workers in the provinces and the central scheme and came to the conclusion that regional field Entomologists in the cane-growing areas in the provinces were essential to the success of the work.

The Committee suggest to the Board that a strong recommendation be made to all local governments to create posts of Regional Entomologists for carrying out observations in the field in the provinces.

The Committee considered that the Regional Field Entomologists should restrict their work to borers and Pyrilla. The following lines of work are

suggested as those on which workers in the provinces can collaborate and co-operate with the central scheme:—

1. The collection and observation of major pests and their parasites.
2. The incidence of pests on different varieties of cane with special reference to the properties of disease resistance in cane.
3. The seasonal incidence of pests.
4. The regional incidence of pests.
5. The incidence of pests in relation to the composition of the soil.
6. The influence of the practice of ratooning on the incidence of pests.

The Committee discussed the question of ratooning and decided that from an entomological point of view there is at present no evidence that second and third ratoons are deleterious. Subject to this suggestion, the Committee approved of the scheme.

*Occurrence of the Codling Moth—A serious pest of fruit trees—subject 37 (ii) of the agenda.*

The Committee approved the scheme but recommend that work should be restricted to the survey of the various fruit growing tracts of Baluchistan to determine the distribution and status as pests of the Codling Moth and *Spilonota ocellana*. The Committee considered that the remaining items of the programme of work should be deleted. The Committee hope that the scheme for research on San Jose Scale in the North-West Frontier Province and the Punjab will be put into immediate operation in order that observations on the possible occurrence of Codling Moth in these areas may be available.

*Application from the Director Imperial Institute of Agricultural Research, for a grant of Rs. 15,770 spread over three years for a scheme of work on biological standardisation of insecticides and fumigants in India (item 38 of the agenda).*

The Committee considered the scheme and concluded that it should be referred to the meeting of the Advisory Board in July 1936, and that in the meanwhile the Imperial Entomologist should correspond with workers in other countries particularly at Rothamsted and the Stored Products Research Laboratory and communicate such information as is obtained together with the scheme revised, if necessary, to the July meeting of the Board.

*Report of work done on the insecticidal investigation of plant, fish poisons and other forest products during January to December 1935 (item 44 of the agenda).*

The Committee considered the report on this scheme and observe that the report is far too brief to enable an opinion to be expressed as to the value of the work. As the scheme is a two-year scheme, the Committee trusts that the final report next year will be much more detailed.

*Scheme for research in Economic Ornithology at a cost of Rs. 41,075 spread over a period of five years submitted by Mr. Salim Ali through the Government of Bombay (item 5 of the agenda).*

As several members of the Committee had only arrived in Delhi a few hours before the time of the meeting and had not received the scheme until the meeting actually began, the Committee felt that they could offer no useful criticisms on details.

## APPENDIX LXIV-A.

Report of Entomologists' Committee which met in New Delhi on the 15th  
February 1936 at 5-30 P.M.

## PRESENT:

1. Sir BRYCE BURT (*Chairman*).
2. Khan Bahadur M. AFZAL HUSSAIN.
3. Mr. M. C. CHERIAN.
4. Rai Sahib G. R. DUTT.
5. Mr. P. V. ISAAC.
6. Mr. H. S. PRUTHI.
7. Mr. P. B. RICHARDS.
8. Dr. F. J. F. SHAW.
9. Mr. T. V. SUBRAMANIAM.
10. Mr. R. D. GUPTA (*Visitor*).

*Application from the Director, Imperial Institute of Agricultural Research for a grant of Rs. 1,49,366 spread over a period of five years for a scheme of work on insect pests of sugarcane in accordance with the Sugar Committee's recommendations [item 37 (i) of the agenda].*

The Committee considered the note submitted by Mr. Isaac on his return from tour and concluded that the case for the establishment of a sub-station at Poona had not been made out. The Committee decided that the question of the sub-station at Poora should be deferred until the scheme had been in progress for two or three years when further information would be available. The Committee considered that the cases of successful introduction of parasites of pests were in general those in which the pest itself was not indigenous and that the assumption that success would be achieved in India by introducing from abroad parasites of allied pests was supported, at present, by insufficient experimental evidence.

The Committee consider the relationship between the work required in the provinces and that of the central scheme and came to the conclusion that regional field entomologists in the cane-growing areas in the provinces were essential to the success of the work. The Committee had commended the following resolution to the Board:—

"In the opinion of the Board it is essential to the success of this scheme that Regional Field Entomological Staff, as contemplated in the recommendations of 1933, be provided by Provincial Governments concerned for carrying out work on the lines indicated in this report."

The Committee agreed that the distribution of work between the provinces and the centre should be on the following lines:—

## (a) Work at the central research station and its sub-Stations—

- (1) Observations by Field Entomologist on the major pests in the areas in which they are working. These areas will be (1) Delhi and Karnal, (2) Pusa, and (3) Coimbatore. One Assistant and one fieldman will be required for this work in each of these areas.

- (2) The collection of parasites and of information regarding local parasites and the forwarding of specimens to the central station will also be carried out at the sub-stations enumerated above. For this purpose the Committee defined major pests as all borers, Phyrilla and White Fly.
- (3) The duties of the Parasitologist will be mainly the investigation of indigenous parasites of the major pests and the importation of promising exotic parasites and their trial. For this work the Parasitologist will require one Assistant and two fieldmen to assist him.
- (4) The class II officer who is to be appointed at the centre for systematic work should be sent for training in the systematics of parasitic Hymenoptera to Europe for two years.
- (5) The Second Imperial Entomologist should collate all information from out-stations and from the provinces.

The Second Imperial Entomologist would also carry out studies on the bionomics of pests and arrange for such work to be carried out at sub-stations, if necessary.

It was agreed that all provincial and State Entomologists would supply to the second Imperial Entomologist—

- (i) a complete set of published papers on sugarcane pests;
- (ii) a complete technical statement of work in progress and of important unpublished results. This statement is supplied for the purpose of enabling the second Imperial Entomologist to prepare his programme, and for the information of all co-operating entomologists but not for publication.

This information should be brought up to date annually.

(b) Work in the Provinces and States by Regional Field Entomologists—

The Committee consider that Regional Field Entomologists should concentrate on the major pests of their regions and suggest the following lines as those on which workers in the provinces should collaborate and co-operate with the central scheme:—

- (1) the collection and observation of major pests and their parasites,
- (2) the incidence of pests on different varieties of cane with special reference to pest resistance in cane,
- (3) the seasonal incidence of pests,
- (4) the regional incidence of pests.
- (5) the incidence of pests in relation to the soil conditions, and
- (6) the influence of the practice of ratooning on the incidence of pests.

The Committee discussed the question of ratooning and decided that from an entomological point of view there is at present no evidence that 2nd and 3rd ratoons are more deleterious than first ratoons.

*Co-ordination work.*—The Committee recommend that there should be a yearly meeting of entomological workers on sugarcane pests and that this Committee should include the Vice-Chairman, the Agricultural Expert and the Director, Imperial Institute of Agricultural Research. The Committee

agreed that provincial workers should submit the first statement of information of published work, unpublished work and work in progress some time during the next three months in order that the first meeting of the co-ordinating committee may take place about, July in Simla.

*Scheme for research in Economic Ornithology at a cost of Rs. 41,075 spread over a period of five years submitted by Mr. Salim Ali through the Government of Bombay (Item 5 of the Agenda).*

This subject had been approved in principle by the Advisory Board and the Committee considered that—

- (1) an Economic Field Ornithologist on the scale of pay Rs. 200—15—600, the initial pay not to exceed Rs. 260 was required for this scheme,
- (2) a laboratory boy and contingencies making up a total expenditure of Rs. 500 would be required.

The Committee concluded that the qualifications of the Economic Field Ornithologist were—a sound knowledge and experience in field ornithology and that academic degrees were not in this case necessary.

The Committee also concluded that the most suitable Institute to which the Economic Ornithologist should be attached is the Imperial Institute of Agricultural Research, Delhi, or Agricultural Institute, Lyallpur.

(Sd.) F. J. F. SHAW.

NEW DELHI,

*The 17th February 1936.*

## APPENDIX LXV.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 15th January 1936, on Subject No. 38:—Application from the Director, Imperial Institute of Agricultural Research, for a grant of Rs. 15,770, spread over three years for a scheme of work on Biological Standardisation of Insecticides and Fumigants in India.**

Attention is invited to the attached copy of a letter (Annexure I) from the Director, Imperial Institute of Agricultural Research, No. 4540-D., dated the 17th December 1935 forwarding a scheme of work (Annexure II) by the Imperial Entomologist on biological standardisation of insecticides and fumigants in India. The scheme involves a non-recurring expenditure of Rs. 3,500 and recurring Rs. 12,270 or a total expenditure of Rs. 15,770 spread over three years.

2. The Vice-Chairman to the Council considers that the scheme should be examined in the first instance by the following Committee:—

- The Vice-Chairman, Imperial Council of Agricultural Research, Chairman *ex-officio*.
- The Agricultural Expert, Imperial Council of Agricultural Research.
- The Director of Agriculture, Bombay.
- The Director of Agriculture, Bengal.
- The Director of Agriculture, Bihar and Orissa.
- The Imperial Entomologist, Imperial Institute of Agricultural Research.
- The 2nd Imperial Entomologist, Imperial Institute of Agricultural Research.
- The Government Entomologist, Madras.
- The Entomologist to Government, United Provinces.
- The Entomologist to Government, Punjab.
- The Government Entomologist, Central Provinces.
- The Government Entomologist, Mysore State.
- The Secretary, Imperial Council of Agricultural Research, Secretary *ex-officio*.

The Committee will meet at 2-00 p.m. on Thursday, the 13th February 1936 and its report will be circulated to the Board in due course.

## ANNEXURE I.

COPY OF A LETTER No. 4340-D., DATED THE 17TH DECEMBER 1935, FROM THE OFFG. DIRECTOR, IMPERIAL INST. OF AGRIL. RESEARCH, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI.

I have the honour to forward herewith a scheme (Annexure II) submitted by the Imperial Entomologist for work on the biological standardisation of insecticides and fumigants in India and to request that it may kindly be placed before the Imperial Council of Agricultural Research for consideration and provision of funds.

The scheme has been approved by the Government of India, and it involves an expenditure of Rs. 3,500 non-recurring and Rs. 12,270 recurring spread over a period of 3 years.

## ANNEXURE II.

### SCHEME FOR WORK ON BIOLOGICAL STANDARDISATION OF INSECTICIDES AND FUMIGANTS IN INDIA.

A large number of new insecticides and fumigants claiming to possess high insecticidal properties are being put on the market every year. In the absence of reports by expert entomologists about their relative efficiency, naturally those which are more loudly advertised are purchased by credulous farmers and fruit growers, frequently with disappointing results. If this state of affairs is allowed to continue for some time, apart from the waste of money and labour involved in the use of spurious stuff, the very principle of insecticidal method of pest control and the profession advocating the use of this method is likely to come into disrepute.

During the last decade some specific insecticides have been tried and recommended for use against a few particular pests in some provinces but since the publication of a work of preliminary nature by Lefroy over 20 years ago, no systematic attempt has been made in India to determine from a co-operative point of view the biological efficiency of various insecticides and fumigants. Moreover, it is only in recent years that in some foreign countries non-arsenical insecticides have been properly graded and found to be very effective against some notorious pests and at the same time harmless to man and cattle,—a very important desideration in a country like India. Such insecticides after a thorough trial under Indian conditions require to be brought to the notice of farmers and fruit growers.

With regard to fumigants, in addition to other points in common with insecticides which require investigation, their proper dosage for various materials under Indian conditions needs accurate determination. It need hardly be emphasized that the penetrative power and consequently killing capacity of a gas, apart from other factors, depends on temperature and humidity. In India, so far we are mostly employing the doses recommended for temperate regions of the world, with the result that sometimes too much re-agent is used resulting in unnecessary waste and sometimes the dose employed is not lethal and the "fumigated" consignments are reported to contain living insects after a short time.

Furthermore, most of the insecticides at present available in the Indian market having been imported from distant countries like America and Europe sell at very exorbitant prices which are beyond the means of Indian farmers. It is, therefore, necessary that efforts should be made to discover, if possible, in India suitable ingredients which can be used for the manufacture of insecticides.

From the foregoing the all-India importance of an intensive study of old and new insecticides will be apparent. It is proposed to initiate work of this kind in Entomological Section at Pusa but properly trained staff for this kind of work is not available. An Assistant Entomologist with good training in Chemistry and one additional Fieldman are needed.



Furthermore, with the present limited grant for apparatus and chemicals, it is not possible to purchase modern sprayers and dusting machines and large quantities of insecticides which are essential for a study of the kind indicated above. It is, therefore, requested that the Imperial Council may be moved to make a grant of Rs. 15,770 spread over three years for this purpose. The figure has been arrived at as follows:—

*Non-Recurring.*

|  | Rs.   |
|--|-------|
| Sprayers, dusting machines, etc. . . . . | 3,500 |

*Recurring.*

|   | I<br>Year.                | II<br>Year.                       | III<br>Year.              | Total.        |
|---|---------------------------|-----------------------------------|---------------------------|---------------|
| One Assistant Entomologist<br>(on Rs. 200—15—230) | $200 \times 12$<br>=2,400 | $215 \times 12$<br>=2,580         | $230 \times 12$<br>=2,760 | 7,740         |
| One Fieldman<br>(on Rs. 40—2½—45).                | $40 \times 12$<br>=480    | $42\frac{1}{2} \times 12$<br>=510 | $45 \times 12$<br>=540    | 1,530         |
| Insecticides . . . . .                            | 1,000                     | 1,000                             | 1,000                     | 3,000         |
|   |                           |                                   |                           | <u>12,270</u> |
|   |                           | Grand Total                       | •                         | <u>15,770</u> |

## APPENDIX LXVI.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 30th January 1936, on Subject No. 44:—Report of work done on the Insecticidal Investigation of Plant, Fish Poisons and other Forest products during January to December 1935.**

The report of work done in Mysore, on the insecticidal investigation of plant fish poisons and other forest products during the period January to December 1935, forwarded by the Mysore Government (Enclosure) is submitted to the Advisory Board for consideration.

2. The report will first be examined by the Progress Reports Committee and its report will be circulated in due course.

## ENCLOSURE.

BRIEF REPORT OF WORK DONE ON THE INSECTICIDAL INVESTIGATION OF PLANT FISH-POISONS AND OTHER FOREST PRODUCTS DURING THE PERIOD JANUARY-DECEMBER 1935.

The following plants which are being largely used as fish-poisons and plant insecticides by the rural population in several parts of the Mysore State were collected during the year under report.

1. *Mundulea suberosa*. 2. *Tephrosia Candida*. 3. *Tephrosia villosa*. 4. *Tephrosia Purpurea*. 5. *Tephrosia* Spp. from Babbur. 6. *Ocimum canum*. 7. *Calotropis Gigantea*. 8. *Anona reticulata*. 9. *Acorus calamus*. 10. *Clerodendron Inermi*. 11. *Balanites rexburghii*. 12. *Diaspyros montana*. 13. *Cajanus indicus*. 14. *Randia*. 15. *Mukkada*. and 16. *Tylophora asthmatica*.

The plants were divided into their individual parts and were then collectively and severally tested against either all or most of the following insects.

Aphids. Caterpillars like *Euproctis*, *Prodenia*, *Crocidolomia*, *Diacrisia*, *Plutella*, *Asura*, Tussock caterpillars, *Hypsa*, *Epilachna*, grasshoppers. green and brown bugs, store pests and Mosquito larvae.

Tests were carried out in the following manner. The material under experiment was sun or air dried and powdered to pass through a hundred-mesh sieve. The powdered substance was soaked over-night in water or absolute-ethyl alcohol to give a 10 per cent. aqueous or alcoholic extract. These extracts were then further diluted to make up the required strengths and tested both as stomachicides and contact insecticides. In the former case insects were allowed to feed on green leaf soaked in the insecticidal extract, in the latter the extract was sprayed on to known number of insects on a green leaf except in the case of mosquito larvae where they were allowed to breed in glass tanks of known volume containing solutions of known strength of the insecticide.

Saponin, ordinary soap solutions and molasses were used as spreaders. It was observed that the last named was the best spreader for the purpose, being at least twice as good as saponin and four times as good as soap.

The cheapness of molasses should add to this advantage in our future large-scale trials.

It may be added that dusting of some of these plant powders was also tried but it was found that this was effective only against store-pests and therefore a specific method was not available for general comparative study.

As a result of these preliminary experiments it was observed that, of the several plants under test, the tephrosias, *Mundulea suberosa* and *Randia* fruit were the most active, the others being more or less of a nominal toxicity; that the activity of the tephrosia was concentrated in its seeds, that of *Mundulea suberosa* in its root and stem bark and that of *Randia* in its fruit. The active substance in no case was a water-soluble one, though aqueous extracts of *Mundulea suberosa* and *Randia* fruit were feebly toxic to mosquito larvae. Of the insects, mosquito larvae were uniformly found to be the least resistant,  $\frac{1}{2}$  per cent. extract of tephrosia seeds being quite toxic and hairy caterpillar the most resistant 3 to 5 per cent. of the same extract being lethal in 24 hours, the lethal dose for other insects being intermediary. In our future experiments it was therefore, decided to bear in mind the gradation of these insects, mosquito larvae being the least and hairy caterpillar the most resistant, the lethal dose being defined as that concentration which produces a kill of not less than 75 per cent. in 24 to 36 hours.

As stated earlier in the report, it was found that tephrosia candida seeds and the root and stem bark of *Mundulea suberosa* could be advantageously worked for their active material. It was therefore decided to undertake a detailed chemical examination of the two plant materials and to isolate and prepare the substance or substances which were responsible for insecticidal activity. During the course of this work it was observed that the activity of *Mundulea suberosa* was definitely specific to certain insects like hairy caterpillars and some aphids were as it is but feebly active against mosquito larvae, *Epilachna* grubs and some others of the aphids. Most of our chemical work during the second half of the year under report was therefore confined to *Tephrosia Candida* seeds.

Preliminary experiments were conducted to determine the best solvent for extracting the maximum amount of the insecticide. Also it was decided to confine ourselves as far as possible to the commoner solvents. Ethyl alcohol, Methyl alcohol, Benzine, Petroleum-ether, Benzoin petrol acetone were all tried and found to extract but part of the active material:—(the extracts thus obtained were all tested biologically against the same or similar types of insects used in our preliminary tests with the original plant material)—in consequence of this, mixtures of these solvents were now tried and a 50 to 50 mixture of acetone and methyl-alcohol was found to be the best solvent, extracting practically completely all the activity in *Tephrosia candida* seeds. Furthermore, this extract either in solution or freed from solvent retains its activity over a considerable number of days showing that the active substance is more stable than some of the plant insecticides latterly described by European and American workers in this field. Also this extract does not answer to Durham's rotenone colour reaction, thereby possibly indicating a substance of a different chemical nature.

A mixture of equal quantities of methyl alcohol and acetone having been found to be the best solvent for the purpose, 600 grammes of seed powder representing on an average about 4,000 units of active material

were thoroughly extracted in a Soxhlet apparatus. The solution thus obtained was concentrated and the concentrate was 20 per cent. of the original material. It was as active as the seed powder itself and therefore contained all the insecticide.

Solvent fractionation of this concentrate was now attempted. Ice-cold acetone or ice-cold methyl-alcohol followed by ether only tended to divide the active material as all the fractions were distinctly less active than the original extract. Fractionation with other solvents like benzine, petrol, also proved equally ineffective. It was, however, observed that these several fractions when combined together, regained their original activity. This indicated that either the toxic substance was sparingly soluble in most single solvents or that the toxicity was due to a group of substances. This latter supposition is supported by the latest work on this subject at Rothamstead.

Fractionation by solvent action having proved unsatisfactory, attempts are now in progress to separate the active material from extraneous matter by, among other things, (1) fractional distillation under reduced pressure, and (2) by treatment with alcoholic solutions of Sodium Carbonate and bi-carbonate, and by alternating both these treatments. The latter method has given a fraction which is considerably more concentrated than the original extract and retaining all its activity. This concentrate is now being further fractionated. It is hoped to be able to separate the substance or groups of substances in the course of the next few months when a detailed account of the work will be submitted in a form ready for publication.

During the course of these experiments, several fatty bodies have also been obtained. These are feebly active by themselves but acquire comparable activity on conversion into soap. These several fractions are also being studied. It is hoped to present a detailed account of these substances during the course of the year.

*Mundulea suberosa* about which mention has been made, earlier, was the second plant material taken for examination. Bark from the roots and stems of this plant was dried, powdered and extracted in a Soxhlet in the usual manner. Methyl-alcohol was found to be the best solvent in this case, with acetone a good second. The extract was as active as the original substance and showed the Durham rotenone colour reaction, thus indicating that the extract contained rotenone or a related substance. The extract also exhibited deterioration of activity on keeping, characteristic of this group of substances. Further fractionation with ether and acetone—a method adapted for rotenone—did not however yield any pure or simple substance,—the fractions all giving resinous oily residues. Furthermore these several fractions were all specific in their activity and definitely limited in their use. Again, it was found that extracts prepared under the same conditions from several different batches of material were not uniformly active, suggesting that the concentration of the active material in the substance was definitely subject to seasonal and environmental conditions. Because of these several disadvantages, work on *Mundulea suberosa* has been temporarily suspended till the separation of the active substance from *Tephrosia* has proceeded further. In view, however, of the easy availability of this plant and also of its active material being possibly related to rotenone, it is proposed to continue the work on this substance. A further detailed report will in due course be submitted.

In concluding, we would like to place on record the efficient manner in which Mr. M. Puttarudriah, B.Sc. (Hons.), Junior Assistant Entomologist and Mr. K. Lakshminaravana Bhatta, B.Sc., Junior Assistant Chemist, have discharged their respective duties. We would like to express also our appreciation of good work turned out by the Field and Laboratory Staff.

B. KRISHNAMURTI,  
Acting Entomologist.

NARAYANAN,  
Senior Assistant Chemist

## APPENDIX LXVIII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 29th January 1936, on Subject No. 46 (a):—Annual Report of the office of the Agricultural Marketing Adviser to the Government of India for the year 1935.**

The attached Report (Enclosure) submitted by the Agricultural Marketing Adviser to the Government of India for the year 1935, is for the consideration of the Advisory Board. The Report will first be discussed by the Marketing Sub-Committee of the Advisory Board whose report will be circulated in due course.

## ENCLOSURE.

OFFICE OF THE AGRICULTURAL MARKETING ADVISER TO THE GOVERNMENT OF INDIA.

## ANNUAL REPORT, 1935.

In accordance with the Government of India Resolution No. F-16-M-1934, the office of the Agricultural Marketing Adviser was established with effect from the 1st January 1935.

The Resolution provided for the appointment of a Central Marketing staff, and made financial provision, through the Imperial Council of Agricultural Research, for the appointment of a nucleus Marketing Staff in each of the Provinces. The work to be undertaken by the Central Marketing Staff, in conjunction with Provincial Marketing Staffs was divided into three main divisions, *viz.*, (1) Investigation work, (2) Development work, and (3) Work on Grade Standards.

Briefly according to the terms of the Resolution, the investigation work should consist of a series of marketing surveys with immediate reference to the more important commodity groups, *viz.*, Cereals, Oilseeds, Special Crops, Dairy Products and Livestock. The survey should include also certain general questions, *viz.*, regulated markets, marketing organisation, the problems of transportation, storage and preservation of the commodities dealt with, standardisation of containers, etc.

Development work should in general aim at the more extensive use of agreed commodity standards, the elimination of waste and the better organisation of producers for marketing purposes.

Headquarters work on grade standards should be mainly of a technical character relating to the chemical and physical characteristics of such products as oilseeds, grain, fruit, etc., and the testing of grading technique and equipment under practical conditions.

Work connected with the execution of these surveys should be shared between the Central and Provincial Marketing Staffs, and the planning of the surveys, compilation of data and preparation of the reports would fall mainly on the Central Staff.

The marketing surveys, when completed, should depict the present system of marketing the commodities, not only in each of the Provinces separately but in relation to inter-State, inter-Provincial and foreign trade so as to provide an all-India picture of existing conditions and a common basis for future progress. The report on each survey, to be complete, should set out in precise technical detail, definite suggestions for standard

grades, containers, handling, methods of packing, contract conditions, etc., and without committing either the Central Government or Local Governments, should formulate proposals regarding any improvements in marketing organisation which may appear to be necessary and practicable.

*Central Office and Staff.*—The office was opened on the 15th January at the Old Secretariat Buildings, Delhi. The appointment of three Senior Marketing Officers, three Marketing Officers and twelve Assistant Marketing Officers was finally sanctioned, and all of them joined during the month of February 1935. Of the seventeen members of the Ministerial Staff which were sanctioned, the Superintendent, three Assistants and four others joined before the end of January, and others in the course of the year.

*Local Marketing Staffs.*—Forty-four full-time Marketing Officers were appointed in the Provinces before the end of the year. Of these, 32 Assistant Marketing Officers were provided out of funds sanctioned by the Imperial Council of Agricultural Research, and the remaining 12 viz., 9 Senior Marketing Officers and 3 Assistant Marketing Officers were provided out of local funds.

The 9 Senior Marketing Officers appointed by Provincial Governments and 15 Assistant Marketing Officers had joined by the first week in April, another 13 Assistant Marketing Officers by the end of June and the remaining 7 by the first week in August.

In Indian States and Minor Administrations 29 full-time Marketing Officers were appointed. Of these 7 had joined by the end of August 11 joined during the month of September and the remainder before the close of the year.

The full-time local Marketing Officers in Provinces and States number 73. These, in conjunction with the Agricultural Marketing Adviser and Central Marketing Officers make a total of 92 full-time Officers working throughout India and Burma. In addition 223 officers were nominated to deal with marketing questions in the smaller Indian States and Minor Administrations. A list of the Marketing Officers in all the Provinces and States was prepared and published. About 400 copies were issued to the parties concerned.

In agreement with the respective Governments the local Marketing Staff in the Provinces and major States undertake marketing survey work also in respect of those Minor Administrations and States which adjoin or fall within their borders. The number of such States is approximately 120, leaving 210 minor States and Administrations to be dealt with by the Central Marketing Staff direct. There remains outstanding a number of very small States whose trade, in the opinion of the Agents to the Governor-General concerned, is not sufficiently significant to warrant special marketing investigation.

The Marketing Officers concerned cannot be expected to find time to execute this auxiliary survey work in complete detail. It is, however, anticipated that they will be able to collect enough information to round off the local surveys and ensure that there are no vital gaps in the final all-India reports.

*Programme of Work.*—A Conference of the Central Marketing Staff and Senior Marketing Officers in Provinces and Indian States was held at Delhi from 5th to 9th March 1935. This Conference passed draft synopses in respect of the following commodities:—Rice, Wheat, Linseed, Groundnuts,

Tobacco, Fruits, Milk, Eggs, Livestock, Hides and Skins, and also draft synopses for a report on Fairs, Markets and Produce Exchanges in India and one on co-operative Marketing by Producers in India. At the same time questionnaires were passed indicating the type of information to be sought from the different groups of persons concerned in handling the various commodities.

The Conference also agreed to the issue of certain rules for the guidance of Marketing Officers in their work. These rules have been generally adopted by Local Governments and were published along with the List of Marketing Officers.

A note on the Proceedings of the Delhi Conference and a copy of the draft synopses and questionnaires was published. About 800 copies were issued to the parties interested.

So far as headquarters work on grades standards was concerned, arrangements were made in the course of the year for the analysis of commercial samples of linseed to be carried out by the Harcourt Butler Technological Institute, Cawnpore. Similar work for groundnuts was undertaken by the Oilseeds Specialist, Government of Madras, at Coimbatore. Arrangements were made for the analysis of wheat at the Punjab Agricultural College, Lyallpur, and for tobacco at headquarters in conjunction with the Imperial Institute of Agricultural Research. The Rice Research Officers in the Provinces undertook to do the physical analysis of paddy and rice, but certain special work on cooking quality was assigned to the Research Officers at Dacca and Coimbatore.

*Nature of Work.*—In carrying out marketing surveys, and for eliciting primary facts reliance has been placed on personal interviews by Marketing Officers, assisted by a standard list of questions as set out in the Proceedings of the Delhi Conference. There seems no alternative to this method when the information desired is complex and there is reluctance or indifference on the part of the informants. In regard to their business affairs most men are not only indifferent but in many cases definitely hostile to anything in the way of interrogation. They particularly object to putting on paper what in most cases they consider to be private business affairs or secrets. They are not likely, therefore, to give any detailed information of value till their confidence has been secured and they are satisfied regarding the object of the particular enquiry. Their assistance and co-operation cannot generally be secured until the Marketing Officer has made himself intimately acquainted with the personnel and practice of the market place, and until he shows a real practical knowledge of the physical characteristics of the products with which he is concerned.

Apart from personal interviews the enquiries are supplemented by means of questionnaires in cases where it is desirable to obtain statistical information from certain groups of persons, so long as they are reasonably limited in number—for example, exporters, millers or other manufacturers—but generally in such cases the ground has first of all to be covered by means of personal interviews.

The surveys include also the summarising, checking and utilising of secondary information collected by other agencies, for example, official statistics—which are, in many cases, far from being as accurate as they might be—international and railway statistics, and also statistics provided by various Chambers of Commerce and Trade Associations and so on.



In practice the marketing surveys are carried out by the Marketing Officers visiting the centres of concentrated production and also those areas where production is relatively sparse. As a general rule they begin at the producing end and work up gradually to the chief consuming centres. In all areas they interview representative members of different groups of persons concerned in the production and distribution of the commodity affected, for example, producers, wholesalers, manufacturers, railway agents, etc. Each Marketing Officer is responsible for making sure that the sample interviews are suitably representative of all the different groups of persons in the chain of distribution.

Since the main object of the whole enquiry is to secure better prices for the producer a considerable amount of attention must be devoted to ascertaining—from merchants' books and other records—the correct prices obtained by producers and also the prices paid by the ultimate consumer. Not only is it necessary for average prices to be studied in producing and consuming centres, but also the seasonal and periodic movement in the prices. The general price structure has to be analysed by sampling, in each district, a number of representative consignments on the way from producer to consumer so as to see what part of the price margin goes in market charges, merchants' commissions, transport costs, etc. Prices must naturally be associated not only with a certain quantity but also with a certain quality of produce. A price quotation which does not refer to a specific grade or quality of produce is valueless for purposes of comparison. Where a commercial description is used to indicate quality, it is essential to know in what sense the description is applied in different markets. It is for that reason that headquarters work on grade standards, at the moment, is mainly devoted to an analytical examination of thousands of commercial samples of oilseeds, cereals, tobacco, etc., drawn from different parts of India.

*Progress of Work during the year.—(1) Local Marketing Surveys.*—During the year marketing survey work on the above lines and in respect of the commodities referred to were commenced by all the local Marketing Staffs in the Provinces and States. The progress made month by month is reported to the Agricultural Marketing Adviser and submitted to the Imperial Council of Agricultural Research Department. The amount of ground covered before the end of the year depended naturally to a large extent on the date of appointment of the Marketing Staff in each case. In the latter months the local staffs in the Provinces and States were interviewing altogether about 3,000 persons a month in addition to their other work of preparing reports, compiling statistics, preparing crop and stock maps, etc.

*2. Work by Central Marketing Staff.*—The Central Marketing Officers operated in Delhi Province during the month of March in order to learn marketing survey technique, and a draft report in respect of each commodity has since been prepared. The Central Marketing Staff later visited the chief ports to study the export and import trade and paid visits to all the Provinces and major States in order to consult with and assist the local Marketing Staffs in their surveys. In addition they visited 78 Indian States and Minor Administrations to carry out survey work locally. Altogether the Officers of the Central Marketing Staff spent 2,644 days on tour in the course of the year, and covered approximately 3,50,000 miles. Before the end of the year the Central Marketing Staff had compiled most of the statistical data regarding export and import trade and prepared the

first rough draft of the introductory sections of the all-India report on each commodity.

**Headquarters Work on Grade Standards.**—Grain and oilseeds are analysed for refraction (*i.e.*, percentage of impurities, etc.). The physical characteristics are also examined and a chemical analysis for oil and moisture is made in the case of oilseeds, and cooking tests applied in the case of rice. Tobacco samples are examined and classified according to various quality factors, *i.e.*, colour, texture, etc.

During the year 976 commercial samples of wheat had been collected by Marketing Officers and 372 of these had been analysed at Lvallpur. 682 samples of linseed had been collected and 585 analysed by the Harcourt Butler Institute. 145 samples of groundnuts had been received and analysed by the Oilseeds Specialist, Coimbatore. 474 samples of tobacco had been received at headquarters and 403 analysed. Altogether at different centres 498 samples of rice and paddy had been received of which 278 had been analysed.

**General Office Work.**—Up to the end of the year, 9,802 communications had been despatched by the office, and approximately the same number of letters and other communications had been received apart from 4,000 miscellaneous items, such as vouchers, samples, etc. 1,629 graphs, diagrams and photographs had been prepared. In the latter months of the year the typing section average 2,000 foolscap pages per month of typing, and the stenographers averaged 650 pages of shorthand per month. Before the end of the year 1,265 current files had been opened and 545 publications placed in the library.

**Position at the end of the year.**—By the end of the year preliminary marketing survey reports in respect of various commodities had been received as follows:—

| Commodity                  | No. of Provinces. | No. of States. |
|----------------------------|-------------------|----------------|
| Wheat . . . . .            | ..                | 5              |
| Rice . . . . .             | ..                | 3              |
| Groundnuts . . . . .       | 1                 | 2              |
| Linseed . . . . .          | 1                 | 4              |
| Tobacco . . . . .          | 1                 | 1              |
| Fruits . . . . .           | 1                 | 1              |
| Milk . . . . .             | 1                 | 1              |
| Poultry and Eggs . . . . . | ..                | 1              |
| Livestock . . . . .        | ..                | 1              |
| Hides and Skins . . . . .  | ..                | 1              |

At the Delhi Conference it was agreed that local survey in respect of the commodities which are being surveyed this year should be completed by the end of March 1936.

Progress reports received from the local Marketing Staffs seem to indicate that the actual survey work in most cases will be completed by the agreed date, although in some instances the reports may be a little later.

At the meeting of the Indian Coffee Cess Committee at Bangalore in November 1935, arrangements were made to appoint a Marketing Officer for Coffee and to attach him to the Office of the Agricultural Marketing Adviser. This Officer was appointed and commenced work towards the close of the year.

*Future Programme.*—A tentative programme of marketing survey work, as per copy attached, was sent out U/O by the Agricultural Marketing Adviser to the Senior Marketing Officers in Provinces and Major Indian States. The extent to which the programme can be adhered to must depend very largely on the number of Marketing Staff and the amount of development and incidental work which the local Marketing Officers may be called upon to do, and representations have already been received from various quarters that the programme as outlined is beyond the capacity of the existing local staffs, within the time indicated.

The programme should, therefore, be regarded only as indicating the commodities which it is proposed to deal with in the near future, and the proposed sequence in which the surveys will be carried out. It should not be in any way considered as a strict time-table of events.

It is intended that in future headquarters work on grade standards will continue for another year on more or less the same lines, but will, naturally be related to the new products under survey. So far as development work is concerned the Agricultural Marketing Adviser has under consideration certain specific proposals which have been formulated by the Central Marketing Staff, as a result of the preliminary investigation work. These proposals, if followed up, are designed to lead to early adoption by the trade of contract standards for grain and oilseeds—particularly in regard to 'futures' contracts.—and also for raw hides and skins and leather. Other proposals related to the establishment at certain centres of grading and packing stations for eggs and fruits. It is not possible, however, to proceed further with those proposals until their financial implications are examined and until they have received the consideration of the other interests concerned without whose co-operation it would not be possible to put them into effect.

*Tentative programme of Marketing Surveys.*

| Subjects               | Commencement of local surveys | Completion of local surveys | Submission of reports by Central Marketing Staff |
|------------------------|-------------------------------|-----------------------------|--|
| 1                      | 2                             | 3                           | 4  |
| <i>Cereals</i>         |                               |                             |  |
| Wheat . . . . .        | ..                            | January 1936                | June/July 1936.                                  |
| Rice . . . . .         | ..                            | March 1936                  | Aug./Sept. 1936                                  |
| Barley . . . . .       | March 1936                    | January 1937                | } Aug./Sept. 1937                                |
| Gram . . . . .         | March 1936                    | January 1937                |  |
| Maize . . . . .        | September 1936                | May 1937                    | Oct./Nov. 1937                                   |
| <i>Oilseeds</i>        |                               |                             |  |
| Linseed . . . . .      | ..                            | December 1935               | June/July 1936                                   |
| Groundnuts . . . . .   | ..                            | February 1936               | Aug./Sept. 1936                                  |
| Coconuts . . . . .     | February 1936                 | January 1937                | July/Aug. 1937                                   |
| Mustard-seed . . . . . | } March 1936                  | March 1937                  | } Sept./Oct. 1937                                |
| Rape-seed . . . . .    |                               | March 1937                  |  |
| Toria . . . . .        | } February 1936               | January 1937                | } May/June 1937                                  |
| Castor-seed . . . . .  |                               | March 1936                  |  |

| Subjects   | Commencement<br>of local surveys | Completion<br>of local surveys | Submission of<br>reports by<br>Central Marketing<br>Staff |
|--|----------------------------------|--------------------------------|---|
| 1  | 2                                | 3                              | 4   |
| <i>Fruits and vegetables</i>   |                                  |                                |   |
| Grape . . . . .  | ..                               | January 1936 . . .             | March 1936  |
| Banana (Plaintain)   | ..                               | February 1936 . . .            | May 1936  |
| Pineapple . . . . .  | ..                               | April 1936 . . . . .           | June 1936   |
| Stone fruits and small<br>fruits . . . . .   | ..                               | May 1936 . . . . .             | September 1936  |
| Apple and other Pome<br>fruits . . . . .   | ..                               | June 1936 . . . . .            | October 1936  |
| Oranges and other citrus<br>fruits . . . . .   | ..                               | October 1936 . . . . .         | December 1936   |
| Potato . . . . .   | November 1935 . . .              | February 1937 . . .            | April 1937  |
| Papaya . . . . .   | February 1936 . . .              | December 1936 . . .            | March 1937  |
| Mango . . . . .  | March 1936 . . . . .             | July 1936 . . . . .            | August 1936   |
| Litchee . . . . .  | March 1936 . . . . .             | April 1937 . . . . .           | June 1937   |
| Guava, Roseapple and<br>other Eugenia . . . . .  | April 1936 . . . . .             | November 1936 . . .            | January 1937  |
| Melons . . . . .   | May 1936 . . . . .               | March 1937 . . . . .           | May 1937  |
| Peas and Beans . . . . .   | May 1936 . . . . .               | May 1937 . . . . .             | July 1937   |
| Pomegranates . . . . .   | June 1936 . . . . .              | April 1937 . . . . .           | August 1937   |
| Custard apple and other<br>Anonas . . . . .  | June 1936 . . . . .              | October 1937 . . . . .         | December 1937   |
| Sapodilla (Chikko) . . . . .   | December 1936 . . .              | September 1937 . . .           | November 1937   |
| Tomato . . . . .   | December 1936 . . .              | ..                             | ..  |
| <i>Special crop</i>  |                                  |                                |   |
| Tobacco . . . . .  | ..                               | January 1936 . . . . .         | April 1936  |
| Coffee (on completion of<br>tobacco survey).   | ..                               | ..                             | ..  |
| <i>Animal husbandry and dairy products</i>   |                                  |                                |   |
| Eggs . . . . .   | ..                               | January 1936 . . . . .         | May 1936  |
| Cattle . . . . .   | ..                               | February 1936 . . . . .        | June 1936   |
| Milk (including condensed<br>and dried) . . . . .  | ..                               | March 1936 . . . . .           | July 1936   |
| Hides and Skins . . . . .  | ..                               | April 1936 . . . . .           | August 1936   |
| Fish and Prawns . . . . .  | January 1936 . . . . .           | February 1937 . . . . .        | July 1937   |
| Sheep and Goats . . . . .  | February 1936 . . . . .          | March 1937 . . . . .           | June 1937   |
| Ghee and Butter . . . . .  | March 1936 . . . . .             | April 1937 . . . . .           | September 1937  |
| Wool and Hair . . . . .  | April 1936 . . . . .             | May 1937 . . . . .             | August 1937   |
| Table poultry and poultry<br>products . . . . .  | February 1937 . . . . .          | January 1938 . . . . .         | April 1938  |
| Bee and bee products<br>(honey and wax) . . . . .  | February 1937 . . . . .          | February 1938 . . . . .        | May 1938  |
| Meat (Meat, casings,<br>bones, lard, manures,<br>etc.) . . . . .                         | March 1937 . . . . .             | November 1937 . . . . .        | February 1938   |
| Pig and pig products . . . . .   | March 1937 . . . . .             | February 1938 . . . . .        | June 1938   |
| Dairy products (cream,<br>Mows, Chenna, Curd,<br>Casein, Cheese,<br>Margarine) . . . . . | April 1937 . . . . .             | March 1938 . . . . .           | May 1938  |

**Subject No. 46(a).—Supplementary.**

OFFICE OF THE AGRICULTURAL MARKETING ADVISER TO THE  
GOVERNMENT OF INDIA, OLD SECRETARIAT BUILDINGS.

Delhi, the 15th February 1936.

MARKETING NOTES—JANUARY 1936.

*A.—Central Marketing Staff.*

During the month the Agricultural Marketing Adviser visited Indore to address the Indian Science Congress on 'agricultural marketing' and to discuss with the Prime Minister the question of appointing a separate full-time marketing staff in the State.

The annual report on the work of the office for 1935 (copy attached) was prepared.

The marketing staff in all sections were engaged generally on compilation work connected with their respective all-India reports. Messrs. Thomson, Shah and Prasad also arranged a number of baking tests of various wheat flours and attas and cooking tests on the main types of rice marketed in Delhi. Mr. Bhargava visited Nabha and Mr. Chetty left on tour in the United Provinces towards the end of the month. Dr. Shirname visited important trade and tobacco manufacturing centres in the Punjab. Mr. Javarava visited Sind and Jodhpur, and along with Mr. Khan attended the Fruit Show at Lahore. Examination of fruit samples was continued and new types of returnable fruit containers were tried. Mr. Samuel visited Cawnpore, Calcutta and Rangoon. At Cawnpore, he arranged for the analyses of samples of wet and wet salted hides from Central and Southern India. The draft synopsis of the marketing of fish in India was prepared and copies supplied to all the Provinces and major States.

Mr. Gopala Menon the Assistant Marketing Officer for coffee appointed by the Coffee Cess Committee joined at Headquarters on 21st January and started collecting data for the Delhi Province. A synopsis for the coffee marketing report was prepared. Mr. Y. T. Desai discussed co-operative marketing in N. W. F. P. and Kashmir with the Provincial Marketing Officer and the Director of Agriculture respectively, during their stay at Delhi.

*Crop and Stock Atlas. Rules and Regulations, etc.*—The local crop and stock maps were received from Jind. The compilation of an all-India map in respect of wheat and linseed was taken in hand.

*Headquarters work on Grade Standards.*—Arrangements have been made with Messrs. Cooper Allen & Co., Cawnpore, for an analysis to be made of wet salted hides. Certain export firms have also undertaken analysis work in regard to skins. Altogether 665 samples were received for examination during the month. Details regarding the various commodities are shown on attached table.

*List of Marketing Officers.*—Page 14, under Punjab States Agency. Delete the entry in respect of Jind.

*B. (I).—Provinces and Minor Administrations.*

*Madras.*—Surveys were conducted and over 60 persons interviewed for rice, tobacco, fruits, milk, eggs, livestock and hides and skins in East and West Godavari, Guntur, Cuddappah, Kurnool, Bellary, and Anantapur districts. Statistics regarding groundnuts were compiled. Large quantities of groundnuts and groundnut oil are exported from the Presidency. 3,50,000 maunds of tobacco are despatched from Guntur which is the largest exporting centre. At Koduru the newly started Fruit Growers' Association and the Fruit Research Station received special attention. Preliminary reports on the marketing of wheat and linseed were compiled and those for groundnuts and eggs were under preparation.

*Bombay.*—Surveys in regard to the ten commodities under survey this year were continued. In all 16 places (including Sangli, Miraj and Kolhapur States) were visited and 232 persons interviewed. The co-operative societies at Nipani and Sangli and the Belting Factory at Miraj received special attention. Pandharpur is an important centre for manufacturing snuff tobacco.

*The writing of preliminary reports was commenced.*

*Sind.*—January report not yet received. In December, surveys for groundnuts, linseed, tobacco and fruits were conducted in Karachi City, Groundnut is not grown in Sind. The imports of foreign linseed oil are declining. Beedies are gradually giving place to cigarettes. Indian tobacco is given flavour by mixing foreign tobacco. The trade in furs and fancy skins received special attention.

*Bengal.*—January report not yet received.

*United Provinces.*—Surveys were conducted and over 100 persons interviewed in 10 districts for wheat and rice; in 4 districts for oilseeds; in 8 districts for tobacco; in 5 districts for fruits; and in 6 districts for milk, eggs, cattle, hides and skins. Three oil mills, one factory for making chewing tobacco (Shahjahanpur), the Agricultural Institute Naini, the Moradabad Trading Association dealing in "Futures", the Chandausi Chamber of Commerce and the Ardbkumbhi Mela (which is held once in six years) Allahabad were also visited. Benares market is an important fruit distributing centre for eastern stations of the province.

*Punjab.*—The whole month was spent at Headquarters in writing the final reports which are nearing completion. The Assistant Marketing Officer for fruits visited Jullundur and Amritsar.

*Central Provinces.*—Surveys in regard to rice, groundnuts, linseed, tobacco, milk, eggs, cattle, hides and skins and potatoes were carried out. In all 24 places including Nandgaon, Khairagarh, Chhuikhadan, Kawardha, Baster, Kanker, Kondagaon and Bhandpuri States were visited. Rajnandgaon, Dhamtari, Drug and Raipur have well organised "ganjs" (markets) owned and controlled by the respective Municipalities. Baster exports more than 8,000 heads of cattle every year. Hide cess is levied in Rajnandgaon and Khairagarh States.

*Bihar and Orissa.*—Almost the whole month was spent in compilation of material for wheat, tobacco and egg reports, the drafting of which is nearing completion. A statement showing the various weights and measures prevalent in the Province was prepared. The Khagra (Kishanzani) Cattle Fair, one of the biggest fairs of the Province, received special attention.

Thousands of cattle and also elephants, horses, goats, sheep, etc., are brought to the fair from distant places and business of every kind is transacted.

*Assam.*—Marketing surveys were completed for wheat in Sibsagar district and Manipur State; for tobacco and fruits in Sylhet and Cachar districts; and for eggs, milk, and hides and skins in Assam Valley. Tobacco survey was also undertaken in Manipur State. Compilation of preliminary reports on linseed, tobacco and eggs was taken up.

*North-West Frontier Province.*—Surveys in regard to wheat, linseed, rice, tobacco, fruits, eggs, cattle, and hides and skins were continued. Special attention was given to the weekly fairs for cattle and fur skins at Peshawar and Pabbi and to the Takhat Bhai Market (for grains). Preliminary reports on the marketing of tobacco, linseed and fruits were under preparation. (Cf. Reports for December 1935, and January 1936).

*Burma Coorg.*—January reports not yet received.

#### B. (2).—Indian States.

*Kashmir (including Jammu).*—January report not yet received. During December data regarding milk and milk products were collected from dairies in Srinagar. Reports on the marketing of wheat, linseed, fruits, eggs and poultry, and hides and skins were under compilation.

*Patiala.*—Surveys regarding fruits and hides and skins were continued. First reports on the marketing of wheat and linseed were completed, while those for groundnuts, tobacco, grapes, eggs and livestock were nearing completion. Figures for area under potatoes were being collected.

*Jind.*—The Central Staff has taken over the marketing work of Jind State, so far as it relates to the 10 commodities at present under investigation.

*Baroda.*—Surveys in regard to all commodities selected for this year were continued. In all 19 places were visited and 318 persons interviewed. Randheja Market exports 15,000 to 20,000 bags (50 to 60 lbs. each) of tobacco every year. At Dohgam there is an association of Mochis whose members are prohibited from importing made-up shoes. Each family prepares about 600 shoes and slippers. Preliminary reports on wheat, linseed and eggs were under preparation.

*Hyderabad.*—Marketing surveys in regard to the commodities under survey this year were continued. Over 30 places were visited and 100 persons interviewed. The Cattle Fairs at Deoni and Udgir were attended. Information regarding coffee and statistics for wheat and linseed were collected.

*Mysore.*—Surveys regarding rice, groundnuts, tobacco, and fruits were continued. In all 16 places were visited and about 60 persons interviewed. Statistics of exports of tobacco and exports and imports of fruits were collected.

*Cochin.*—Surveys in regard to rice, tobacco, grapes, milk and cattle were conducted in 9 places and about 30 persons interviewed. Preliminary report on eggs was completed and those for tobacco, grapes and cattle were under preparation.

*Travancore.*—Four places were visited and about 15 persons interviewed with regard to marketing surveys of wheat, fruits (pine-apple), groundnuts and eggs. Eggs valued about 3 lakhs rupees are exported annually. Statistics were compiled for the report on wheat, which is a very minor crop.

*Pudukottai.*—Surveys in regard to rice, tobacco and hides and skins were continued and about 50 persons interviewed. Preliminary report on the marketing of rice was under preparation.

*Alwar.*—Certain export figures in respect of the state were furnished.

*Bhopal.*—No progress report has so far been received for the last 5 months.

*C.—Headquarters work on Grade Standards: January 1936.*

| Centre of Examination                                 | No. of samples received | No. of samples examined | Balance on hand   | Progressive Total |          | Remarks  |
|---|-------------------------|-------------------------|-------------------|-------------------|----------|--|
|   |                         |                         |                   | Received          | Examined |  |
| <i>Wheat</i>  |                         |                         |                   |                   |          |  |
| Punjab Agricultural College, Lyallpur                 | 186                     | *130                    | 650               | 1,162             | *512     | }  |
|   |                         | †27                     |                   |                   | †174     |  |
| <i>Linseed</i>  |                         |                         |                   |                   |          |  |
| Harcourt Butler Technological Institute, Cawnpore     | 28                      | *125                    | ‡45<br>‡95<br>‡60 | 710               | *710     | }  |
|   |                         | ‡40‡                    |                   |                   |          |  |
|   |                         |                         |                   |                   |          |  |
| <i>Groundnuts</i>                                     |                         |                         |                   |                   |          |  |
| Oilseeds Specialist, Government of Madras, Coimbatore | 45                      | 45                      | Nil               | 190               | *190     | }  |
|   |                         |                         |                   |                   | †140     |  |
| <i>Tobacco</i>  |                         |                         |                   |                   |          |  |
| Headquarters  | 41                      | 49                      | 63                | 515               | 452      |  |
| <i>Wet Salted Hides</i>                               |                         |                         |                   |                   |          |  |
| Messrs. Cooper Allen & Co., Ltd., Cawnpore            | ...                     | ...                     | ...               | ...               | ...      | Samples are not due to arrive until 15th of February 1936. |

\* For physical examination.

† For Chemical analysis.

‡ For oil and moisture content.

§ For oil content.

¶ For moisture content.

‡ Samples of oils.



## C.—Headquarters work on Grade Standards: January 1936—contd.

| Centre of Examination                                    | No. of samples received | No. of samples examined | Balance on hand | Progressive Total |            | Remarks  |
|--|-------------------------|-------------------------|-----------------|-------------------|------------|--|
|  |                         |                         |                 | Received          | Examined   |  |
| <i>Rice and paddy</i>                                    |                         |                         |                 |                   |            |  |
| Crop Botanist, Government of Bombay, Karjat              | 56                      | 25                      | 31              | 108               | 72         |  |
| Economic Botanist, Government of Bengal, Dacca           | 138                     | 72<br>*22               | 66              | 138               | 72<br>*22  |  |
| Paddy Specialist, Government of Madras, Coimbatore       | Nil                     | 10<br>*42               | Nil             | 114               | 114<br>*42 |  |
| Assistant Cerealist, Punjab, Kalashah Kaku               | 71                      | 50                      | 67              | 117               | 50         |  |
| Assistant Paddy Specialist, U. P., Nagina                | 46                      | ...                     | 46              | 50                | 4          |  |
| Rice Research Scheme, C. P., Raipur                      | Nil                     | 11                      | 47              | 82                | 35         |  |
| Economic Botanist, Assam, Jorhat                         | 21                      | 21                      | 50              | 130               | 80         |  |
| Paddy Specialist, E. & O., Sabour                        | †                       | †                       | †               | 99                | 56         | For December 1935. Report for January 1936 not received.                   |
| Paddy Specialist, Burma, Rangoon                         | †                       | †                       | †               | Nil               | Nil        | For November 1935. Report for December 1935 and January 1936 not received. |
| Agricultural Research Station, Sind, Sakrand             | 32                      | 18                      | 15              | 66                | 51         |  |
| Crop Specialist, Hyderabad, Deccan                       | †                       | †                       | †               | 13                | Nil        | For November 1935. Report for December 1935 and January 1936 not received. |
| The Industrial and Testing Laboratory, Mysore, Bangalore | †                       | †                       | †               | Nil               | Nil        | For November 1935. Report for December 1935 and January 1936 not received. |
| Total  | ...                     | ...                     | ...             | 912               | 584<br>*64 |  |

\* Cooking rests.

† Reports not received.

## APPENDIX LXIX.

**Note by the Secretary, Imperial Council of Agricultural Research, dated 27th January 1936, on Subject No. 46 (b):—Note by Mr. R. G. Allen, regarding rate of progress of market Surveys and Adequacy of Funds and Staff.**

Attention is invited to the papers that were circulated to the Advisory Board at its meeting held in September 1934, on the subject of "Marketing" (*vide* pages 538-565 of the printed proceedings).

2. In pursuance of the recommendations of the Royal Commission on Agriculture in India and the Central Banking Enquiry Committee as endorsed by the Provincial Economic Conference, 1934, the Government of India decided to embark on a comprehensive marketing scheme. This included, *inter alia*, the appointment of a Central Marketing Staff, the appointment of Provincial Marketing Officers, and the inauguration of marketing surveys in respect of selected commodities. The Central Staff has since constituted a separate office of the Government of India. As regards the provincial side, it was, strictly speaking, for the local Governments to take such steps as they deemed fit to take advantage of the Scheme. The Government of India, however, recognised the necessity for providing funds in the initial stages for the appointment of a *nucleus* staff in the various provinces, so that the All-India Surveys might not be left incomplete for want of financial provision in any of the provinces through the inability of particular provinces to finance their share of such surveys.

3. Subject to the vote of the Legislative Assembly, the Government of India agreed to make to the Council a grant of Rs. 2 lakhs per annum for five years to be distributed among the provinces for the marketing work. The question as to the allocation of funds to the several provinces was first discussed at the Crop Planning Sub-Committee in June 1934, and it was considered that the funds should be distributed on a flat rate basis but that Assam and North West Frontier Province should each receive half the amount of the grant to be allotted to the bigger provinces. It was also agreed to regard Sind as a special case and treat it as a separate major province for the purpose of the grants. The Advisory Board at its meeting in September 1934, considered the provincial proposals and accepting the principle just mentioned recommended that each of the major provinces (including Sind) should receive a maximum average grant of Rs. 20,000 and Assam and North-West Frontier Province Rs. 10,000 each. There was no intention that the Imperial Council of Agricultural Research should meet the whole expenditure connected with the local Marketing staff. On the other hand, it was expected that if the needs of particular provinces warranted the appointment of additional staff beyond that mentioned in the schemes submitted, funds should be found by the local Governments concerned. The recommendations of the Advisory Board were accepted by the Governing Body in January 1935 and money is being paid to the provinces in the usual manner.

4. As indicated in the Imperial Council of Agricultural Research Department Resolution of 10th January 1935, Survey work started with five groups, *viz.*, Cereals, Oilseeds, Plantation and Special Crops, Daily products and Livestock. The number of commodities for immediate survey

was fixed at ten at a Conference of the Central and Local Marketing Officers held at Delhi in March 1935. These are wheat, rice, linseed, groundnuts, tobacco, fruits (oranges, apples and bananas), milk, eggs, cattle and hides and skins. It was agreed that the Surveys for these should be completed before March 1936.

5. A representation regarding the start and funds allotted to the United Provinces has been received from Mr. R. G. Allen (then Director of Agriculture, United Provinces) a copy of which (letter of 17th October 1935) is attached. As Mr. Allen considered that his difficulties were common to several provinces the Vice-Chairman has decided that the representation should be placed before the Advisory Board for consideration and that it should first be examined by a Sub-Committee consisting of the Vice-Chairman, Agricultural Expert, Animal Husbandry Expert, Agricultural Marketing Adviser to the Government of India, Sir C. V. Mehta, K.C.S.I., Diwan Bahadur T. Raghaviah, C.S.I., Mr. E. J. Bruen, Livestock Expert, Bombay, three senior marketing officers and those Directors of Agriculture and Veterinary Services who administer marketing schemes in the various provinces.

COPY OF A LETTER No. 6318 (a) I-97-B., DATED THE 17TH OCTOBER 1935, FROM THE DIRECTOR OF AGRICULTURE, UNITED PROVINCES, LUCKNOW, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, SIMLA.

I have the honour to inform you that I have addressed every Director of Agriculture on the subject of the present marketing survey as is being attempted in the Provinces and we are unanimously of the opinion that the staff and provision made by the Imperial Council of Agricultural Research is hopelessly inadequate for the far too ambitious and extensive programme, as designed by the Chief Marketing Officer as the work for the present or next year and that either this survey must be cut down very considerably or the Imperial Council of Agricultural Research must find money to provide assistants and more travelling allowance for the marketing staff. The programme of work, the character of the questionnaire and the added calls such as detailed studies of railway shipments, have been drawn out without sufficient consideration of the conditions prevalent and either these demands must be modified or the staff must be strengthened to meet a programme which, though calling for about 4 years work, is being attempted to be pressed into two. The results can only be unsatisfactory. Few of us are in a position with other calls on the time of our district staff to provide special assistants to help these officers and even the help provided by the district staff when the marketing staff visit a district, is being provided in many cases, because of the character of the demands, to the detriment of the work for which local Governments provided these men.

Though I propose to bring this matter and the whole scheme, as it is now being worked, for consideration of the Advisory Board at its next meeting, I am lodging the present protest, as on the grant of the present year. I am certain, as are other officers in-charge of Provincial Departments, that the marketing survey cannot be effectively done and that its only outcome will be either inadequate data or what is worse incorrect or inadequately digested and sifted data.

## APPENDIX LXX.

Imperial Council of Agricultural Research Advisory Board, thirteenth meeting, February 1936, Subject No. 46 (a) & (b):—Report of the Marketing Sub-Committee which met at New Delhi on the 12th February 1936.

## PRESENT.

1. Mr. N. C. MEHTA (*Chairman*).
2. Mr. A. M. LIVINGSTONE.
3. Mr. E. J. BRUEN.
4. Mr. W. J. JENKINS.
5. Dr. W. BURNS.
6. Sir C. V. MEHTA.
7. Mr. J. H. RITCHIE.
8. Mr. R. G. ALLAN.
9. Rao Bahadur D. ANANDA RAO.
10. Mr. D. R. SETHI.
11. Mr. G. T. TAIT.
12. Mr. J. C. McDOUGALL.
13. Mr. A. M. MUSTAFA.
14. Professor C. N. VARIL.
15. Dr. J. K. DUBEY.
16. Mr. J. N. CHAKRAVARTY.
17. Mr. NIZAMUDDIN HYDER.
18. Mr. J. CHARLTON.
19. Mr. A. M. THOMSON.
20. Mr. C. B. SAMUEL.
21. Mr. H. C. JAVARAYA.

The Committee had before them.—

- (1) The Annual Report to the Government of India by the Agricultural Marketing Adviser. [Item 46(a) of the Agenda].
- (2) Note by Mr. R. G. Allan regarding rate of progress of market surveys and adequacy of staff and funds. [Item 46(b) of the Agenda].
- (3) Representation from the Assam Government for the increase of staff for the marketing scheme in Assam [Item 46(b) Supplementary of the Agenda] Appendix LXXI.

In regard to the Annual report of the Agricultural Marketing Adviser views were expressed that the report was somewhat general in character and did not sufficiently indicate results so far achieved. While it was recognised that in the present state of the work this was perhaps inevitable, it was desired that subsequent reports should furnish more detailed information as far as possible.

The Sub-Committee also considered the programme of marketing surveys attached to the report and a memorandum circulated by the Agricultural Marketing Adviser in regard to the time-table, along with Mr. Allan's letter. Various Provincial representatives were strongly of the opinion that it was impossible to carry out the programme of work as outlined without additional staff. They felt that if the Provincial reports were to be submitted in accordance with the time-table, the information supplied would be inadequate and possibly inaccurate. It was pointed out however that it was impossible to form any opinion regarding the adequacy of the material which had so far been collected until the reports were in fact submitted.

Difficulties experienced by the local Marketing Staffs in the collection of certain material indicated in the synopses of the reports were explained to the Committee. It seemed clear that certain of the items included in the synopses were specially related to All-India reports and the local Marketing Staff should be informed accordingly.

It was the generally expressed wish that some further guidance might be provided to the local staffs in regard to the form and content of the reports to be submitted by them.

The findings of the Sub-Committee on the points raised were as follows:—

- (1) On the motion of Dr. Burns it was agreed that although in the view of the local Marketing Staff the material collected was not fully adequate, reports should nevertheless be submitted according to the time-table, and that where necessary provinces which were in arrears should be sent reminders.
- (2) On Mr. McDougall's motion the Committee recommended that the points in the synopses, *e.g.*, exports, imports, formulation of recommendations, etc., which can and are to be dealt with specially by the Central Marketing Staff should be noted and local Staffs informed accordingly. Further, the nature of the information to be collected by the Local Marketing Staffs regarding railway traffic, etc., should be clearly specified.
- (3) As a guide to the local Marketing Staffs in preparing their future reports the drafts of the Marketing reports in respect of Delhi Province should be circulated in due course.
- (4) On the motion of Sir C. V. Mehta the committee recommended that any reports which were ready, particularly those for milk and cattle should be submitted to the next Advisory Board meeting and be available for the information of the Committees which are preparing the material for the consideration of the British Specialists whom it is proposed to bring out to India. Further, that in view of the practical difficulties which had been brought to light in the course of the discussion it was desirable that the Marketing Adviser should, at some convenient date, convene a Conference with the Provincial Marketing Officers, to discuss the possibility of simplifying the procedure.

- (5) In regard to the application from Assam the Committee recommended that consideration of this application should be deferred till the next meeting of the Advisory Board in view of the fact that no more funds were at present available.

In the meantime the Sub-Committee wish to put on record their opinion that the funds at present allotted for the purpose are not sufficient to carry out the work adequately in accordance with the present programme and recommend that this question should be put down on the agenda for the next meeting of the Advisory Board for consideration.

NEW DELHI;

13th January 1956.

## APPENDIX LXXI. (a)

**Supplementary note by the Secretary, Imperial Council of Agricultural Research, dated the 8th February 1936, on Subject No. 46(b):—  
Representation from the Assam Government for the increase of staff for the Marketing Scheme in Assam.**

In continuation of the Note on the subject No. 46(b) already circulated the enclosed copy (Enclosure) of letter No. 4377, dated 19th November 1935, from the Government of Assam, asking for a further increase in the staff is submitted to the Special Committee and to the Advisory Board for consideration.

## ENCLOSURE.

COPY OF A LETTER NO. 4377-E, DATED THE 19TH NOVEMBER 1935, FROM THE SECRETARY TO THE GOVERNMENT OF ASSAM, IN THE TRANSFERRED DEPARTMENTS, SHILLONG, TO THE SECRETARY, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

**SUBJECT:—Marketing Enquiry—Increase of Staff for.**

I am directed by the Government of Assam, to invite a reference to this Department letter No. 2270-E., of the 20th October 1934, and to forward an extract from a letter from the Director of Agriculture, Assam, which bears out the apprehensions then entertained that the provision made for staff in Assam would be inadequate for the actual scope of the work expected by the Council. I am to enquire whether the Council would consider an additional grant of Rs. 1.316 for the period December 1935 to March 1936, which is the minimum considered necessary by the Director if the time schedule is to be maintained.

EXTRACT FROM LETTER NO. II. M.-1/3751, DATED THE 2ND NOVEMBER 1935, FROM THE DIRECTOR OF AGRICULTURE, ASSAM, TO THE SECRETARY TO THE GOVERNMENT OF ASSAM, IN THE TRANSFERRED DEPARTMENTS.

I have the honour to address you on the subject of the Marketing survey which is now being conducted in this province. The programme drawn up by the Agricultural Marketing Adviser, and adopted at the Marketing Officers' Conference held at Delhi in March last, requires the survey in regard to certain commodities, *viz.*, Eggs, Milk, Tobacco, Fruits, Groundnuts, Wheat and Linseed, to be finished by the end of December and that in regard to the remaining commodities, *viz.*, Hides, and Skins, Cattle Fairs and Markets, Co-op. marketing, by the end of March 1936. From experience obtained during the last few months it appears quite certain that one Marketing Officer and two Asst. Marketing Officers are quite inadequate to bring the survey to a satisfactory conclusion within the short time allotted if the work is to be completed with the accuracy needed. The survey has to be more extensive than was formerly anticipated as it entails the breaking of much fresh ground and requires detailed supervision. The programme is far too detailed for the small staff and for the conditions prevailing in this province where big markets and organised marketing are almost non-existent and all information has to be collected from the interior. For lack of communication facilities, touring in Assam is difficult particularly during the rains. There are also three hill districts in the province besides the two hilly frontier tracts

and the Manipur State, where protracted touring during the rains is not possible. The work has been divided as follows between the staff:—

- (1) Marketing Officer—General supervision and Cereals and Oil seeds in the Assam Valley.
- (2) One Asst. Marketing Officer—All cattle products including hides and skins.
- (3) One Asst. Marketing Officer—Fruits and vegetables for the whole province and Oil seeds and Cereals in Surma Valley.

I find that there is a very considerable amount of collection and compilation of Statistics and their interpretation which will have to be carried out at Headquarters by the Marketing Officer.

The result is that either the general supervision and the compilation of Statistics, or the enquiry on Cereals and Oil seeds in the Assam Valley, which are our most important crops, will suffer. Similarly one Asst. Marketing Officer cannot satisfactorily deal with fruits and vegetables, in which considerable improvement in marketing can be expected immediately over the whole province, as well as Cereals and Oil seeds in Surma Valley. Moreover it will be impossible for the present staff to visit the Hills at all within the time allotted, as touring in our Hills will probably take one officer nearly a month each. What is really wanted is an additional Asst. Marketing Officer for the Cereals of the whole province, thus relieving the Marketing Officer for supervision and Oil seeds and one Asst. Marketing Officer for fruits and vegetables alone.

In view of the above facts it is clear that either more time should be allowed or the staff should be strengthened immediately so that the work may be finished within a reasonable period. The result of any attempt on the part of the small staff to hustle the enquiry is bound to be unsatisfactory. No development work can be intelligently taken up on the basis of insufficient and inaccurate information which is all a hurried enquiry can provide. The compilation of figures and writing up all the Reports within this short period will also require the assistance of an additional clerk for this period.

I would therefore request you to move the Secretary, Imperial Council of Agricultural Research, to make provision for additional funds for the appointment of an additional Asst. Marketing Officer and a clerk for four months from 1st December 1935. I believe an additional Asst. Marketing Officer will be essential for Assam for the whole period of the enquiry if it is to be done satisfactorily on the lines laid down by the Marketing Adviser to the Government of India. A statement is enclosed herewith showing the amount which will be actually required for four months.

\* \* \* \* \*

**Supplementary grant for Extra Staff in Assam, 1935-36.**

|   | From 1st December<br>1935 to 28th February<br>1936 (3 months)<br>1935-36. | 1936-37<br>March. | Total |
|---|---|-------------------|-------|
| One Assistant Marketing<br>Officer at Rs. 150 . . . | 450   | 150               | 600   |
| T. A. for A. M. O. and his<br>peon at Rs. 125 . . . | 375   | 125               | 500   |
| One Typist at Rs. 40 . . .                          | 120   | 40                | 160   |
| One peon at Rs. 14 . . .                            | 42  | 14                | 56    |
|   |   |                   | 1,316 |



## APPENDIX LXXII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 6th February 1936, on Subject No. 53:—Report on the working of John's disease investigation among the cattle in Mysore, under the Imperial Council of Agricultural Research for the period ending November 1935.**

The report will be considered by the Committee to examine the Bombay scheme for control of ticks and progress reports of Veterinary Investigation Officers, etc., and its report will be circulated to the members of the Board in due course.

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**REPORT ON THE WORKING OF JOHN'S DISEASE INVESTIGATION AMONG THE CATTLE IN MYSORE, UNDER THE IMPERIAL COUNCIL FUNDS FOR THE PERIOD ENDING NOVEMBER 1935.**

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**INTRODUCTION.**

The prevalence of John's Disease among Cattle in Mysore was for the first time noticed in the Palace Dairy Farm at Rayankere in the year 1923. Vaccination against John's Disease, undertaken in 1928-29 under instructions from the Director, Imperial Institute of Veterinary Research, Muktesar, was found unsatisfactory. The Vaccine consisted of live avian tuberculosis bacilli suspended in normal saline. Therefore a system of elimination and segregation of clinically affected Cattle from the Dairy was recommended and is being adopted.

This procedure has reduced the incidence of the disease on the Farm and the spread of infection considerably. No statistical evidence being available regarding the incidence of the disease in Mysore State, it was thought that an intensive investigation was imminent. But, for want of funds this work could not be started. Now that the Imperial Council of Agricultural Research have sanctioned a grant for the purpose, the problem has been taken up for intensive work.

**STAFF AND COMMENCEMENT OF WORK.**

During the last week in January, a special staff consisting:—(1) One Veterinary Inspector, (2) Two Salustries and (3) One laboratory Assistant, all possessing a basic scientific knowledge and professional training, was entertained. Laboratory facilities and a pukka shed for the experimental animals were provided for the work at the Serum Institute. During the month of February the equipment of the Laboratory and such preliminary work as was necessary were completed.

The first batch of experimental animals, consisting of a group of seven clinically affected cows, was obtained from the Palace Dairy Farm, Mysore, early in March 1935 for purposes of a systematic study of the Disease.

Owing to the resignation of the subordinate staff one after the other, to better their prospects elsewhere, there was considerable handicap, particularly as the resulting vacancies could not suitably be filled up for some time and the regular work was commenced only in August 1935.

The programme of work as approved by the Council may be classified into :—

1. Epizootological.
2. Bacteriological and serological.
3. Chemotherapeutical.

#### EPIZOOTOLOGICAL.

Before an epizootological survey is undertaken, it is essential that the diagnostic agents for use on suspicious cases such as Johnin and avian tuberculin should be prepared and made available. Although the Council did not emphasise the preparation of these agents, it was thought that a Johnin prepared from the Local strain would be found of value. An attempt was made and samples of Johnin and avian tuberculin were prepared for comparative study with samples from Europe and America. Maps of Bangalore and Mysore Cities are prepared for the intended survey and it is contemplated to divide the cities into convenient blocks for detailed inspection of Cattle, going from door to door. Data relating to the incidence of the disease and the influence of such factors as Age, Sex and Breed will be collected and recorded. At present, a herd of animals consisting of representative breeds has been built up. Systematic preliminary examinations of blood, faeces, bowel washings and rectal smears have been undertaken and after having satisfied that these animals were free from Johnin's disease as well as other parasitic diseases they have been drenched with infective materials. These artificially infected animals have been divided into groups and each group provides data relating to various factors such as :—

1. Period of incubation,
2. The effect of oil chaulmoogra and its derivatives,
3. Mineral deficiency as a predisposing factor,

with regard to 2 and 3, controls have been maintained.

#### BACTERIOLOGICAL.

The isolation and artificial cultivation on Laboratory media of the local strain of the bacillus of Johnin's disease is undertaken. Primary cultures are obtained from the bowel scrapings and mesenteric lymph glands of the naturally affected cases. The isolation and cultivation of the local strain of the casual organism has been a success, and is being maintained. The following media are being employed for the purpose :—

- (a) Dorsett egg with extract of phlei,
- (b) 2 per cent. nutrient agar with extract phlei,
- (c) Santons synthetic medium.

The following type cultures were obtained from Lister Institute, London, for comparative study :—

1. B. Phlei.
2. B. M. Johni.
3. B. M. tuberculosis (avian).
4. B. M. tuberculosis (bovine).
5. B. M. tuberculosis (human).

B. Phlei has been used to enrich the culture medium employed for the cultivation of the local strain of the M. Johni. Bacillus of Avian, and Human tuberculosis, are employed for the preparation of Tuberculin.

Samples of Johnin and Avian Tuberculin have just been prepared and samples from Europe and America are being asked for, for comparative tests.

#### SEROLOGICAL.

Agglutination and complement fixation tests have just been commenced. The preparation of antigen, amboceptor, etc., are in progress.

#### BIOCHEMICAL.

Biochemical consists of 1. Blood determinations, 2. Analysis of Oil. Chaulmoogra. In addition to the routine hæmatological determination, study as the enumeration of red and white cells, total as well as differential counts, estimation of calcium, phosphorous and sugar will be undertaken.

With regard to the analysis of chaulmoogra oil, necessary references have been collected and it is proposed to arrange for its analysis with a view as study the curative properties of the several derivatives beside the crude oil, as soon as the experimentally infected animals show the symptoms of the disease.

Appendices I to IV will explain the details of systematic Bacteriological and Pathological work undertaken during the period under report.



## APPENDIX II.

*Result of Post-Mortem Examinations performed.*

Seven post-mortem examinations have been conducted so far, of these 4 cases were examined immediately after death. All except one were confirmed as having been in an advanced stage of the disease. A thorough search was made for any microscopical evidence of tuberculosis in all these carcasses, with negative results. In every case it was the routine procedure to make smears from and collect pieces of the following organs. Sections were also cut of the latter and were examined after staining both for histopathological and bacteriological study.

|                                   |     |   |
|-----------------------------------|-----|---|
| 1. Intestinal mucosa . . . . .    | +++ | Ileum, Cæcum and colon without exception, except in one instance. |
| . Following Lymph glands—         |     |   |
| Premaxillary . . . . .            | —   |   |
| Prescapular . . . . .             | —   |   |
| Prefemoral . . . . .              | —   |   |
| Superficial inguinal . . . . .    | —   |   |
| Supramammary . . . . .            | —   |   |
| Mesenteric Lymph glands . . . . . | +++ |   |
| 3. Pancreas . . . . .             | —   |   |
| 4. Liver . . . . .                | —   |   |
| 5. Spleen . . . . .               | ++  |   |
| 6. Kidney . . . . .               | —   |   |
| 7. Lung . . . . .                 | —   |   |

## APPENDIX III.

*The result of Bacteriological examination of such materials that could be collected during life of the animal.*

| Total number of smears examined for the demonstration of acid alcohol fast, antiformin resistant organisms. |                | Number declared positive. |                | Number declared negative. |                | Number doubtful. |                |
|---|----------------|---------------------------|----------------|---------------------------|----------------|------------------|----------------|
| Bowel washing.  | Rectal mucosa. | Bowel washing.            | Rectal mucosa. | Bowel washing.            | Rectal mucosa. | Bowel washing.   | Rectal mucosa. |
| 105   | 105            | 24                        | 32             | 74                        | 73             | 7                | 1              |

NOTE.—Attempts at the demonstration of the bacillus of Johne's Disease in (1) Urine and (2) milk of the animals affected with the disease, have met with negative results so far

## APPENDIX IV.

Result of Allergy tests performed on the affected herd.

| For Tuberculin. |       | Johne's Disease.   |                              | Result of Post-Mortem and Allergy tests logically combined.  |                 |                 |              |
|-----------------|-------|--|------------------------------|--|-----------------|-----------------|--------------|
| Animal.         | Date. | How tested.  | Result.                      | 0.2 c.c. of avian tuberculin intradermally on 22-5-35 followed by the injection of the same quantity at the same place 48 hours after. |                 |                 |              |
|                 |       |  |                              | After 24 hours.  | After 48 hours. | After 72 hours. | Result.      |
|                 |       |  |                              | Thickness.   | Thickness.      | Thickness.      |              |
|                 |       |  |                              | Local reaction.  | Local reaction. | Local reaction. |              |
|                 |       |  |                              | Thickness of the fold of the skin at the time of injection.  |                 |                 |              |
| 1. Cow X2       | .     | All were subjected to a subcutaneous tuberculin test on 17th March 1935. The reaction was studied commencing 9 hours and once in every 3 hours after till the end of 21 hours. | None of the animals reacted. | 7.3 m.m.   | 14.3 m.m.       | 20.7 m.m.       | Living.      |
| 2. Cow K14      | .     |  |                              | 6.8 m.m.   | 10.3 m.m.       | 13.2 m.m.       | +++ Johne's. |
| 3. Cow X65      | .     |  |                              | 8.5 m.m.   | 12.5 m.m.       | 13.6 m.m.       | Living.      |
| 4. Cow 642      | .     |  |                              | 6.0 m.m.   | 14.2 m.m.       | 21.0 m.m.       | +++ Johne's. |
| 5. Bull calf    | .     |  |                              | 6.2 m.m.   | 6.6 m.m.        | 14.9 m.m.       | Living.      |
| 6. Cow calf     | .     |  |                              | 4.6 m.m.   | 6.3 m.m.        | 5.5 m.m.        | Living.      |

The Tuberculin used for the tests was obtained from the Imperial Institute of Veterinary Research, Muktesar.

## APPENDIX LXXIII.

**Note by the Secretary, Imperial Council of Agricultural Research, dated the 31st January 1936, on Subject No. 51:—A note on the planning of complex experiments with special reference to confounding' by the Statistician, Imperial Council of Agricultural Research.**

A note on 'the planning of Complex Experiments with special reference to Confounding' is circulated for the consideration of the Advisory Board.

2. The note will first be considered by the Research Sub-Committee of the Standing Rice Committee and Dry Farming Research Schemes co-ordination Committee.

A NOTE ON 'PLANNING OF COMPLEX EXPERIMENTS WITH SPECIAL REFERENCE TO CONFOUNDING BY THE STATISTICIAN, IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH.

The object of this note is to set forth some suggestions with regard to the layout of 'Complex Experiments'. Such experiments are now becoming very popular but serious defects have been observed in the manner in which they are conducted. It has now been established definitely by Dr. Fisher, Dr. Wishart and others, that complex experiments, intended to elicit information on a number of inter-related points can be made more efficient than simple experiments each involving a single factor only. But defects in the usual types of layout for complex experiments (*i.e.*, where there is a complete randomisation of ultimate treatments in each block) are found to be:—firstly, there are agricultural difficulties in randomising the several treatments (such as say differential irrigations and methods of cultivation), secondly, the block-size becomes very large on account of the large number of ultimate treatments in each block. Apart from the fact that it is difficult for the experimenter to secure sufficient space for the usual layout for a complex experiment, the efficiency itself of the experiment is considerably lowered, owing to a large block-size. Improved methods of layout (and appropriate methods of analysis) have now been devised at Rothamsted to meet both these difficulties, and the paper on 'Complex Experiments' by Yates recently read before the Royal Statistical Society, London, (*vide* J. R. S. S., Vol. II, No. 2, 1935), has opened a very wide scope for adoption of new types of layout. In India we might adopt these new types, with suitable adaptations.

*Split-plot arrangement.*

To minimise the first defect pointed above (*i.e.*, the agricultural difficulty), what are known as split-plot designs are now being used in which the main treatments (A) are separated out in distinct sub-blocks, with the sub-treatments (B) randomised in each sub-block; if there are more than one set of sub-treatments say B, C.....they may either be combined and completely randomised in each block, or may be split up into separate divisions in each sub-block. A very great advantage in these split-plot designs is the agricultural convenience in separating out the several factors, which otherwise complicates the agricultural operations.

A plan of a split-plot arrangement involving three factors is given in the Appendix and also the appropriate method of analysis. It may be seen that while in the case of a completely randomised type of layout there

is only one *error variance* which forms the basis for judging the significance of all effects including interactions, in the case of a split-plot arrangement *different* error-variances should be separately calculated, and each set of factors is associated with its appropriate error. In the latter case, as the *error* of sub-treatments is derived from closely contiguous plots, their comparisons are more accurate than those of main treatments whose *error* is based upon large-sized plots. A distinction should therefore be made between the comparisons of the several sets of treatments, and in general the effects of main treatments alone cannot be conclusive from such methods of layout unless differences between them are sufficiently large. A fair compromise seems to be to have a sub-block-size neither large nor small and to limit the number of sub-treatments in such cases. Assuming, say,  $\frac{1}{2}$  an acre as a suitable sub-block-size and  $1/40$  acre as a plot-size, we can possibly have only 20 sub-treatments.

### 'Confounded Experiments.'

The second defect in the ordinary layout of a Complex Experiment pointed out already is that the block-size becomes unduly large, because of the large number of ultimate treatments included in each block. This defect is remedied by the process of what is known as 'Confounding' explained below. What are known as 'factorial designs' successfully adopted at Rothamsted (where all possible combinations of individual treatments are considered in a single replication) are best suited to this 'process of confounding'. A simple illustration of 'Confounding' is afforded by a  $2 \times 2 \times 2$  factorial design, involving, say, two levels of three fertilisers n, p, k, so that there are on the whole 8 treatments:—control, n, p, k, np, nk, pk, npk (in this case the two levels are 0 and 1). Here the main effects and interactions will be judged by:—

$N$  = average of four responses to n, in presence of p, k, and pk, and in absence of other manures.

$$= \frac{1}{4} [(npk - pk) + (np - p) + (nk - k) + (n - \text{control})]$$

(and similar expressions for P and K). Similarly the first-order interaction NP will be the average of interactions between n and p in the presence and absence of k, and is given by:—

$$NP = \frac{1}{2} \left\{ \frac{1}{2} (npk - nk - pk + k) + \frac{1}{2} (np - n - p + \text{control}) \right\}.$$

The Second-order interaction NPK will be defined as one-half of the difference of the above two interactions and is given by—

$$NPK = \frac{1}{2} (npk - nk - pk + k - np + n + p - \text{control}).$$

Now to explain the principle of 'Confounding', we usually base our estimate of 'error' on interactions involving 'blocks', and its validity therefore depends upon a *sufficient* number of replications, but from experience of experimental data we know that some interactions generally second-order interactions and higher orders (and sometimes even first-order interactions) are very small compared to experimental errors. This point is made use of to reduce the number of replications, and to split each complete block in such a way that the unimportant second-order interactions are confounded (or mixed up) with block differences, while the main effects and the first-order interactions which are important are kept clear of the block-totals. Thus in the case of a  $2 \times 2 \times 2$  design, explained above, the NPK formula consists of 4



positive terms and 4 negative terms. Now if the complete sub-block consisting of all the 8 treatments be split up into two sub-blocks such that the four treatments with + sign are put in one sub-block, and the four with -ve sign in the second, then the second-order interaction is said to be mixed up with block differences, and in the final analysis of variance the second order interaction will be included under 'blocks'. It is also seen that the formula for N, P, K, and NP do not involve such mixing up in the sub-blocks, and are therefore distinctly calculable from them. The plan and the method of analysis in this simple case is given in the Appendix. The same principle is extended to more complicated designs, and in every case from the exact formula to be employed for the several effects we can decide the exact method of confounding to be adopted. It may be added that where there are more than one set of second-order interactions (as *e.g.*,  $3 \times 3 \times 3$  design), either a single set only may be confounded in the several blocks, or the several sets confounded separately each in one of the several blocks; and in the latter case the analysis of variance should separate the 'unconfounded' interactions from those included under 'blocks'.

### Manurial Experiments.

The factorial designs and the method of 'Confounding' explained above are particularly adapted to manurial experiments. In India, the planning of manurial experiments is still not quite satisfactory as has been observed recently by the Fertilisers' Committee of the Imperial Council of Agricultural Research. The general principles on which such planning should be based are, firstly that the effects of the several fertilisers such as n, p, k, and their interactions should be judged, and secondly that the effects of increasing doses of each fertiliser and their interactions should also be assessed. All these different aspects should be brought together in the same experiment, and the layout should be suitably planned. As an example, with 3 levels for each of 3 fertilisers, the factorial design should include  $3 \times 3 \times 3 = 27$  combinations of treatments; of the 8 D.F.'s for second-order interactions, a set of 2 may be confounded in a block of 3 sub-blocks, or if replications are possible, the four different sets of 2 D.F.'s each may separately be confounded in four blocks of 3 sub-blocks each. In judging the main effects, it seems necessary to split up 2 D.F. for each of the main effects into (1) 1 D. F. for *Linear* response (*i.e.*, the effect of highest dose—the effect of smallest dose or control), and (2) 1 D. F. for deviation from linear response. The plan and method of analysis for a 'Confounded Experiment' for a  $3 \times 3 \times 3$  design is given in the Appendix.

### Summary.

The object of this note is to emphasise the importance of what are known as 'Confounded Experiments' successfully adopted at Rothamsted, which are intended to remove, on one hand, the agricultural difficulties usually experienced in the conduct of some complex experiments (such as those involving *differential* irrigations), and on the other hand to reduce the number of replications. The main principles involved in 'Confounding' are explained and a few plans and appropriate methods of analysis are given in the Appendix. A detailed note explaining the methods of analysis in such cases and the actual calculations involved will be circulated shortly by the Imperial Council of Agricultural Research to the Directors of Agriculture of Provinces and States.

## ENCLOSURE.

(1)

*Split-plot arrangement*

(A complex experiment on rice involving three factors:—spacing, ages of seedling and plants per hole).

Number of ultimate plots in each complete replication =  $4 \times 4 \times 4 = 64$

Number of complete replications:—3.

*Plan of each Complete Replication.*

Under each 'Spacing' (say  $S_1$ ) randomise the 16 treatments combining ages of seedling and plants per hole. Each complete replication will thus have four sub-blocks corresponding to  $S_1, S_2, S_3, S_4$ , and the 16 treatments randomised in each sub-block.

*Analysis of variance*

|   |       |
|---|-------|
|   | D. F. |
| Blocks . . . . .  | 2     |
| Spacings . . . . .  | 3     |
| Error (a) . . . . .                                       | 6     |
| Total   | 11    |
| Ages . . . . .  | 3     |
| Ages $\times$ Spacings . . . . .                          | 9     |
| Error (b) . . . . .                                       | 24    |
| Total   | 47    |
| Plants per hole . . . . .                                 | 3     |
| Spacings $\times$ number of plants per hole . . . . .     | 9     |
| Ages $\times$ number per hole . . . . .                   | 9     |
| Spacings $\times$ ages $\times$ number per hole . . . . . | 27    |
| Error (c) . . . . .                                       | 96    |
| Total   | 191   |

(2)

Plan of a confounded experiment ( $2 \times 2 \times 2$  design).

(Assume four complete replications and split each complete block into two sub-blocks with the second-order interaction confounded).

| $A_1$ | $A_2$   |
|-------|---------|
| npk   | nk      |
| n     | pk      |
| p     | np      |
| k     | control |

→ 4 complete blocks  
or  
8 sub-blocks.

*Analysis of variance*

|                                 | D. F   |
|---------------------------------|--|
| Blocks . . . . .                | 7 (This includes one confounded second-order interaction). |
| <i>Main effects.</i>            |  |
| N . . . . .                     | 1  |
| P . . . . .                     | 1  |
| K . . . . .                     | 1  |
| <i>First-order interaction.</i> |  |
| NP . . . . .                    | 1  |
| PK . . . . .                    | 1  |
| NK . . . . .                    | 1  |
| Error . . . . .                 | 18   |
| Total . . . . .                 | <hr/> 31 <hr/>   |

(3)

*Plan of a confounded experiment* ( $3 \times 3 \times 3$  design).

(Three increasing doses of three fertilisers,  $n_0, n_1, n_2, p_0, p_1, p_2$ , and  $k_0, k_1$ , and  $k_2$ ).

NOTE:—Of the 8 second-order interactions the following set (2 D. F.) is confounded with block differences:—

contrasts between

|               |               |               |
|---------------|---------------|---------------|
| $n_0 p_0 k_0$ | $n_0 p_1 k_0$ | $n_0 p_2 k_0$ |
| +             | +             | +             |
| $n_0 p_1 k_1$ | $n_0 p_2 k_1$ | $n_0 p_0 k_1$ |
| +             | +             | +             |
| $n_0 p_2 k_2$ | $n_0 p_0 k_2$ | $n_0 p_1 k_2$ |
| +             | +             | +             |
| $n_2 p_1 k_0$ | $n_2 p_2 k_0$ | $n_2 p_0 k_0$ |
| +             | +             | +             |
| $n_2 p_2 k_1$ | $n_2 p_0 k_1$ | $n_2 p_1 k_1$ |
| +             | +             | +             |
| $n_2 p_0 k_2$ | $n_2 p_1 k_2$ | $n_2 p_2 k_2$ |
| +             | +             | +             |
| $n_1 p_2 k_0$ | $n_1 p_0 k_0$ | $n_1 p_1 k_0$ |

(3)

Plan of a confounded experiment ( $3 \times 3 \times 3$  design).

(Three increasing doses of three fertilisers,  $n_0, n_1, n_2, p_0, p_1, p_2,$  and  $k_0, k_1,$  and  $k_2$ ).

NOTE:—Of the 8 second-order interactions the following set (2 D. F.) is confounded with block differences:—

contrasts between

|               |               |               |
|---------------|---------------|---------------|
| $n_0 p_0 k_0$ | $n_0 p_1 k_0$ | $n_0 p_2 k_0$ |
| +             | +             | +             |
| $n_0 p_1 k_1$ | $n_0 p_2 k_1$ | $n_0 p_0 k_1$ |
| +             | +             | +             |
| $n_0 p_2 k_2$ | $n_0 p_0 k_2$ | $n_0 p_1 k_2$ |
| +             | +             | +             |
| $n_2 p_1 k_0$ | $n_2 p_2 k_0$ | $n_2 p_0 k_0$ |
| +             | +             | +             |
| $n_2 p_2 k_1$ | $n_2 p_0 k_1$ | $n_2 p_1 k_1$ |
| +             | +             | +             |
| $n_2 p_0 k_2$ | $n_2 p_1 k_2$ | $n_2 p_2 k_2$ |
| +             | +             | +             |
| $n_1 p_2 k_0$ | $n_1 p_0 k_0$ | $n_1 p_1 k_0$ |
| +             | +             | +             |
| $n_1 p_0 k_1$ | $n_1 p_1 k_1$ | $n_1 p_2 k_1$ |
| +             | +             | +             |
| $n_1 p_1 k_2$ | $n_1 p_2 k_2$ | $n_1 p_0 k_2$ |

Plan of Confounding.

A single set of three blocks indicated above (or as many sets as space will allow).

Analysis of variance.

|  | D. F. |
|--|-------|
| Blocks . . . . .                             | 2     |
| linear response N . . . . .                  | 1     |
| deviation N . . . . .                        | 1     |
| linear response P . . . . .                  | 1     |
| deviation P . . . . .                        | 1     |
| linear response K . . . . .                  | 1     |
| deviation K . . . . .                        | 1     |
| N linear response $\times$ P linear response | 1     |
| N linear response $\times$ K linear response | 1     |
| P linear response $\times$ K linear response | 1     |
| Error . . . . .                              | 15    |
| Total . . . . .                              | 26    |