1929.

PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA.

SECOND ANNUAL REPORT

OF

THE COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

FOR THE

Year ended 30th June, 1928.

Presented pursuant to Statute; ordered to be printed, 14th March, 1929.

[*Cost of Paper*:—Preparation, not given; 855 copies; approximate cost of printing and publishing, £50.]

Printed and Published for the GOVERNMENT of the COMMONWEALTH of AUSTRALIA by H. J. GREEN, Government Printer, Canberra.

No. 17.—F.350.—PRICE 1s. 8D.

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COMMONWEALTH OF AUSTRALIA

Council for Scientific and Industrial Research.

SECOND ANNUAL REPORT, FOR PERIOD ENDED 30TH JUNE, 1928.

I.—GENERAL.

The progress that has been made in the various activities of the Council during the last twelve months relates, in the main, to the planning and organization of investigational work and to the collection of the necessary personnel and apparatus. Some progress in actual investigational work has been made and important results of no little economic value have been obtained, but, as is only to be expected, these have been chiefly confined to the investigations that have been in progress over a period of years and passed on to the Council by its predecessors. As regards investigational work recently initiated, the experience obtained in other countries, that the gathering together of a comprehensive research organization is a matter of several years, and that research generally reduces to the slow systematic expansion of knowledge with here and there a rapid, illuminating, and valuable acceleration of progress, has been abundantly confirmed. The chief work of the year has been the creation of the nucleus of a strong and effective organization which, in the next two or three years, will provide for Australia a research institution capable, in co-operation with existing institutions, of solving many of the pressing national problems that now are so evident.

In the report that follows, information is given as to what has been done and what it is proposed to do. Investigational work and results obtained are not discussed in detail, as information of that nature is given in the various publications of the Council, namely, its bulletins, pamphlets and quarterly Journal.

1. *The Council.*—Since the previous report was made two meetings of the full Council have been held, the first in December, 1927, and the second in April, 1928. Unless special circumstances arise it is probable that in future two meetings will be held each year, of which the first will be sufficiently early to allow of consideration of draft estimates of expenditure for the following financial year. The Council meetings that have been held to date have each extended over three days. The present constitution of the Council is given elsewhere in this report. (*See* Appendix.)

2. *Executive Committee.*—Under the Act constituting the Council, in between full meetings of the latter, all its powers and functions are vested in the Executive Committee. During the period under review, 39 meetings of the Executive Committee, allowing one meeting per day, have been held. The ninety-seventh meeting of the Committee was held on 14th June, 1928.

3. *State Committees.*—The various State Committees of the Council, whose main functions are to advise regarding the general business of the Council, and regarding any particular matter of investigation and research, have now been in existence for a sufficient time to give indications of the way in which they may most usefully develop. The constitution of the Committees provides for representatives of the scientific sections of State Departments and of different branches of science and industry. Provision for the co-option of additional members enables each Committee to be so constituted that all the major industrial activities followed in each individual State may be given a voice on the local body.

In practice, it has proved that the State Committees have provided the Council with a facile and rapid means of obtaining complete information on different aspects of particular problems. They have also ensured that any important information obtained from State sources is a well-balanced statement of the position, viewed from all aspects, and not a coloured version of one particular body or individual. The State Committees, especially those far distant from the head-quarters of the Council, have also served on occasions to draw attention to problems previously little known or whose importance and potentialities had not been fully realized.

They have also proved most helpful instrumentalities in connection with the introduction of eminent visitors to individuals and organizations interested in the objects with which the visitors are concerned. The Council itself has been responsible for several visits of eminent authorities, who have been invited to Australia in order to advise on various activities or on the most suitable lines of future work.

4. *Co-operation with State Organizations.*—One of the duties of the Council is to co-operate with State organizations with a view to the prevention of unnecessary overlapping and the utilization of facilities and staffs available in the States. Further attention to the matter has been given during the period under review. The more important investigations in which this co-operation has been established are given below. Further details are given in the sections relating to each particular research. In addition to this co-operation in major investigations, mutual help has been given on numerous occasions in connexion with many minor matters.

(i) *Co-operation with State Departments.*—In Western Australia, co-operation has been established with the State Department of Agriculture in investigations concerning bitter pit in apples, Kimberly horse disease and a braxy-like disease in sheep. The State Department of Forests is also co-operating in the work on tannin extracts. The authorities of the Pathological Laboratory of the Adelaide Hospital are affording valuable facilities in connection with work on haematuria in cattle. In Victoria the State Department of Agriculture and the Department of Railways are co-operating in investigations on the storage, preservation and transport of citrus fruit. The former is also helping in the work on the freezing of meat. The State Rivers and Water Supply Commission has made valuable facilities available from time to time in connexion with the Research Station at Merbein. In New South Wales the Department of Agriculture is co-operating with the Council in its work on poison plants, on the blowfly problem, on the flying fox problem, and on paralysis in pigs and toxaemic plethora in lambs. The Water Conservation and Irrigation Commission is closely associated with the work on the production of citrus fruit being carried out at the Research Station, Griffith. In Queensland the Department of Agriculture is co-operating in the work to be commenced on the flying fox problem, in cattle tick dips investigations and, through the Committee of Direction of Fruit Marketing, in the investigations on the storage, preservation and transport of bananas. The co-operative work of the Prickly Pear Board is mentioned in greater detail later.

(ii) *Co-operation with Universities.*—In Western Australia the University is co-operating in the work on tannin extracts. It is also carrying out a minor piece of work on the hydrolysis of cellulose for the production of power alcohol. The University of Adelaide and the Council are associated in a large way. For the last two years the University has housed the Division of Animal Nutrition and has made available the land on which the Laboratory of the Division is being erected. Very close links have been made with the Wai e Agricultural Research Institute of the University of Adelaide. In co-operation with the Council and the Empire Marketing Board, the Institute is carrying out extensive investigations of the mineral deficiencies of animal pastures. The Institute is also the centre of the soils work of the Council and of the work being done on virus and soil-borne fungous diseases of plants, notably, tomato wilt. The University has passed over to the Council its work on the regeneration, in eaten-out pastoral areas, of native vegetation, and is continuing to afford facilities for the investigation. In Victoria the University of Melbourne is co-operating with the Council in the investigations of pleuro-pneumonia in cattle, tuberculosis in cattle, braxy disease in sheep, on the transport, maturation and storage of bananas, and on the freezing of beef. It is also one of the active parties in the operations of the Radio Research Board. The University of Sydney is co-operating with the Council in the investigation of poison plants, of parasitological pests of sheep and stock, braxy disease and caseous lymphadenitis of sheep, and in the activities of the Radio Research Board. The University of Queensland has recently agreed to join with the Council in investigations on the study of preservation and maturation of bananas. Previously it provided facilities in the shape of laboratories and personnel for investigations on squirter disease and bunchy-top in bananas

5. *Co-operation with Commonwealth Bodies.*—Very close relations have been established with all the scientific organizations of the Commonwealth. The Department of Defence and the Postmaster-General's Department are intimately associated with the Radio Research Board and the former also with the Committee on the Maintenance of Standards. An agreement has been reached with the Inspector-General of Forests and the authorities of the proposed Federal Forestry Bureau whereby the Council will undertake researches connected with the utilization of forest products, and the Bureau will assume responsibility for researches in problems relating to the growing tree. Both bodies will co-operate in other forestry researches that may prove necessary and that may involve such sciences as entomology, plant pathology, &c., a staff experienced in which the Counci has already obtained for other purposes.

Close touch has been maintained with the Australian Commonwealth Engineering Standards Association and with the more recently formed Australian Commonwealth Association for Simplified Practice.

6. *Liaison with Scientific Organizations in Other Countries.*—An important function of the Council is that of acting as a means of liaison between the Commonwealth and other countries in matters of scientific research. Further progress in establishing the necessary relations with these bodies has been made.

In Great Britain, scientific research on national problems falls into two main classes, namely, that connected with the agricultural industry and that connected with the secondary industries. Research work in the former category is subsidized on an extensive scale by the Development Commissioners, the actual work being carried out by independent organizations such as the Rothamsted Experiment Station for soils work and the growth of plants, the Rowett Research Institute for animal nutrition, the East Malling Research Station for horticulture, &c., each Institute specializing in a particular aspect of agricultural problems. With many of these organizations touch has already been established and all have been particularly ready to afford the Council their help, both in the direction of furnishing advice on particular problems and in making the results of their own research work freely available. In addition, in several instances, arrangements have been made for the British organization to house an Australian investigator for a period sufficient to enable him to obtain full information as to the methods of research adopted, and experience in details of technique, &c. There is no doubt whatever that this help will be of considerable value to the Australian agricultural and pastoral industries in the future.

The research needs of the secondary industries of Great Britain are chiefly the concern of the British Department for Scientific and Industrial Research, and, in general, the Department's main activities relate to those industries. Here, again, the relations that have been established between the Council and the Department are proving most valuable. The major investigations of the Department of most interest to Australia are those of its National Physical Laboratory and its Boards dealing with researches in fuels, forest products and the preservation of foods. The Department is carrying out very fundamental work on these matters, the results of which it has freely offered to make available to the Council. It is difficult to assess the great value of the aid so offered. Moreover, it places the Council in the most fortunate position of being able to leave matters covered by the British Department very largely alone and to concentrate its limited energies and funds on the attack of other urgent problems. Were the Council not in that position, there would be a much more pressing need for it to spread its energies over a wider field with a consequent risk of failure owing to lack of concentration. In addition to help in the above major activities, the Department has, on numerous occasions, been of no little service in connection with the many minor matters that arise from time to time.

The Empire Marketing Board is another body with which most fruitful relations have been established. The constitution and aims of this body were outlined in the previous report. It has been most generous in contributing towards the cost of Australian investigations. Details of the various co-operative arrangements entered into by the Board are mentioned in the various sections of the report that follow.

In addition to the organizations in Great Britain mentioned above, close relations have been established with bodies corresponding to the Council in the other parts of the Empire. In Canada the counterpart of the Council is the Advisory Council of Science and Industry. It has recently been decided by the Government concerned to enlarge the activities of this body very considerably and it is understood that a Bill to give effect to that decision is to be introduced at an early date. The Canadian body is already engaged in many investigations of interest to Australia, notably in connection with forest products and with problems connected with the production of cereals. It also proposes to establish the nucleus of a National Physical Laboratory or Bureau of Standards.

Coming nearer home, the New Zealand Department of Scientific and Industrial Research and the Council are collaborating and helping each other in a number of matters. Naturally, many problems are of mutual interest and concern.

In the case of India, too, there is mutual interest in forests products. The work of the long-established Forests Products Research Institute at Dehra Dun will soon have its counter-part in the forests products organization of the Council and the authorities of the two bodies have already established touch.

To sum up, the Council is fully alive to the desirability of its forming one of a team in an Empire-wide attack on the various problems that now confront the Empire as a whole. The free inter-change of information that is already taking place between the component organizations of that team will ensure the minimum of overlapping and will lead to the most

efficient and effective work. Incidentally, it will result in considerable savings to Australia. The Council hopes that, in return, it will be able to play its part and furnish results of equal value to the other parts of the Empire.

A similar movement for the establishment of team work in matters of scientific research is becoming somewhat evident throughout the world as a whole. Various organizations in the United States of America, for instance, have taken up an extremely helpful attitude. Scientific organizations in other countries, too, have adopted a similar attitude to those mentioned in the United States. Up to date, the lines of co-operation that have been established have been mainly in the direction of an interchange of published and unpublished reports. In this way the Council is gradually becoming a central repository of much scientific literature of value in connection with the study of our national problems.

7. *Visit of the Chairman to Europe and America.*—During the year under review, the Chairman of the Council, Mr. G. A. Julius, was able to visit both Europe and America. He took the opportunity of personally visiting most of the authorities of the various organizations and bodies mentioned in the section above. The value of the personal contacts he was thus able to make is already evident, and will continue to become still more so as time goes on. The importance of such personal contacts cannot be over-emphasized. So far as Great Britain is concerned the relations established by Mr. Julius, and to a considerable extent by Mr. F. L. McDougall before him, are being maintained through the agency of Mr. McDougall in his capacity of representative of the Council in Great Britain.

8. *Organization of Work of Council and Formation of Divisions.*—As at present organized, the work of the Council relates mainly to the primary industries and falls into a few main sections. It has been decided to refer to these main sections of work as Divisions, and to the officers in charge of them as Chiefs. The following Divisions have been formed :—

The Division of Animal Nutrition—Professor T. Brailsford Robertson, Ph.D., D.Sc. (Chief).
The Division of Economic Entomology—Dr. R. J. Tillyard, F.R.S., D.Sc., &c. (Chief).
The Division of Economic Botany—Dr. B. T. Dickson, Ph.D., (Chief).
The Division of Forest Products—Mr. I. H. Boas, M.Sc. (Chief).

In addition, some half dozen investigators have been appointed to carry out investigations on various diseases of animals, and ultimately these will be organized into a Division of Animal Health.

The Council has adopted the policy of refusing to carry out extensive investigations in any particular field until it has obtained the services of an eminent authority in the sciences involved to direct the work in the capacity of a Chief of a Division. The adoption of this policy has naturally led to some delay, for the services of authorities of the capacity required are not always readily available, and to obtain them extended and protracted inquiries are often involved. Despite such delays, however, it is considered that it is far better to refuse to carry out any work at all than to run risks of having investigations misdirected. A similar policy has been adopted in the case of minor and more or less independent researches.

It is largely by reason of the adoption of the above policy that the actual investigational work in many directions is not very far advanced. While research is imperatively necessary before national problems and hindrances to progress can be overcome, it is nevertheless such an important matter that too much care cannot be spent in ensuring that it is undertaken on right lines.

The admitted shortage of scientific personnel adequately trained in the directions necessary for the study of Australian problems is another factor militating against rapid progress. The problems of Australia most likely to be solved by the application of scientific methods belong mainly to the agricultural and pastoral industries. The sciences involved are those of entomology, applied botany, pathology and physiology (animal and plant), bacteriology, &c. Even as short a period as a decade ago the demand for research workers trained in such sciences was slight, and the inducement to the individual to take up such work was small as compared with that offering in engineering, chemistry, &c., upon which secondary industries so largely depend. The effect of the world-wide movement for the greater application of science to all industry, whether primary or secondary, that has taken place since the termination of the world war, has therefore been particularly noticeable in the consequent acute shortage of research workers trained in those sciences that may be broadly classified as biological. This shortage will quite probably be made up in the not distant future, but at the present time it is most certainly a factor militating against rapid progress.

9. *Tenure of Investigators.*—In addition to the shortage of personnel, another difficulty met with in the obtaining of staff is that the individuals eventually chosen are naturally anxious as to the tenure of appointment in such a specialized branch of activity. The power given to

the Council, subject to Ministerial approval, to give an assurance on this point has been a very valuable provision, particularly in the search for Chiefs of Divisions. Under the Act constituting the Council it is possible also to bring certain appointees under the Commonwealth Superannuation Fund. The advantages of this provision are obvious, and the fundamental factors for ultimate success, namely, a contented staff with opportunities of carrying out steady, continuous work, now apply.

10. *The Science and Industry Investigation Fund.*—In the previous report, mention was made of the creation of this Fund in order that the Council might be able to exercise its various functions. In the Act constituting the Council in 1926 an amount of £250,000 was appropriated from Revenue to form the Fund. Towards the close of the period under review an additional amount of £250,000 was appropriated for the same purpose. The total contributions to the Fund therefore amount to £500,000. Up to 30th June, 1928, the sum of £106,981 had been spent from this Fund.

II.—AGRICULTURAL RESEARCH IN GENERAL.

1. *Imperial Agricultural Research Conference.*—An event of particular importance to bodies carrying out agricultural research in the Empire took place in October, 1927, when the first Imperial Agricultural Research Conference met in London. Some 200 individuals attended and all parts of the Empire were represented. In the words of the Chairman of the Conference, Lord Bledisloe, it was "a great step forward with a view to the spread of ascertained knowledge to meet the needs of the Empire in relation to its most vital industry . . . . . It has been noteworthy for its comprehensively representative character; the eminence of its personnel, both scientific and administrative; the unfailing high character of its discussions. . . . . ."

The Conference surveyed the whole tropical and sub-tropical Empire as a field for agricultural research, considered the question of man-power in relation to research, and prepared and examined in detail plans for a considerable extension of the existing machinery for co-operation between research workers in different branches of agricultural science all over the Empire. Its main recommendations were for the establishment of three new Imperial Bureaux along somewhat similar lines to those of the existing Imperial Bureaux of Entomology and of Mycology. The new Bureaux proposed are for Soil Science, to be located at the Rothamsted Experiment Station; for Animal Nutrition, to be at the Rowett Research Institute; and for Animal Health. In addition, the establishment of four new Correspondence Centres to deal with genetics, plant breeding, agricultural parasitology and fruit production was recommended. Other important recommendations related to a proposed chain of research stations, and to the training and interchange of scientific research workers.

Australia sent a strong delegation to the Conference in Mr. G. A. Julius (Chairman of the Council), Professor A. E. V. Richardson (Director, Waite Agricultural Research Institute, University of Adelaide, and also a member of the Executive Committee of the Council), and Dr. S. S. Cameron (Director, Victorian Department of Agriculture). It has been arranged that the next Conference will be held in Australia in 1932.

2. *Standing Committee on Agriculture.*—The Standing Committee on Agriculture is a body that has been set up to ensure intimate collaboration between the Council and the State Departments of Agriculture. It has been found that two meetings of the Committee per annum, one of them being held concurrently with the meeting of the State Ministers of Agriculture, and the other some six months later, will probably suffice. The second and third meetings of the Committee were held on 6th and 7th March at Melbourne, and on 5th June at Perth, respectively. The more important matters considered at these meetings were the work of the Imperial Agricultural Research Conference and the proposed new Imperial Bureaux and Correspondence Centres, Dairy Research in the Commonwealth, the most appropriate body to undertake rice investigations in Australia, tobacco investigations, the proposed work of the Council's Divisions of Economic Entomology and Economic Botany, and problems in the storage of citrus fruit. The more important decisions reached in regard to such matters are discussed in subsequent sections in detail.

3. *Register of Agricultural Research.*—The compilation of the Register containing details of the agricultural research work in progress in the Commonwealth during the year 1927 has been completed. Copies of the Register have been forwarded to the principal organizations and Institutes concerned with agriculture and agricultural research, both in Australia and in other parts of the Empire. It is hoped that in this way the collection of information desired by such bodies will be facilitated, and that, so far as Australia is concerned, overlapping will be prevented. In accordance with a recommendation of the Standing Committee of Agriculture, it has been decided to bring the Register up to date from time to time.

4. *Proposed Tropical Agricultural Research Institute.*—In the previous report, mention was made of the proposed establishment of a Tropical Agricultural Research Institute in Queensland, towards which the Empire Marketing Board had offered to contribute £25,000 on the capital cost, and £5,000 per annum towards annual maintenance on the £ for £ basis with the Commonwealth. It was proposed that this Station should be one of a series in tropical parts of the Empire. When, however, close consideration was given to the conditions of the general scheme, and these were examined in the light of further knowledge of Queensland, it was realized that the original plan would require very considerable modification before its adoption would be justifiable.

The whole matter was carefully examined by the Director of the Rowett Research Institute, Aberdeen (Dr. J. B. Orr) during his recent visit to Australia, and by Sir Arnold Theiler. As a result, the proposal is in abeyance for the time being, and it is not likely that effect will be given to it without considerable modification.

III.—PLANT PROBLEMS.

1. *Division of Economic Botany.*—It has been decided to organize a Division of Economic Botany on a somewhat extensive scale. The activities of Dr. B. T. Dickson, formerly Professor of Plant Pathology, McGill University, Canada, and who was originally brought to Australia to take charge of the mycological investigations of the Council, have been extended, and he has been appointed as Chief of the Division.

The Standing Committee on Agriculture is being closely consulted in regard to an appropriate programme of work for the Division, and in regard to the allocation of problems as between the Division and the State Departments. Broadly speaking, this programme may be divided into four main sections, namely, plant pathology, plant physiology, genetics and certain agrostological problems.

Applications have recently been invited for appointment to the position of Senior Plant Pathologist (two positions), Senior Plant Geneticist and Senior Plant Physiologist.

Steps are also being taken to appoint a second in command or Deputy Chief to Dr. Dickson. It is possible one of the above appointees may be appointed to this position at a slightly higher salary.

In addition to the above senior positions, applications have recently been invited for appointment to four junior positions, the idea being to provide each of the seniors with a junior assistant.

Plans for central laboratories for the Division are now under consideration. The buildings eventually decided upon will be erected with the necessary green houses, &c. on portion of the area of some 40 acres made available to the Council at Canberra. Laboratories for other Divisions of the Council will eventually be erected on this site as well. Pending the erection of laboratories at Canberra, the University of Sydney has kindly afforded Dr. Dickson laboratory accommodation in its Department of Botany.

The erection of central laboratories at Canberra will not mean that all the investigational work of the Division of Economic Botany will be carried out at that place. On the contrary, much of it will be undertaken in the localities in which the problems exist. Such work will be housed in general and existing laboratories, e.g., those of other organizations co-operating in the investigations, although in some cases it may prove necessary to erect small and temporary sub-stations.

2. *Prickly Pear Pest.*—The Australian investigations into the biological control of prickly pear are being carried out under the direction of the Commonwealth Prickly Pear Board, which is financed by contributions on 1–1–2 basis from the State Governments of New South Wales and Queensland and the Council, respectively. A full account of the recent operations of the Board is given in the Bulletin No. 34 issued towards the end of the year 1927.

The results obtained to date are extemely encouraging. Several varieties of insects that are voracious feeders on pear have been established in large numbers in numerous centres. In particular a caterpillar (*Cactoblastis cactorum*), has been found to be particularly effective. Other insects, such as certain cochineals and the so-called red spider, are also reducing the pear in large tracts of infested country. The results have been so encouraging that in order to intensify the operations of the Board before parasites or predators, unusual climatic conditions, outbreaks of disease, &c., may combine to delay or nullify the work of the insects which have already been introduced and established, the contributing parties have recently agreed to increase their contributions by 50 per cent.

The contributions of the Council for the financial year 1928–29 and for two years after that will accordingly be at the rate of £9,000 per annum.

3. *Tomato Wilt.*—Some of the results obtained from the co-operative investigation of this problem have been published in the Journal of the Council (Vol. 1, No. 2). Details are given of work from which it was concluded that an aphis (*Thrips tabaci* Lindeman) transmits the disease. The investigations are being continued under the immediate supervision of Mr. G. Samuel, of the Waite Agricultural Institute, who, since the transfer of Mr. H. A. Pittman to Perth, for work on bitter pit of apples, has been assisted by a recent appointee of the Council, Mr. J. G. Bald, B.Sc. *Thrips tabaci*, as an agent whereby the virus is spread, has been studied further, as have other species of thrips also.

4. *Bitter Pit in Apples.*—This problem is a very serious one to the Australian fruit-growing industry. As long ago as the year 1911 the Commonwealth Government, in conjunction with the State Governments of Victoria, Tasmania, New South Wales, Western Australia and South Australia, initiated a series of scientific investigations into the cause, prevalence and possible methods of control of the disease. This undertaking is of special interest as having been one of the earliest recorded instances of a co-operative endeavour to solve a serious national problem by systematic scientific research. The terms of agreement were that the Commonwealth provided £1,000 per annum for a period not exceeding four years, an additional £1,000 being provided by the States mentioned. At the end of the four years the investigations were suspended as they had not yielded very definite results.

During the past twelve months the Council arranged with the Department of Agriculture in Western Australia for an investigation of the trouble, under the direction of one of its senior officers, Mr. W. M. Carne. The Council has provided the services of an investigator, Mr. H. A. Pittman, and the Department is providing other facilities in the shape of personnel, laboratory accommodation, &c. Encouraging results have already been obtained, and it is believed that at least a fairly definite indication as to the cause of the condition and a practical means of avoiding it have been discovered.

The British Food Investigation Board is also interesting itself in the bitter pit problem, and quite recently has made a survey of the conditions of Australian fruit arriving on the English market. It has found that the chief wastage of apples on arrival at London ports is due to bitter pit, and that the worst developments of this disease are generally in the early shipments, and more particularly with the varieties known as Cleopatra, Cox's Orange Pippin, Rig Stone and Sturmer Pippin.

5. *Noogoora Burr* (*Xanthium Sp.*).—The spread of this plant is increasing rapidly in New South Wales and in Queensland, and, particularly in the latter State, it is developing into a very serious pest. The presence of the burrs in wool seriously depreciates the value of the latter, and land badly infested with the weed is practically useless for sheep-raising purposes. Attempts to control the pest by close grazing with sheep before the burrs or seeds are formed, hand-pulling after rain, mowing and burning before the ripening of the burrs, poisoning, &c., have not been very successful so far in Australia. In any case, such methods are costly.

The whole problem was recently examined in a preliminary way by Dr. B. T. Dickson, during a visit to Queensland. He has reported that the burr is spreading at an alarming rate in some districts, and that it is not considered possible to control it by mechanical means on large stations. There is some doubt as to its exact botanical classification. Dr. Dickson is not growing the plant from seed, and is considering possible lines of further investigation. The possibilities of the control of the pest by biological means will also be considered by the Division of Economic Entomology.

6. *Leaf spot on Bananas—Water blister on Pineapples.*—During his visit to Queensland, Dr. Dickson also made preliminary inquiries into these matters. In the light of the information so obtained, he is of the opinion that the organism causing leaf spot is seasonal in its effect and, further, that it is not likely to be a very strong parasite. Where conditions are favorable to the organism, e.g., in poor root systems, where the borer is at work, in unsuitable soils, and in cold and wet weather, the spread of the condition is rapid.

Water blister in pineapples appears to occur only from about the beginning of November to the end of April, reaching a maximum in February and March.

7. *Tobacco Investigations.*—The tobacco investigations are being continued under the co-operative agreement detailed in the previous report. The actual work is controlled by an Executive Committee, and is administered from the offices of the Development and Migration Commission.

Mr. C. M. Shagg, who was formerly an officer of the Department of Agriculture, Canada, has been appointed as Director of the Investigation. An extensive programme of work in all States has been adopted. It aims at thorough practical testing of typical soils and climates.

8. *Visit of Dr. A. W. Hill, C.M.G., F.R.S.*—The Empire Marketing Board recently made a grant of £4,000 per annum for a term of five years to the Royal Botanic Gardens, Kew, with a view to extending the work of the gardens and placing it on a wider Imperial basis. One of the results is that the Director of the Gardens and other senior officers will be able to visit the various Dominions and Colonies from time to time, and thus help, *inter alia*, to secure co-ordination in the development of systematic botany throughout the Empire. Towards the end of 1927, Dr. A. W. Hill, C.M.G., F.R.S., the present Director of the Gardens, was able to pay a visit of a few weeks' duration to Australia and New Zealand. He reached Western Australia late in November and, after proceeding to each of the other States and New Zealand, finally left Queensland in March, 1928.

Shortly after his departure he furnished the Council with a confidential report on the observations he had made. The most important suggestions included in the report related to the establishment of a National Herbarium at Canberra, the improvement of the various State Herbaria and the initiation of a scheme involving the periodical sending of an Australian botanist to Kew to obtain first-hand information concerning the methods of work and classification adopted in that place.

Largely for financial reasons, it has not as yet been possible to give effect to the comprehensive recommendations made.

IV.—IRRIGATION SETTLEMENT PROBLEMS.

At the present time large additions to the national income of Australia are being furnished by the various irrigation settlements. The possibilities of greatly increasing the present production of the areas are also bright. Nevertheless, certain cultural problems have already arisen and there is always the consideration that intensive production, and the use of what may ultimately prove to be unsuitable cultural methods, will eventually create many more fundamental and far-reaching problems. From that point of view, irrigation in Australia is but in its infancy. The importance of the industries concerned, and the large amount of public money that has already been spent in the erection of dams, channels, &c., fully warrants the initiation of extensive research work in order to ensure not only that any cultural methods that may be put into practice from time to time will result in the most economic immediate results, but that they will cause no permanent damage to the areas. Unfortunately, it is not difficult, by the adoption of mistaken practices, to reduce the productivity of an irrigation area very considerably.

1. *Viticultural Problems—Research Station, Merbein.*—Work on the production problems of vine fruits has been continued. Pamphlet No. 6 on standard methods of dipping sultana grapes has been issued.

A considerable amount of attention has been given to the programme of work to be carried out at Merbein in the future, particularly from the point of view of the possible establishment of an Irrigation Research Station in Australia to study fundamental problems of irrigation practice in general, for which studies the land at the Merbein Station is quite unsuitable. In the meantime a Technical Committee, consisting of Dr. B. T. Dickson (Chairman), Professor T. G. B. Osborn and Professor J. A. Prescott, has been appointed to take charge of the planning of future work at the (Merbein) Station. It has been decided that the ecological survey of a comparatively small field, that is now in progress, will be completed, in order to enable preliminary investigations on salting to be carried out. Additions work will consist of studies on vine root growth in order to ascertain how far vine roots react to irrigation practice. Vine variability will also be investigated in order to arrive at a basis for the numbers necessary in the plots of replicated experiments. In addition, the study of vine growth, bud development, pruning reactions, &c., will be continued as at present.

2. *Citricultural Investigations—Research Station, Griffith.*—An account of this Station was given in the second issue of the Journal. Investigations are being carried out chiefly on cultural and manuring problems and on bud selection of citrus stock. The original field experiments laid down were designed to yield information on the following problems :—

(*a*) The effect of different soil treatment on the structure, yielding capacity and other properties of the soil.
(*b*) The most profitable fertilizer treatment for citrus fruit under local conditions.
(*c*) The effect on soil and citrus trees of various methods of green manuring.
(*d*) Bud selection.

As the first trees were planted only in 1924, it is as yet too early to expect any definite results. As indicated in the last report, the work is financed jointly by the Council and the Water Conservation and Irrigation Commission of New South Wales. The latter body is contributing £1,500 per annum towards the expenses of the Station, and is supplying all water free of cost.

Tenders have recently been let for the erection of a laboratory and residence at the Station, at an approximate cost of £2,800. An overhead irrigation system has also been installed, and it is hoped by its use to obtain valuable information as to the value of irrigation by sprays, with which the amount of water can be very strictly controlled, as against the older methods depending on the use of the channels, &c., in which individual irrigations are both variable and difficult to control. Some work on soils will also be undertaken at the Station. An officer has recently been appointed to the staff at Griffith after a period of training at the Waite Institute, under Professor J. A. Prescott.

3. *Proposed Imperial Irrigation Research Station.*—The Empire Marketing Board has lately been giving a considerable amount of attention to a proposal that an Imperial Irrigation Research Station be established in some suitable locality within the Empire. An Irrigation Research Sub-Committee of the Committee of Civil Research has been constituted to investigate the proposal in detail and to recommend a site, &c. Until a decision has been made as to the locality in which this Station will be placed, and as to the lines of work it will undertake, it will be undesirable for the Council to make definite arrangements for the enlargement of its own programme of irrigation research. Consideration of that enlargement is, accordingly, being held in abeyance for the time being.

4. *Formation of Murray Advisory Committee.*—In February, 1927, the Prime Minister, acting on a recommendation of the Development and Migration Commission, convened an important and representative Conference to advise on the future development of the various irrigation schemes of the Murray River Valley. As a result, a permanent Advisory Committee has been set up to advise on irrigation developments and production. The Council is not represented on the Committee, but it has been decided that all problems requiring scientific research, coming before the Committee, will be brought under the notice of the Council.

As regards the proposed Imperial Irrigation Research Station, the Conference was impressed with the advantages which Australia, as containing the largest irrigation settlements of white people within the Empire, offered in connexion with the location of such a Station.

5. *Cultivation of Rice.*—In the previous report, the question of investigations concerning the production of rice, large quantities of which are now grown in the Murrumbidgee area, was discussed. A report was prepared by Messrs. F. J. Watson and E. S. West, outlining proposals for these investigations. It contained suggestions that weed control, fertilizers, rate of seeding, rotation of crop, time of sowing, time of draining off, production of pure seed, preparation of seed beds, and soils be investigated. The report was referred to the Standing Committee on Agriculture, which considered that the investigations proposed were on lines somewhat similar to those upon which the States were already engaged in connexion with the production of wheat and other crops, and that they came within the scope of State Departmental functions, as defined by the Agricultural Conference of March, 1927. It was thought that the State, rather than the Commonwealth, was the appropriate authority to organize this work. Mr. G. D. Ross, the Under Secretary for Agriculture in the State concerned (New South Wales), having agreed that his Department would undertake the necessary work, the Council decided not to proceed further with the proposed investigations.

V.—SOIL PROBLEMS.

1. *Work in Co-operation with the Waite Agricultural Research Institute.*—Satisfactory progress has been made under the co-operative agreement outlined in the previous report. Professor J. A. Prescott has been appointed as adviser (part-time) on soil problems to the Council, and, as such, and in his capacity of an officer of the Waite Institute, he directs the soils investigations. The work is, naturally, being confined to the more densely settled agricultural areas, namely, the various irrigation districts. A survey of an area at Renmark, South Australia, has been completed, and that of an adjoining tract is now in hand. A detailed survey has also been completed of an area at Woorinen, in Victoria. The work will be extended to the Murrumbidgee area in the very near future, and probably to certain parts of Tasmania.

The co-operation of the Air Force has been obtained, in order to ascertain whether aerial photographs will be of any use in the general survey of Australian soil types. The Board has undertaken to make an aeroplane available during the spring or early summer of 1928, and photographs of the areas that have been already surveyed in detail will be made. The photographs will be subsequently examined in order to see whether any known differences of soil types are disclosed.

A pamphlet on standard methods of soil examination, from the chemical and physical point of view, has been prepared by Professor Prescott and Mr. C. S. Piper, B.Sc., and is now in the press.

2. *Visit of Sir John Russell.*—Under the auspices of the combined Australian Universities, provision is made each year for a series of public lectures by authorities from overseas, eminent in various branches of learning. Early in 1928 the Universities arranged for the visit of Sir John Russell, Director of the Rothamsted Experiment Station, England. Sir John, who reached Australia late in May, was able to visit various irrigation areas and typical Australian farming districts. Prior to his departure, an opportunity was taken by the Executive Committee of the Council to discuss Australian soil and irrigation problems with him. He drew attention to the need for further work on varieties of wheat suitable to different soils and different climates of Australia, to work on the fundamental factors on which present practices of cultivation from the point of view of conservation of soil moisture, are based, to the possibility of growing tilled crops on occasion in place of fallowing, to investigations aimed at ascertaining the best way of getting rid of stubble whether by burning or by other means, particularly in Western Australia and South Australia, to manurial problems and to mosaic troubles. As regards the irrigation areas, he indicated that a soil survey was necessary, and that a survey of the water table of various areas was also desirable and important. The best lay-out of irrigation channels, and the duty of water from the point of view of its conservation, were other matters requiring investigation. A clay-pan constituted another problem. He had found a pan present in many places in the existing irrigation areas, and, being probably a sodium clay, it was quite likely to give rise to serious trouble eventually. He therefore regarded the investigation of the pan, and of cultural methods suitable for it, as being particularly important.

VI.—ANIMAL PROBLEMS.

1. *Visit of Sir Arnold Theiler, K.C.M.G.*—Sir Arnold Theiler, who was for many years Director of Veterinary Research and Professor of Tropical Veterinary Medicine in South Africa, where he established the well-known Veterinary Research Institute at Onderstepoort, and carried out research work on many animal problems, especially on certain deficiency diseases in stock, reached Australia on a six months' visit in April, 1928. Arrangements have been made for him to visit every State of the Commonwealth, and to obtain information on problems affecting the health of animals of economic importance. In addition to informing himself generally on the whole question of veterinary problems and research in Australia, with a view to closer Empire co-operation in the study of such matters, Sir Arnold will advise the Council as to the immediate development of plans for research in those matters, and as to the organization of a Division of Animal Health.

2. *Poison Plants Committee.*—In the previous Annual Report a full account was given of the formation of this Committee for the investigation of the principal poison plants of the Commonwealth. Certain alterations have taken place in the personnel of the Committee during the past year. Professor Jas. Kenner, F.R.S., has left Australia to take up a position in Manchester, and has accordingly resigned from the Chairmanship. Professor H. G. Chapman, owing to pressure of special research work on cancer, has also been forced to resign. To fill these vacancies, Mr. H. Finnemore, of the Department of Pharmacy, University of Sydney, has been appointed Chairman and Associate; Professor Priestley, of the University of Sydney, has been added to the Committee. Professor J. C. Earl, University of Sydney, and Dr. B. T. Dickson have also become members. The present personnel is therefore as follows:—Mr. H. Finnemore (Chairman), Dr. B. T. Dickson, Professor J. C. Earl, Mr. Max Henry, Dr. H. R. Seddon, Professor T. G. B. Osborn, Associate-Professor H. J. Priestly, Dr. G. P. Darnell Smith and Brigadier-General I. G. Mackay (Secretary).

A number of investigations on various plants is under way. Feeding tests are carried out at the Glenfield Veterinary Research Station, botanic identification at the Botanic Gardens, Sydney, and chemical and physiological tests at the University of Sydney. An account of the work which has been done by Dr. H. R. Seddon at the Glenfield Veterinary Research Station on milkweed (*Euphorbia Drummondii*) was published in a recent number of the *Journal*. References have also been made in other numbers of the *Journal* to the progress of investigations on the difficult problem of the toxicity of various species of the Acacias. Several other varieties of plants are under investigation.

3. *Kimberley Horse Disease.*—Work on this problem, also known as "walk-about" disease, which was carried out in co-operation with the Department of Agriculture in Western Australia, has practically been completed. The cause of the so-called disease has been demonstrated to be the eating by horses of the leaves and twigs of *Atalaya hemiglauca* (whitewood). Full detail of the work and of the conclusions reached have recently been published and issued in Bulletin No. 36.

A few confirmatory tests are now being carried out in Melbourne. As a result of these it has already been demonstrated that Kimberley horse disease can be induced in Victorian horses that have never been near Western Australia, simply by feeding them with whitewood.

4. *Parasitological Problems.*—The veterinary parasitologist of the Council, Dr. I. Clunies Ross, who is stationed at the Department of Veterinary Science, University of Sydney, has made further progress in the study of certain parasitological problems of Australian sheep. A report on liver fluke has been published in pamphlet form. It contains the results of work done to determine when the snails responsible (*Limnea brazieri*) become infected by the fluke, when the young fluke leave the snails and attach themselves to the grass, and therefore when the fluke infect sheep. It also contains information on preventive methods of freeing pastures from fluke by the use of copper salts and on the treatment of infected sheep with carbon tetrachloride. Most encouraging results have been obtained throughout Australia in connexion with the latter treatment. Work is now being carried out with a view to investigating the possible association of liver fluke with braxy disease. In addition to the fluke pamphlet, a bulletin or hydatid disease in man is now in the press.

Work is also in progress on stomach and intestinal worms in sheep and on the varieties of lice and tick that affect sheep. As regards the worms, various drugs for internal use are under investigation, it having been found that medicinal treatment with arsenic and copper, while effective in South Africa against the large stomach worm, is ineffective in Australia as a means of controlling the small *Ostertagia* worm.

5. *Paralysis in Pigs.*—The investigations on pig paralysis are being continued at the Glenfield Animal Research Institute of the New South Wales Department of Agriculture. An officer of the Council, Mr. W. A. Carr Fraser, B.V.Sc., is engaged upon this work, under the supervision of the Director of the Station, Dr. H. R. Seddon. Prior to Mr. Fraser reaching Glenfield, the staff there had already commenced some work on the problem, the results of which they have made freely available to him. An extensive survey of the literature bearing on the matter has been concluded, and endeavours are now being made to obtain further information by experiments aimed at (i) an endeavour to induce the condition experimentally, and (ii) an effort to ameliorate the naturally occurring condition or at least to observe the effect of certain therapeutic measures.

6. *Contagious Pleuro-Pneumonia of Cattle.*—Work on this problem is being carried out by an officer of the Council, Mr. T. S. Gregory, B.V.Sc., stationed at the Veterinary Research Institute, University of Melbourne. The investigation is aimed at the development of a satisfactory serological test for the disease. Such a test is of considerable importance in the application of control measures, as by present means of physical examination, &c., it is extremely difficult to detect this condition in animals with any certainty, and so to prevent the dissemination of the disease. A reliable test is also of considerable importance to Tasmania, where the disease does not occur at present, by enabling an effective examination to be made of imported animals.

Some of the results of the work carried out to date are reported in the second issue of the *Journal* of the Council.

7. *Tuberculosis in Stock.*—Work on this problem also is being carried out by Mr. Gregory at the Veterinary Research Institute, University of Melbourne. It is chiefly aimed at a study of the " B.C.G." vaccine for the prevention of tuberculosis. Some of the results obtained have been reported in the third issue of the *Journal* of the Council.

8. *Braxy Disease in Sheep.*—A sheep disease very similar to the braxy disease of Scotland, Iceland and other European countries, occurs in practically every State of the Commonwealth, and the total losses due to its onset are by no means small. When located at the Pasteur Institute, Paris, some short time ago, Mr. A. W. Turner, B.V.Sc., gave a considerable amount of attention to the study of braxy, and on his return to Australia he was appointed an officer of the Council, and afforded laboratory accommodation at the Veterinary Research Institute of the University of Melbourne. He is now carrying out a study of the Australian disease under the supervision of Professor H. A. Woodruff. The work is a continuation of earlier work carried out in Melbourne by Mr. H. E. Albiston. It has been found that while the so-called " braxy " of Victoria is identical with that of New South Wales and New Zealand, and probably of Tasmania, it is not identical with the braxy disease of Scotland. A preventive vaccine has been prepared and several thousand sheep vaccinated. Whenever the vaccinations have been made, only half the flock concerned has been treated, so that proper controls may be ensured. Indications obtained to date are that the vaccine is distinctly beneficial. The further work in progress is being directed mainly to discovering the mode of entrance of the infection, so that preventive measures may be applied if possible. It has been suggested, for instance, that the liver fluke may play a part in that connexion. Attention is also being given to the determination, if possible, of the prevalence of the casual microbe in the soil of infected districts.

A somewhat similar condition to that in New South Wales occurs in Western Australia, particularly in the Beverley district, where it often results in serious economic losses. Arrangements have been made with the Department of Agriculture of Western Australia for the

Department to second to the Council one of its veterinary officers, Mr. H. W. Bennetts, B.V.Sc. He will carry out an investigation of the trouble as it occurs in Western Australia, laboratory facilities being provided by the Department.

9. *Haematuria in Cattle* (*Endemic Redwater*).—Work on haematuria in cattle, particularly the condition occurring in the Mount Gambier district of South Australia, has been continued at the Government Laboratory of Bacteriology and Pathology of the Adelaide Hospital. The investigation is being carried out by an officer of the Council, Mr. C. G. Dickinson, B.V.Sc., under the direction of Dr. Lionel Bull. A survey has been made to determine the geographic distribution and incidence of the disease in the affected area. Botanical surveys of affected farms have also been made and samples of the pasture and other grasses collected for analysis. In addition, numerous pathological samples of the various organs of affected cattle have been obtained and examined.

That the disease warrants investigation is evident from the effect it has on the dairying industry of the locality in which it occurs. On some farms it is a constant menace and losses are heavy and continuous; in fact, some farmers have given up dairying altogether on account of losses from the disease.

10. *Caseous Lymphadenitis.*—The problem of caseous lymphadenitis is of considerable importance in connexion with the export of frozen mutton from Australia. At the present time, little is known as to the cause of the condition. For a greater proportion of the year under review the Meat Industry Board of New South Wales seconded one of its veterinary officers, Mr. R. C. Cramp, B.V.Sc., to the Council in order that he might carry out some investigations under the direction of Professor J. D. Stewart, of the University of Sydney. Mr. Cramp's studies were largely of a statistical nature, and concerned the incidence of the condition in carcases at abattoirs in New South Wales and the distribution of lesions in the affected animals. Some bacteriological examination of affected glands was also carried out with a view to distinguishing between the various kinds of infection, some of which, it is suspected, are not true caseous lymphadenitis due to the action of the Preisz-Nocard bacillus.

Mr. H. R. Carne, of the Veterinary Department of the University of Sydney, is undertaking a study of serological methods of diagnosis, quite independently of the Council. Mr. T. S. Gregory, at the Veterinary Research Institute, University of Melbourne, is now also studying serological methods of diagnosis, as well as the identification of types of the bacillus. In addition to the work of these investigators, arrangements have recently been made for some preliminary observations on the production of immunity to the disease in laboratory animals (by use of vaccines) to be carried out by Mr. C. G. Dickinson under the direction of Dr. Lionel Bull, of Adelaide.

11. *Cattle Tick Dips Committee.*—As a result of the recommendations made by a Special Committee on Tick Eradication, which met in Sydney in 1916, experiments were initiated for investigating the possibilities of obtaining a dip for the eradication of cattle tick, economically superior to the standard dip regularly in use in Queensland and New South Wales.

A special committee, consisting of representatives from what was then the Institute of Science and Industry and the Departments of Agriculture in New South Wales and Queensland, was formed to undertake the work. Arrangements were made for the expenses to be defrayed by equal contributions from the Commonwealth, New South Wales and Queensland Governments. The Committee commenced work in 1918, and is still in operation.

The initial experiments were designed to ascertain with certainty the action of standard arsenical dips on ticks during the moulting stage, the extent of the protective action, if any, of medicament against re-infestation by larval ticks, and the effect of subsequent rainfall on the efficacy of treatment. Later, further experiments were planned varying the composition of the arsenical dip and investigating the possibilities of other parasitological substances as cattle dips. An amount of valuable information was gathered as a result of these experiments, but it was found that a great deal still remained to be learned, and therefore during the past year the Committee recommended that an isolated area be procured, where experiments could be carried out under natural conditions. Accordingly a property at Samford was selected, and rented for a period of two years, and experiments are now in progress on this area. The cattle which have been purchased and placed here are considered for all practical purposes to be in quarantine, and trespassing on the area is strictly prohibited. The main purpose of the experiments is to discover the most suitable interval between dippings, and the composition of dipping fluids resulting in the optimum economic results.

Some of the results of the work of the Committee are reported in the quarterly *Journal* (Vol. I., No. 3).

VII.—ANIMAL NUTRITION INVESTIGATIONS.

1. *Division of Animal Nutrition.*—The Division of Animal Nutrition, under the direction of Professor T. Brailsford Robertson, has been established to carry out an extensive and fundamental investigation into problems associated with the nutrition of stock in Australia. For many years to come the work, which is being carried out in co-operation with the University of Adelaide, will be confined to the study of sheep. The ultimate aim of the investigation is to obtain information, whereby sheep living in various localities and climates of Australia may be so fed as to yield the best economic results. Particular attention will be given to the effect of various proteins and minerals. Details of the proposed work appear in the first number of the *Journal* of the Council.

As indicated in the previous report, a laboratory is being erected in grounds provided by the University of Adelaide. A tender for the erection of a suitable building at a cost of £12,070 was let some time ago, and it is to be expected that the building will be completed and ready for occupation early in October, 1928.

In addition to the above laboratory scale work, it is proposed to ascertain the relationship between weight and age of sheep in various typical pastoral districts, and at the same time to correlate these results with the production and quality of the wool. Further, as data regarding the fodder plants, stock waters and underlying geological formation in these districts are obtained, it will probably be possible to correlate definite deformations of the growth curves of the sheep, with definite fodder, soil, water or climatic conditions. As a result, it will probably be possible to ascertain at what age the animal most particularly suffers from a given deficiency, that age being the period at which correction of a deficiency is most essential. In order to obtain these data, field stations have been established at the Waite Agricultural Research Institute, at "Kolendo" Station, near Port Augusta in South Australia, at Buln-Gherin, near Beaufort, Victoria, and at "Keytah" Station, near Moree, New South Wales. The field stations are quite simple establishments and consist essentially of a weighing machine, with a few sheep pens attached. In each case, the owner of the station has agreed to make the necessary small number of sheep available for the work.

2. *Mineral Deficiencies of Pastures.*—As indicated in the previous report, the problem of mineral deficiencies of pastures is at present exercising the minds of agricultural authorities throughout the Empire. The Empire Marketing Board has made funds available on a contributory basis for carrying out research on this problem in Australia. The Australian investigations are centred at the Waite Agricultural Research Institute, under the supervision of the Director of the Institute, Professor A. E. V. Richardson. The Council also is contributing towards the cost of the work, in accordance with the co-operative agreement outlined in the previous report.

3. *Regeneration of Pastures—Investigations at Koonamore.*—A considerable proportion of the pastoral activity of Australia is in regions where the annual average rainfall is less than 10 inches. In many of the dry regions, the effect of continued grazing of the natural vegetation is very marked. Many areas have been over-grazed, and little knowledge is available as to the nature of the re-growth of plant life under such conditions. A study of the regeneration of native vegetation in such areas thus becomes of importance. Investigations of this nature have been in progress at Koonamore (N.E. South Australia) for some time. They were commenced by the University of Adelaide on an area of 1,000 acres of eaten-out salt-bush country, vested in the University as a vegetation reserve for research work. The main objects of the investigations are :—

(*a*) the study of the regeneration of natural vegetation,
(*b*) the study of the effect of grazing of known intensity on the process of regeneration, and
(*c*) the study of the ecology of the area.

The original investigations were carried out under the direction of Professor T. G. B. Osborn, late of the University of Adelaide, but now of the University of Sydney. Subsequent to Professor Osborn's transfer, it was arranged that the investigations at Koonamore would be undertaken by the Council, in co-operation with the University of Adelaide. A sum of £200 has been provided by the Council for capital expenditure, and it has also been arranged that the Council will provide from £550 to £650 to meet general expenses, including the salary of a full-time investigator, Mr. T. B. Paltridge, B.Sc., who is located at Koonamore.

4. *Visit of Dr. J. B. Orr.*—At the invitation of the Council, Dr. J. B. Orr, Director of the Rowett Research Institute, Aberdeen, was freed by the governing body of the Institute for the necessary time and visited Australia in April, 1928. Half the costs involved were borne by the Empire Marketing Board. Although Dr. Orr was able to remain for a period of some two months only, he saw many types of pastoral country in that time.

The visit was of special importance to Australia as, in addition to giving much helpful advice, Dr. Orr was able to obtain first-hand information in connexion with Australian nutritional problems, and to make personal contact with Australian investigators of such problems. In view of the probable establishment at the Rowett Institute of the proposed Imperial Bureau of Animal Nutrition, the visit was of considerable general importance.

5. *Proposed Investigations in Cloncurry District, Queensland.*—Whilst on a tour in Queensland, Professor Brailsford Robertson's notice was drawn to a problem that occured over large tracts of country, extending from about Cloncurry in the South to practically the Gulf of Carpentaria in the North. A similar trouble, apparently, occurs also in other Queensland areas, for example around Hughenden. It has been found that a flock introduced into the districts in question remains practically stationary in numbers, or in other cases, the rate of natural increase is very much lower than normal. Nothing is known as to whether the trouble is due to a mineral deficiency, or to other causes, such as the action of bacteria, &c.

The consideration of a possible investigation of the problem is in abeyance for the time being, pending the restocking of parts of the area subsequent to its almost complete depletion during the recent dry period.

VIII.—ENTOMOLOGICAL PROBLEMS.

1. *Division of Economic Entomology.*—Progress has been made with the organization of the Division of Economic Entomology. Dr. R. J. Tillyard, F.R.S., late Assistant Director of the Cawthron Institute, New Zealand, has been appointed as Chief of the Division. Towards the end of April he left on a visit to Europe and America where, *inter alia*, he will make arrangements for the study and supply of insects likely to be of service in the control of Australian insect and plant pests. Prior to his departure, he furnished the Council with a report on a general scheme of research for the Division. This scheme, together with information on the personnel, laboratories, &c., necessary for its initiation, has been published in full in the May issue of the Journal of the Council.

In the first instance the lines of research that will be undertaken will be mainly those delimited by the broad term "methods of biological control". They may therefore be divided into the two following types:—

(*a*) the control of insect pests by beneficial parasites or predators, and
(*b*) the control of noxious weeds by their natural insect enemies.

The weeds which Dr. Tillyard suggests might first be investigated are St. John's wort, saffron thistle, the burrs, stinkwort, Scotch thistle, Patterson's curse, hoary cress, and skeleton weed. Also, work might be done on the blackberry, ragwort and gorse, in collaboration with New Zealand entomological organizations which are already working on them.

Among the noxious insects, he suggests that attention should be given to the sheep blowfly, buffalo fly, pests of orchard and fruit crops, such as thrips, the lucerne flea and pea mite, the underground grass-grub of Tasmania, and certain insect pests of forests.

Although Dr. Tillyard's scheme will not be carried out in all its details, effect will be given to it in the main. It is proposed that a central research laboratory be erected at Canberra and that, in addition, sub-stations be put up in other localities where necessary. Plans for the central laboratory are now under consideration.

Some appointments to the staff of the Division have already been made. Mr. G. F. Hill, who has been on the entomological staff of the Council for some time, is at present acting as Deputy-Chief to Dr. Tillyard. In addition, applications have recently been invited for appointment to three positions of Senior Entomologist. Consideration is now being given to the applications that have been received. Two of these senior appointees are intended for work on noxious insects and noxious weeds, respectively. The other will be stationed at the central laboratory of the Division at Canberra, and will be required to give expert advice and technical assistance in various branches of the investigations, and to take charge of the museum. Some appointments of less experienced investigators than those required for the foregoing positions have already been made. Messrs. F. Holdaway, S. Garthside and J. Evans, who have recently completed either one or two years post-graduate training under the Science and Industry Endowment Fund, have now been attached to the Division in suitable capacities.

The potential importance of the Division of Economic Entomology from the point of view of many Australian problems can scarcely be over-rated. The Council is continually receiving urgent requests for help in connexion with the depredations of insect pests. Now it is the Rutherglen bug in Victoria, then the lucerne flea in South Australia and Western Australia, and so on. The total economic loss caused by insects in a country such as Australia, where the main industries are primary and will be for many years to come, must be enormous. Dr. L. O. Howard, formerly Chief of the United States Bureau of Entomology, and President of the recent

Fourth International Congress of Entomology, has stated that in his country alone the economic losses due to insects amount to £400,000,000 per annum or, in other words, the work of more than 1,000,000 men is annually nullified.

Up to the present it has been quite impossible for the Council to afford the help desired by Australian primary producers, for without the necessary personnel and laboratories effective work is obviously out of the question.

2. *Co-operation of Empire Marketing Board.*—After consideration of the scheme put forward by Dr. Tillyard the Empire Marketing Board has recently decided to co-operate in the entomological work of the Council on a very considerable scale. It has offered to contribute towards the cost of the work on a £ for £ basis with the Council to the extent of £25,000 for capital expenditure, and, in addition, to contribute towards the annual maintenance cost at the rate of £9,275 per annum for the first two years, £6,895 per annum for the subsequent two years, and £4,710 for the fifth year. This offer has been very gratefully accepted. Further, as a result of suggestions made by the Board, Dr. Tillyard's scheme has, to a certain extent, been modified. In the original scheme a tentative suggestion was made that the towns of Montpelier and Toulouse in the south of France should be made the bases for the supply of European insects likely to be of use in Australia. It has been decided not to proceed with that suggestion, but instead to centre the European work at Farnham Royal, the "parasite zoo" towards which the Empire Marketing Board has made substantial contributions.

3. *Arrangements for Importation of Insects.*—The question of quarantine measures naturally arises in connexion with any importation of insects into Australia. The quarantine measures in Australia are administered by the Federal Department of Health and accordingly the whole question of the Council's intended importations of insects has been discussed with that Department. As a result, mutually satisfactory arrangements have been made. Briefly, these arrangements are that the Council will give notice to the Department of its intention to import certain specified insects and at the same time will furnish full details concerning the life history, the hosts, the hyper-parasites, &c., of the insects. Every consignment will remain subject to the provisions of the Quarantine Act until released or destroyed. When the Council's experiments with the insects in quarantine have been completed a full report will be forwarded to the Department together with a recommendation as to the destruction or release of the insects. No action will be taken by the Council on either recommendation until approval is given by the Department.

4. *The Buffalo Fly Problem.*—The buffalo fly continues to be a most serious menace to the cattle industry of the Northern Territory, and of the North of Australia in general. It has spread eastward as far as the Queensland border, and, in one or two isolated localities, over that border.

Further information has been obtained as to the possibilities of *Hydrotaea dentipes* as a possible parasite of the fly. Unfortunately, the use of this insect does not appear to be promising, as attempts made in England to breed it in dung have failed. A somewhat peculiar aspect of the whole problem is the fact that the buffalo fly, while certainly occurring in India and British and foreign Colonies and Protectorates in Africa, does not constitute a pest in those places. Consequently, little scientific work on the genus has been carried out, and the reason why it does not constitute a pest is therefore not known.

By the kindness of Dr. B. Maaesmach, Director of the Veterinary Institute at Buitenzorg, Java, a member of the staff of the Institute, Dr. O. Nieschulz, has been working on a particular phase of the buffalo fly problem for some time. This work, which is being undertaken at the expense of the Council, is directed to the discovery of parasites likely to be useful in the control of the pest in Australia. Dr. Nieschulz has found some four different varieties of ichneumon fly which parasitize the pupa of the buffalo-fly, and it is possible that these may be of ultimate value here. His work has mainly been centred at Buitenzorg, but it is now proposed to carry out some investigations in Timor, which has a climate much more resembling that of Australia than has Buitenzorg. In addition, Dr. Meyers, of the Imperial Bureau of Entomology, will search for likely parasites of the fly during a two years' visit that he is shortly making to the West Indies. When the Division of Economic Entomology becomes more completely organized, it will be possible to carry out more intensive work on the problem.

5. *Underground Grass Grub.*—Mr. G. F. Hill has continued his work on the underground grass grub in Tasmania throughout the whole of the period under review. The life history and habits of the grub (*Oncopera intricata*) have been thoroughly worked out, and efforts are now being centred on an endeavour to find methods by which the grub may be controlled in a satisfactory and economical manner. Artificial methods of destruction by means of liming, poisoning in different ways, such as by the use of baits, spraying with various mixtures, top-dressing, &c., have been tested, and the relevant efficiencies of the different procedures determined. A report on this work will be issued at an early date.

It has been found that spraying by means of weak arsenical solution is economically feasible on the better classes of grazing land, but that it cannot be profitably employed on hilly and partly cleared areas constituting the less valuable properties. Work aimed at the discovery of an insect parasite likely to be of service in the control of the grub has therefore been continued on the mainland. The Imperial Bureau of Entomology has been asked for its assistance in this direction. Arrangements have also been made for Dr. Woods, of the University of Cambridge, to carry out some preliminary work on an ichneumon fly parasite, which is known to attack *Hepialus*, an allied form in England.

6. *Insect Pests of Dried Fruit.*—The Empire Marketing Board has published Dr. Myers's report referred to in the previous Annual Report. Following on the advice he furnished, several experimental shipments of sultanas have been sent from Australia to London during the past year. On their arrival they have been inspected for their grub contents. The main object of the shipments has been to test the efficacy of boxes lined with paper bags and sealed in various ways. As a result of the work carried out, it has been demonstrated that, provided reasonable care is exercised, insect infestation of dried fruits can be avoided, and the necessity for securing uninfested fruit at the packing houses and using insect-proof containers, is becoming widely known.

7. *Codlin Moth.*—The codlin moth was first recorded in Australia in about the year 1857, when a severe outbreak occurred in Tasmania. Since then it has appeared in all the other States, Western Australia being the last to become infested. Until the present time the method generally employed for its control has been the application of arsenical sprays and powder at certain stages during the development of the fruit. This practice has been almost universally adopted by applegrowers throughout the world. The embargo, which has recently been enforced by public health authorities in Great Britain on apples carrying more than one-hundredth of a grain of arsenic per pound, has given a considerable impetus to the search for other methods of control. Encouraging results have been obtained in California with the use of *Trichogramma minutum* as a parasitizing agent. The technique for the rearing of *Trichogramma* in commercial numbers is not yet very satisfactory and, accordingly, attention is being given by the Division of Economic Entomology to its improvement. Provided a satisfactory technique can be developed for the rearing of the parasites in large numbers, the prospects for the ultimate control of codlin moth by biological methods are bright.

8. *The Sheep Blow-fly Pest.*—In the previous report mention was made of the co-operative arrangement made with the New South Wales Department of Agriculture for work on this problem. During the year, the entomological officer of the Council associated with this work resigned to take up a position with the University of Sydney. The veterinary officer, Mr. Mulhearn, has continued his investigations at the Nyngan Station of the Department.

The above work constitutes but a small part of the effort the Council will shortly make in an endeavour to obtain a solution of the problem, the national importance of which is so very great. The main effort will be initially a search for a method of biological control. This work will be carried out by the Division of Economic Entomology. Its initiation has been delayed pending the organization of that Division and the obtaining of the necessary personnel. Attention will also be given to other avenues along which a solution may lie, e.g., to the use of preparations repellent to the fly.

IX.—FOREST PRODUCTS INVESTIGATIONS.

1. *Formation of Division of Forest Products Research.*—The Council has recently decided to establish a Division of Forest Products. In the first instance, no great expenditure will be incurred in establishing a section to undertake tests of the strengths of timbers. On the other hand, work will probably be undertaken on timber seasoning, timber preservation and the utilization of wood waste and forest products generally. Mr. I. H. Boas, M.Sc., has been appointed to the position of Chief of the Division. He has had many years' experience in matters concerning the utilization of forest products. Under the former Institute of Science and Industry he initiated its work on the production of paper pulp from hardwoods. Prior to joining the staff of the Council he was for some years a member of the technical staff of Messrs. Michaelis, Hallenstein and Co. Pty. Ltd., a large firm of tanners.

Arrangements have been made for Mr. Boas to leave Australia immediately and to visit the Research Station of the Forests Products Research Board of the Department of Scientific and Industrial Research at Princes Risborough, England, with a view to ensuring the utmost co-operation between that organization and the Australian Division. Mr. Boas will also visit the Forest Products Laboratory, Madison, United States of America, on his way back to Australia. On his return he will formulate detailed plans for the operations of the Division.

2. *Visit of Mr. A. J. Gibson, I.F.S.*—Prior to proceeding with the establishment of the above Division of Forest Products Research, the Council obtained advice on the matter from Mr. A. J. Gibson, F.C.H., F.L.S., F.Z.S., a senior officer of the Indian Forest Service. At the request of the Council, Mr. Gibson visited Australia during the latter part of 1927 and, after spending two or three months in visiting all the Australian States, inspecting the more important forestry areas and industries closely concerned with the utilization of forest products, and after considering research work in hand and all the relevant literature that was available, he furnished the Council with a detailed report on the whole question of forest products research in Australia. That report will be published as one of the Council's pamphlets. Briefly, Mr. Gibson recommended the immediate establishment of an Australian Forests Products Laboratory, which he estimated would involve an initial outlay of £49,000 as capital expenditure, and an annual maintenance cost of approximately £19,000.

The report has been considered by the Council, which has decided that, chiefly in view of the expense involved, it could not reasonably recommend the adoption of Mr. Gibson's proposals in their entirety. Effect is, however, being given to his suggestions in a modified form.

3. *Paper Pulp Investigations.*—The semi-large scale tests of the pulping of *Pinus insignis*, mentioned in the previous report, were concluded in November, 1927, and the results showed that a highly satisfactory wrapping paper could be made from that timber. At the present time, it is considered that there is hardly sufficient pulpwood available at any one place to render the production of pulp particularly attractive, as the scale of operations would necessarily be on rather too small a scale to make the proposition economically sound. However, the results have shown the way to the utilization of the thinnings of large *Pinus insignis* plantations at some future date, when these are available in sufficient quantity to keep a 60-ton per day mill supplied. The results of both laboratory and semi-commercial scale investigations have been published in Bulletin 35 ("Kraft Pulp and Paper from Pinus Insignis"). The main cost of the semi-commercial investigation was borne by the Development and Migration Commission.

Subsequent to the above-named tests, the whole staff of the pulp and paper section, with the exception of the newly-appointed cellulose chemist, resigned to take up technical positions with the Tasmanian Paper Pty. Ltd. This company is at present verifying, on a semi-commercial scale, the results which were obtained by the Council in the laboratory, and is spending £50,000 in doing so. It is anticipated that, in a very short time, the company will be in a position to decide whether it will be justified in entering into the wood-pulping industry on a larger scale.

Prior to their departure the research officers brought to a conclusion the work which had been in progress for the previous three or four years on the pulping of the eucalypts by the sulphite (or acid) process. This work has been recorded, and will shortly be published as Bulletin 37 ("Paper Pulp and Cellulose from the Eucalypts by the Sulphite Process").

Other work that was carried out during the year dealt with the possibility of successfully pulping some N. S. Wales scrubwoods, known as the Bulga brushwoods. The results of this work were communicated to the New South Wales Forestry Commission.

The paper pulp laboratory has been closed since early in the year (1928) and, pending further organization of the Division of Forest Products Research, no further work on cellulose and paper has been carried out.

4. *Artificial Silk.*—A small sample of a few pounds weight of high-grade bleached sulphite pulp was sent to the Imperial Institute, London, for report as to its suitability as a raw material in the manufacture of artificial silk. The sample was prepared from upland-grown Tasmanian stringy bark (*Eucalpytus obliqua*). The Imperial Institute has reported, after analysis and submission to one or two commercial artificial silk manufacturing firms, that the material appears to be quite suitable from the technical point of view. It has requested that a much larger sample, approximating a ton in weight, be sent for further tests. Judging from the prices being paid for this material, there appear to be quite good chances of establishing an export trade from Australia in this product.

5. *Tannin Investigations.*—The co-operative arrangement between the Western Australian Forests Department, the University of Western Australia and the Council was outlined in detail in the last Annual Report.

The semi-commercial scale plant then mentioned has since been erected and practical operations commenced. A description of the plant was given in the fifth number of the Council's quarterly *Journal*. The investigation is nearing completion in so far as karri bark in concerned. Later it is proposed to carry out investigations on marri kino, on the bark of ridge gum (*Eucalyptus alba*) and on the barks of various wattles and mangroves. The whole object of the work is the development of a satisfactory tannin extract prepared from Australian raw materials. It is well known that Australia is annually importing large quantities of such substances, notwithstanding the fact that the barks of many indigenous timbers are high in tannin content,

notably varieties of wattles (*Acacias*). One of the present difficulties in the way of preventing the use of many Australian barks and tanning materials, kinos, &c., is the fact that undesirable colour effects are often produced. It is hoped to overcome these troubles by suitable blending.

6. *Empire Forestry Conference*—1928.—The sessions of the Conference will be held in the various State centres. The question of forest products research will also be discussed at Canberra. Mr. Julius and Dr. Rivett will attend the last-named meeting as representatives of the Council. They will furnish the Conference with a statement of the work already carried out by the Council and its predecessors in the field of forest products and will indicate in very general terms the Council's plans for the future.

X.—COLD STORAGE PROBLEMS.

1. *Report by Dr. F. Kidd and Dr. W. J. Young.*—Consideration has been given to the report mentioned previously as having been furnished by Dr. F. Kidd of the British Food Investigation Board, and of Dr. W. J. Young, Associate Professor of Biochemistry, University of Melbourne. The report outlined a scheme for the organization of investigations on cold storage problems, and dealt generally with the related questions of equipment and personnel. Research problems were considered under three main heads, viz., (i) economic research, (ii) technical research, and (iii) fundamental research. The most important recommendations were as follows:

(*a*) As regards economic and technical or applied research, it was recommended that the Council should explore the possibilities of promoting and assisting the formation of industrial research associations,

(*b*) As regards meat problems, especially beef, it was recommended that a full scale experimental abattoir and a fully-equipped biological, bacteriological, physical and chemical laboratory should be established at one of the existing abattoirs to conduct investigations on storage, handling and transport problems.

(*c*) As regards fruit, it was recommended that investigations be carried out on such matters as the reactions of fruits to temperature, fungal diseases, the effect of various methods of wrapping, sweating, sterilization and packing, and the behaviour of fruit in relation to exposure to air, sugar content, &c.

Largely by reason of the lack of the necessary personnel, it has not yet been possible to give effect to many of the recommendations made, nor to proceed very far with the organization of any Division of Cold Storage Research that might be proposed. The investigations on which work has already been commenced are reported in the paragraphs that follow.

2. *Fruit Problems in General.*—Activities in this field have practically been confined to the work on citrus fruit and bananas reported below. A certain amount of work on bitter pit, however, has been carried out in Western Australia, but this has been reported elsewhere (*see* Section III). It has not yet been possible to study the storage conditions of other fruits nor to carry out further work on shipboard conditions.

3. *Problems of the Preservation of Citrus Fruit.*—For some considerable time it has been felt by those connected with the production of citrus fruit, that the industry could be considerably expanded if means were discovered whereby citrus fruit could be successfully stored for a period sufficiently long to permit its export to British and other markets, and, further, to make it capable of being placed on the Australian market throughout the greater part of the year.

Methods adopted in South Africa were investigated by Dr. W. J. Young on the occasion of his visit to that country last year. Californian methods were investigated by Mr. W. Ranger, Manager of the Queensland Committee of Direction of Fruit Marketing, also last year. Dr. Young and Mr. Ranger have recently collaborated and prepared a report on the matter which has been issued as the Council's Pamphlet No. 7 entitled "The Export of Oranges."

A recent development, the outcome of two conferences, one called by the Minister for Markets and the other by the Council, is a decision reached by the Victorian Department of Agriculture, the Victorian Railways Commissioners, the Victorian Central Citrus Association, and the Council, to co-operate in a series of experiments on a number of different preservative methods. This work is being controlled by a Committee nominated by the second Conference and appointed by the Council, consisting of the following:—

Dr. W. J. Young (Chairman), Biochemistry Department, University of Melbourne
W. D. Bracher, Esq., Victorian Railways.
Captain D. Halhed, Victorian Citrus Growers' Association.
J. Hepburn, Esq., Chief Engineer and Works Manager, Victoria Dock Cool Stores, Melbourne.
W. Ranger, Esq., Manager, Committee of Direction of Fruit Marketing, Queensland.
F. M. Read, Esq., Department of Agriculture, Victoria.

The Committee has drawn up a programme of work embracing the carefully supervised handling of the fruit from the tree to the final packing, and aiming at the elimination of all factors, other than the preservative method employed, which might influence the keeping qualities of the fruit. The object of the work will thus be a study of the effects of different preservative treatments. In the absence of proper equipment for the processes to be employed, it became necessary to improvise. A loan of equipment from the Lightning Fruit Grader Company, Melbourne, has been of very great value to the Committee. It is anticipated that all arrangements for the experiments will be completed early in September. Following the various treatments, the fruit will be placed in cool storage and its rate of deterioration noted.

4. *Banana Investigations.*—Preliminary inquiries regarding the condition known as "squirter", which often appears in bananas, particularly in those that are sold in the markets of the south, have been completed. From the information thus obtained it has become evident that a general study of the maturation, transport and storage of the fruit is desirable. This work will involve studies in environmental conditions during maturation, such as the influence of carbon dioxide, humidity, &c. Exact details of the history of the fruit used in experimental and observational consignments will also be necessary.

Arrangements have been made for the necessary laboratory work to be carried out at the Universities of Queensland and Melbourne, under the direction of Acting Professor L. S. Bagster and Associate Professor W. J. Young, respectively.

A Committee consisting of Mr. W. Ranger, B.Sc., Committee of Direction of Fruit Marketing, Queensland (Chairman), Acting Professor L. S. Bagster and Associate Professor W. J. Young, has been established to control the investigations. Small chambers, each about 14 feet by 7 feet by 3 feet 6 inches, will be erected at the Universities of Queensland and Melbourne and will be provided with refrigeration apparatus for the maintenance of low temperature. In these the various storage investigations will be carried out. One assistant to carry out the laboratory work and also some field work will be appointed in Queensland and another in Melbourne.

In addition to the Universities mentioned, the Committee of Direction of Fruit Marketing, Queensland, has offered valuable assistance, particularly in the provision and collection of the necessary fruit.

5. *Meat Problems.*—The investigations on meat preservation which are being carried out by a committee of the Australian National Research Council, subsidised by a grant from the funds of the Council, and helped also by various facilities made available by the Victorian Department of Agriculture and by the University of Melbourne, have been continued. The problem, however, is a difficult one. The work has been confined to a study of the freezing of beef and its subsequent thawing if possible in such a way as to avoid drip in the thawed material. The lack of an accurate quantitative method whereby drip may be measured has proved a serious hindrance to the progress of the work, and a considerable amount of attention has been given to the development of such a method. Previously, slices of the meat were placed between pieces of blotting paper and the "drip" so abstracted by pressure. It has been found that this method is not so reliable as another one that has been developed depending on the use of rubber bags.

XI.—OTHER INVESTIGATIONS.

1. *Geophysical Prospecting.*—To give effect to the acceptance of the offer of the Empire Marketing Board to contribute half the cost of investigations into methods of geophysical prospecting, the Geophysical Prospecting Act 1928 was passed in June. The Act appropriated the sum of up to £20,000 as the Australian contribution to the funds required.

The Government has decided that the work will be controlled, and the funds administered by an Executive Committee, the present constitution of which is as follows:—

Dr. A. C. D. Rivett (Chairman).
G. A. Julius, Esq., Council for Scientific and Industrial Research.
H. W. Gepp, Esq., Development and Migration Commission.
W. E. Wainwright, Esq., representing the Australian Institute of Mining and Metallurgy.
Professor T. H. Laby, Department of Natural Philosophy, University of Melbourne.
*E. C. Andrews, Esq., Government Geologist, New South Wales.
*Dr. L. K. Ward, Director of Mines, South Australia.

* Representing the Departments of Mines of the six Australian States.

Active operations were commenced in Australia towards the end of the period under review and two parties are now in the field. One of these will specialise on gravimetric and magnetic methods and the other on electrical methods. The gravimetric section has commenced work in an area of country at Gelliondale in Gippsland, Victoria, and the electrical section in an area at Anembo near Lake George, New South Wales.

As at present constituted the staff of the Survey, which is known as the Imperial Geophysical Experimental Survey, is as follows :—

Director—Mr. A. Broughton Edge, B.Sc., A.R.S.M.
Deputy-Director—Dr. E. Bieler, M.Sc., Ph.D. (Cantab.).

Gravimetric Section—

Dr. N. B. Lewis, M.Sc., Ph.D.,
Mr. E. L. Blazey, B.E.E. (Melbourne.)
Mr. S. H. Shaw, B.Sc., A.R.S.M.

Electrical Section—

Mr. J. C. Ferguson, B.Sc.
Mr. Lewis Richardson (Surveyor.)

Field Secretary—

Mr. W. H. Scott.

Of the above, Mr. Ferguson and Mr. Shaw are English University graduates who were previously with Mr. Edge in Rhodesia. At the conclusion of the operations of the survey in February, 1930, they will return to Mr. Edge's service. With the exception of Dr. Bieler, who is Assistant-Professor of Physics at McGill University, Canada, the others are Australians. Arrangements have been made for the individual Australian members to obtain experience in all methods, the idea being that they will remain in Australia and possibly undertake further work at the end of the Survey. In addition, certain of the State Departments of Mines are considering the attachment of their own officers to the Survey for training and experience in the methods.

The whole object of the Survey is to conduct as thorough an investigation of geophysical methods of prospecting as is possible in the time and with the money available. The trials will be of an experimental nature and will be carried out in specially selected districts where the type of mineralization and geological conditions are considered to be suitable. When possible, tests will be made over known ore bodies and in areas where the geological structure has already been fully determined. As a result of this experimental work it is anticipated that the Survey will be in a position to provide valuable scientific and practical data regarding the conduct of geophysical exploration for general use throughout the Empire ; also that the activities of the party will result in the employment and further development of this class of work within the Commonwealth.

The actual details of the administrative work are largely attended to by officers of the Council and the above report was made at some length because of that.

2. *Dairy Research.* The Council has experienced considerable difficulty in initiating a programme of research on dairying problems. It is aware of the great importance of the dairying industry to the national welfare and realises that the application of scientific knowledge to the industry must inevitably lead to a material increase in production. One of the difficulties met with, however, has been the reconciliation of conflicting views hitherto held as to the part which the Council might take in any organized scheme of dairy research. The whole matter is discussed at length in an article by Professor Richardson appearing in the fourth issue of the Council's Journal.

At a meeting of the Standing Committee of Agriculture held in March, 1928, it was resolved :—

" That this Committee is in accord with the suggestion that the Council for Scientific and Industrial Research should undertake research on problems affecting the dairying industry. It is considered that not more than one bacteriologist and one chemist would be required in the immediate future."

The Council has now decided to initiate some dairy research in a small way and has accordingly invited applications for the positions of dairy bacteriologist and dairy chemist.

3. *Fuel Problems.*—Further consideration has been given to the attitude the Council should adopt towards research work relating to the important national problem of liquid fuels. At the present time, Australia is almost entirely dependent on other countries for the supply of these necessary and important products.

No change has been made in the policy mentioned in the previous report, namely, that of merely watching the course of developments in other countries. Research in connection with the production of liquid fuels from coal, either by low temperature distillation or by hydrogenation, &c., involves the provision of complicated apparatus and is, therefore, costly. Moreover, large sums on such researches have been spent by private and public interests in various European and American countries. The British Fuel Research Board is in close touch with all the developments that have arisen in regard to such matters, and, as is well known, it itself has been engaged for many years on an extensive programme of liquid fuel research. As a result of the close liaison that exists between the British Department of Scientific and Industrial Research and the Council, and also of the further development of team spirit in bodies interested in research throughout the Empire, Australia is in the fortunate position of knowing that information concerning any important developments in the field of liquid fuel research will be made available to her.

As regards power alcohol, the laboratory scale investigations have been continued under the direction of Professor Wilsmore of the University of Western Australia. The actual experimental work is being carried out by two of Professor Wilsmore's senior students and accordingly the most rapid progress is made during the long summer vacation. As in the previous year, the work has been confined to an examination of the hydrolysis of hardwood sawdust, mainly karri, by means of concentrated hydrochloric acid, and to a study of the resultant sugars. No quantitative fermentation tests have yet been made.

4. *Australian Radio Research Board.*—Professor J. P. Madsen, Chairman of the Board, returned to Australia early in 1928 after a visit to Europe and America. When in Great Britain he took the opportunity of discussing matters with the authorities of the British Radio Research Board, and obtained from them a report as to an appropriate programme of research that might be initiated in Australia in co-operation with the British Board.

Towards the end of 1927 the report of the Royal Commission on wireless, which had been sitting throughout the year, was published. It discussed, *inter alia*, scientific research in radio matters and the Commission recommended "That a special appropriation sufficiently large to enable the present problems in radio to be thoroughly investigated should be made available to the Council for Scientific and Industrial Research", and that a substantial sum of money should be placed at the disposal of the Radio Research Board if adequate work was to be carried out.

After the return of Professor Madsen, further consideration was given to a programme of research for the Board in the light of the British report and of the above recommendations. The Board * reported as follows :—

(i) One of the most important and urgent investigations needing the Australian Radio Research Board's consideration (in conjunction with the Postmaster-General's Department) is the scientific research involved in the allocation on a scientific basis of wave lengths for broadcasting.

(ii) The study of the technical problems of broadcasting in Australia as a whole is needed with a view to reaching people in the country and the remoter areas. It is to be added that in the opinion of the Board the people now living in the remote areas are not able to receive the service they should and the rendering to them of a better service is one of the problems which should be scientifically studied.

(iii) The following items in the programme suggested by the British Radio Research Board are of particular importance to the solution of the problems mentioned in (ii) above :—

(*a*) Investigations by Professor Stapledon's experiments (i) to ascertain the most suitable wavelengths for all sound transmission during daylight and dark hours, and (ii) to elucidate problems of fading.

(*b*) A study of atmospherics and of potential gradients in Australian atmospheres.

In the opinion of the Board, the above programme would involve the expenditure of about £8,000 per annum. Steps are now being taken to ascertain whether a proportion of this amount can be made available from sources other than the Council.

In the meantime the Board is continuing to co-operate with the Universities of Sydney and Melbourne in a determination of the distribution of field intensity around important local stations. It is hoped as a result of this work to obtain information on which to base a further

* At the time the Board's report was made, Mr. H. P. Brown, of the Postmaster-General's Department, and also a member of the Board, was absent from Australia. The report has since been somewhat modified.

improvement in the service of the present stations or the placing of future stations in the most effective positions. The Board is also co-operating with the Watheroo Magnetic Observatory in a study of atmospherics, and recently furnished the Observatory with an atmospherics recorder.

5. *Committee on the Maintenance of Standards.*—This Committee has been set up in order to facilitate further action on matters relating to the maintenance of standards in Australia.

On his return to Australia early in 1928, the Chairman (Professor Madsen) brought with him the draft of an extensive and comprehensive report from the National Physical Laboratory, Teddington, England, on the whole question. The formal report was subsequently transmitted to the Council by the Department of Scientific and Industrial Research, London. The Department also offered most valuable co-operation over a term of years in connexion with the periodical testing of Australian primary standards, and in other ways.

The Committee is of the opinion that little can be done until the Commonwealth introduce legislation relating to weights and measures. This function was granted to it under the Federal Constitution, but so far it has not been exercised. The suggestions and recommendation made in the report of the National Physical Laboratory are now being considered further.

6. *Flying Fox Problem.*—A most serious menace confronting fruit-growers in Queensland and New South Wales is that of the large fruit-eating bats commonly known as flying foxes. There are five species in Australia, the commonest by far being *Pteropus poliocephalus*. The animals are nocturnal in habit and very gregarious living in " camps " of hundreds of thousands of individuals.

The comparative failure of obvious methods of control such as shooting, poisoning, &c. was mentioned in the previous report. It has now been decided to approach the problem from a fundamental basis and to collect further details concerning the biology of the animal. In order that a full study may be made of all sides of the problem, the Council and the Departments of Agriculture of New South Wales and Queensland have agreed to contribute £500 each towards the cost involved. Applications have been called for an investigator to carry out the work at a salary of £600 per annum for two years. The appointee will be expected to make a systematic biological study of those species of flying fox which are a pest in certain parts of Australia, and he will also be required to seek quantitative evidence as to the ravages of the animal and obtain as accurate an estimate as possible of the losses it is causing to the fruit and other industries in New South Wales and Queensland. The ultimate object of the whole investigation will be the attainment of a satisfactory method for large scale destruction of this serious pest.

7. *Pottery Investigations.*—In the previous report, mention was made of the valuable work carried out under the former Institute of Science and Industry on the utilization of Australian clays for the manufacture of the higher grades of whiteware and chinaware. Mention was also made of the sending to England of Mr. R. C. Callister for a special course of training at the Ceramic School at Stoke-on-Trent. Shortly after his return to Australia, Mr. Callister received an offer of an important position with a firm of Australian potters. After full consideration, the Council decided to allow him to resign as it all along had regarded his visit to England as being of a somewhat similar nature to the sending abroad of research trainees. It also considered that his direct transfer to industrial operations would result in the greater application of science to an important Australian industry.

8. *Mineragraphic Investigations.*—Dr. F. L. Stillwell, who is the investigator engaged on this work, was seconded to the Development and Migration Commission for the whole twelve months in order that he might carry out some special geological investigations on the Kalgoorlie mining field. The particular work at Kalgoorlie will be greatly facilitated by the employment of the technique in microscopical examination of minerals by reflected light in which Dr. Stillwell has had considerable experience.

9. *Research in the Field of the Secondary Industries.*—Consideration has been given to the policy the Council should adopt in regard to investigations in the field of secondary industries. The Council is inclined to the view that, in general, research work in the secondary industries should be carried out by these industries themselves which are more favorably placed to carry out investigational work than are the primary industries. At the present time the main operations of the Council are confined to primary industries. As regards secondary industries, it is felt that it may be well in time to aim at the establishment of research associations of a nature similar to those already in existence in Great Britain. If such associations be formed in Australia the Council will explore the possibilities of co-operation with the corresponding bodies in Great Britain. It is known that some of the latter would welcome such co-operation and would also welcome Australian firms as members, although in other cases requests to be admitted would not be favorably considered.

Despite what has just been mentioned, it is felt that there are certain cases in connexion with the secondary industries where the assistance of the Council might rightly be claimed without the formation of an association. In general, however, the Council has for the time being adopted the policy of giving the greater part of its attention to the problems of the primary industries.

XII.—MISCELLANEOUS.

1. *Publications of the Council.*—Consideration has recently been given to the question of responsibility for the accuracy of scientific work and conclusions recorded in the various publications of the Council. The attitude that has been adopted is outlined in the fifth issue of the *Journal*. Briefly it is considered that while it is the Council's duty to secure the best men available under prevailing conditions to take charge of its several Divisions, these men and their colleagues must carry full responsibility for the work which they place on record. They, and not the official heads of the organization, are entitled to receive in enhanced reputations and in other ways the reward of the excellence of their work. Hence too they must accept responsibility for errors if any occur.

The following publications were issued during the period under review :—

(i) *Bulletins*—

No. 34.—The Biological Control of Prickly Pear in Australia, by A. P. Dodd.
No. 35.—Kraft Pulp and Paper from *Pinus insignis*, by L. R. Benjamin, J. L. Somerville, R. B. Jeffreys and W. E. Cohen.

(ii) *Pamphlets*—

No. 4.—The Bionomics of *Smynthurus viridus* Linn. or the South Australian Lucerne Flea, by F. G. Holdaway, M.Sc.
No. 5.—Liver Fluke Disease in Australia—Its Treatment and Prevention, by I. Clunies Ross, B.V.Sc.
No. 6.—Standard Methods of Drying Sultana Grapes in Australia, by A. V. Lyon, M.Agr.Sc.
No. 7.—The Export of Oranges, by W. Ranger and W. J. Young, D.Sc.

(iii) *Quarterly Journal*—

Vol. I., No. 2.—November, 1927.
Vol. I., No. 3.—February, 1928.
Vol. I., No. 4.—May, 1928.

In addition to these printed publications, the issue of the confidential Monthly Summary to members of the Council and of its State Committees, and to the principal scientific and technical officers, has been continued.

2. *Library.*—Throughout the year a steady increase has been maintained in the number of volumes on the library shelves. As heretofore, particular attention has been paid to periodicals and the list now includes 270 current journals of which number 116 are received as exchange and 154 are purchased. The issue of the quarterly *Journal* places the Council in a better position to arrange exchanges with other scientific institutions than was formerly the case. Besides members of the Staff of the Council, the general public and officers of Government Departments are using the library to an increasing extent.

The most important event of the year has been the gift to the Council of the library which had been collected by the Australasian Association for the Advancement of Science. The Association considered that this collection would be of most use if it were to form the nucleus of a scientific library in Canberra and with this end in view asked the Council to accept it and to add it to the Council's own. The offer has been gratefully accepted. The whole collection is, of course, entirely of a scientific nature, consisting mainly of scientific periodicals and transactions of scientific societies throughout the world. The list includes 223 periodicals, many of which are in a complete series from the first volume published to date. Unfortunately, it has been found impossible to accommodate the gift in Melbourne and it has, therefore, been stored in Canberra until such time as the Council is established there.

With the formation of the various Divisions of the Council, the need for better library facilities will grow. The lack of such facilities at Canberra is one of the difficulties that must be faced with the transfer of a large proportion of the Council's activities to that place. In the Public Libraries that have been established for many years in the various State capital cities, a valuable collection of scientific literature has been accumulated and it is hardly to be expected that Canberra will have equivalent collections to offer for many years to come. The provision of adequate library facilities for the various Divisions of the Council that will be established at the national capital therefore becomes a very important matter. The whole question of the development of the present library of the Council, and of its relations to the various out-stations, is now under consideration.

3. *Catalogue of Scientific Periodicals.*—Work is proceeding in bringing up to date the card catalogue of all scientific and technical periodicals in the public and semi-public libraries of Australia. The compilation, which is being carried out by Mr. E. R. Pitt, M.A., of the Melbourne Public Library, has been very greatly facilitated by the cordial co-operation afforded by the authorities of the many libraries concerned. The object of the catalogue is to facilitate the work of scientific investigators in the Commonwealth. It is, for instance, particularly useful, in a country of such large distances, for research workers to be able readily to ascertain which libraries contain particular periodicals they desire to see. Often such periodicals are comparatively rare in Australia. The value of the catalogue to librarians is also obvious.

Entries have already been received from 132 Australian libraries. In addition, some 213 publishing societies and departments have been asked for details as to works issued by them. It is estimated that the compilation work in card form will be completed before the close of the year 1928. It is difficult to estimate how long the printing will take, as delay may arise owing to the necessity of using foreign letters and symbols in certain cases.

4. *Council Representation in Great Britain.*—So far as his relations to the Council are concerned, the position held by Mr. F. L. McDougall, C.M.G., has been altered to that of Representative of the Council in Great Britain. He and his officers have continued to furnish valuable reports on various matters and constitute a most useful means whereby the Council is readily able to obtain information on recent scientific developments in practically any subject whatever. In addition, the services of Mr. McDougall have been of particular value during the negotiations for co-operative investigations between the Empire Marketing Board and the Council. The contributions of the Board towards present and future scientific investigations of the Council have been most generous, and their total value is large.

5. *Accounts of the Council.*—Since its inception, the accounts work of the Council has been carried out by officers of the Prime Minister's Department. Following on the transfer of that department to Canberra, it soon became apparent that it would be desirable to have the work done at the Council's own offices, in order that the very closest touch with the large expenditures of the Council might be maintained and that information of financial matters might be available at short notice. Arrangements have been made with the Treasury accordingly. Appropriation ledgers, &c., will be kept at the headquarters office and it will thus be an easy matter to make dissections of expenditures in various ways with a view to ensuring that an effective and close control of the Council's disbursements shall be exercised.

6. *General Scientific Advice to the Government.*—The Council is more and more coming to be recognized as a source of general scientific advice to the Government, both on matters which it is itself investigating, and on others also. Throughout the year a large amount of such advice was given on a varied assortment of subjects such as: noxious weeds, phosphatic rock, animal diseases, bitter pit, preservation of citrus fruit, tidal power, dingo pest, droughts, bunt in wheat, &c. In addition, advice was given as to Australian representation on a number of miscellaneous scientific congresses and other meetings of an international nature.

7. *Bureau of Information.*—One of the functions of the Council is the establishment of a Bureau of Information for the collection and dissemination of information relating to scientific and technical matters. A considerable amount of information has thus been given to outside organizations and to members of the general public. During the period under review the more important matters so dealt with are as follows:—

(*a*) *Agriculture.*—Smut in wheat; feeding stock with prickly pear; conservation of fodder; storage of potatoes; potato by-products; damage to orchards by frosts; determination of flour strength; effect of nutrition on fruit quality; bitter pit; irrigated lands; pineapples and acidity of pineapple juice; flax; prevention of the destruction of sugar cane by frost; passion fruit; growing cactus for commercial use; apple products (biblio.); drought-resisting wheat; cattle dip—Derris root; sugar content Australian dried fruits; research in agricultural economics; effect of minerals on sheep; cystine, &c.; artificial farmyard manure; vitamins in Australian butter; meal or flour from "paddy" rice; sheep branding fluids; coco-nut fibre; Queensland fruit fly; wool investigation; possible medicinal values of firewood; arsenical dips as preventatives of blowfly attack on sheep.

(*b*) *Patents and Inventions.*—Electro-culture; defrosting process; dyeing—Lloyd process; power production; device for rescuing from submerged vessels; patent engine; water wheel; ship construction; droughts and dew ponds.

(c) *Processing.*—Dried fruits—insect containers; refrigeration of rabbits; distillation of spirits; foam in soft drinks; scientific treatment of leather; coal distillation products; smoke abatement; drying of fruit; nitrogen fixation; cements for leather surfaces; drying stoves for fruit dehydration; low temperature distillation of coal; drying of grape juice; physics of fruit juice evaporation mechanism; candied peel; lemon juice—resistant enamel, &c.; dextrin; concentration of fruit juices.

(d) *Minerals, Metals, &c.*—Testing fireclay; clay; charcoal; magnesite; brick-making plant; mineral samples; South Australian lignites; sulphur pyrites; copper; also marking of; muses of magnesite; silver-plating—spotting out; blackening of aluminium; punctures in tin collapsible tubes; markets and uses of ground mica.

(e) *Forests Products.*—Queensland Black Walnut timber; utilization of waste fibre; analysis of dust (tannin survey); exposed jetties (timber preservation); white ants (timber preservation); Guildford grass—horsehair; paper pulp; eucalyptus oil; paper pulp from *Pinus insignis*; Huon pine oil; forest products research in Empire; examination of Esparto paper sample; turpentine from firs; mechanical tests on timbers; yacca gum (Xanthorrhoea); tanning materials; the growth of wattle bark; tung-oil industry; wattle—Uromycladium notabile; Australian timbers—clothes pegs; Xanthorrhoea—Yacca gum—quantities available; utilization of waste pine shavings; growing Esparto for paper pulp; specimen samples coniferous woods; paper pulp from cornstalks; gums and resins; power alcohol; paper pulp and rubber; calorific value of timbers.

(f) *Biological and Botanical.*—Plant called "Pitcheri"; growth of rainbow trout; silver fish in woollen goods; borers in furniture; orchids; cultivation of castor oil plant.

(g) *Miscellaneous.*—Tidal power; wax-like substances, King Island; siphonic suite—sanitary ware; water testing methods; British Cast Iron Research Association; Industrial Research Associations, Great Britain; alcohol distillery industry liquid fuels.

8. *Commonwealth Scientific Publications Committee.*—Consideration has recently been given to the question of the publication of certain memoirs, reports, &c., embodying the results of special investigations on scientific matters in Australia, as carried out by independent investigators or institutions. Ordinarily, many of these memoirs and reports are not suitable, mainly on account of their length, for publication in any existing journals, or series of bulletins, &c., and no funds are available for their publication through any other channels; nor are they attractive to commercial publishing houses. As a result, under circumstances that existed previously, there was a grave danger of the results of valuable investigations being lost to science and to subsequent workers in the same field.

On the advice of the Council, supported by the Meteorological Bureau, the Forestry Bureau and the Solar Physics Observatory, the Government has now set up a Commonwealth Scientific Publications Committee, consisting of one representative of the Council, one of the Australian National Research Council, and one of the Treasury. In addition, when any particular publication is being considered, a fourth member will be appointed in an *ad hoc* capacity, so that expert advice on the particular matter covered by the publication will be available. The sum of £1,000 is to be made available annually to the Committee as a special appropriation on the estimates of the Prime Minister's Department.

9. *Closing of Council's Laboratory at Brunswick.*—Since the Council's inception its work on paper pulp, pottery and tannins has been housed in a small chemical laboratory set up in rooms rented from the Brunswick Technical School. The authorities of the School have now asked that the rooms be vacated and the laboratory will accordingly be finally closed down as from the beginning of 1929. This action will not inconvenience the Council, in view of the closing down of its paper pulp investigations and of its pottery work, and of the transfer of the tannin investigations to the extract plant at Perth. The apparatus that was located at Brunswick will be stored at the head office, pending its final allocation to the various Divisions.

10. *Economy Campaign.*—In common with other Commonwealth organizations, the Council is reviewing all its expenditure and commitments in the light of the present financial position of the Commonwealth as a whole. An internal economy committee has been set up to suggest possible economies not involving sacrifice of efficiency.

It has proved possible to effect considerable savings by making purchases from the head office as distinct from the various Divisions and individual investigators. Several other advantages have become apparent as the result of carrying out the necessary administration of the various research activities in one central place. Not the least of these is that arising out of the freeing of the research workers from much routine, and thus enabling them to concentrate more closely on their respective investigations.

11. *Secretary's Leave of Absence.*—The Secretary of the Council, Mr. G. Lightfoot, left Australia in the middle of April last on long service leave. He will be away for about eight months, the greater part of which time he intends to spend in Great Britain and other European countries. Advantage will be taken of the opportunity to visit various research centres and to gather full information as to modern practice in the organization of research activities.

XIII.—STAFF AND FINANCIAL MATTERS.

1. *Staff.*—The following is a list of the staff of the Council as at the 30th June, 1928. It is exclusive of miscellaneous assistants, such as typistes, laboratory assistants, labourers, &c.—

1. Head Office Staff.

Chief Executive Officer—A. C. D. Rivett, M.A., D.Sc.
Secretary—G. Lightfoot, M.A.
Assistant Secretary—G. A. Cook, M.Sc., B.M.E.
Chief Clerk—H. P. Breen.
Order Clerk—R. W. Constable.
Accounts Clerk—M. G. Grace.
Records Clerk—H. T. Chadwick.
Records Clerk—P. Domec Carre.
Ledger Clerk—J. Derum.
Biological Assistant—Jean White-Haney, D.Sc.
Librarian—Ellinor Archer, M.Sc.

2. Secretaries of State Committees.

New South Wales—
Brigadier-General I. G. Mackay—University of Sydney.
Victoria—
G. A. Cook, M.Sc., B.M.E.—314 Albert-street, East Melbourne.
Queensland—
Miss H. Todd—Cr. Ann and Edward streets, Brisbane.
South Australia—
E. V. Clark, B.Sc.—University of Adelaide.
Western Australia—
L. W. Phillips, M.Sc.—Box K.766, G.P.O., Perth.
Tasmania—
F. J. Carter—Box U.B., G.P.O., Hobart.

3. Australia House, London.

Representative in Britain—F. L. McDougall, C.M.G. (part time).
Scientific Assistant—A. S. Fitzpatrick, M.Sc., Ph.D. (part time).
Clerical Assistant—A. W. Stuart Smith (part time).

4. Division of Economic Botany.

At Botany Department, University of Sydney—
Chief—Dr. B. T. Dickson, B.A. (Ontario), Ph.D. (Cornell).
Laboratory Assistant—E. H. Kipps, B.Sc.
At Department of Agriculture, Western Australia—
Junior Plant Pathologist—H. A. Pittman, B.Agr.Sc.

At Waite Agricultural Research Institute, South Australia—
Junior Plant Pathologist—J. G. Bald, B.Agr.Sc.

At University of Sydney, under Direction of Poison Plants Committee—
Assistant Research Officer— C. B. Cox, B.Sc.

At Koonamoore Vegetation Reserve, South Australia (under part-time direction of Professor T. G. B. Osborn)—
Research Officer—T. B. Paltridge, B.Sc.

5. Irrigation Settlement Problems.

Commonwealth Research Station, Griffith—
Liaison Officer— F. K. Watson, M.A., B.Sc., A.M.Inst.C.E. (part time).
Officer-in-Charge—E. S. West, B.Sc., M.S.
Accountant—D. Chalmers (part time).
Orchard Superintendent—B. H. Martin.
General Assistant—W. B. Robson (*vice* W. B. Tart, resigned 17th March, 1928).
Field Assistant—E. F. Mackenzie.

Commonwealth Research Station, Merbein—
Officer-in-Charge—A. V. Lyon, M.Agr.Sc.
Agricutural Officer—J. E. Thomas, B.Sc., B.Agr.Sc., B.V.Sc.
Botanical Assistant—C. Barnard, B.Sc.
Secretary and Field Officer—J. E. Giles.

6. Soil Problems.

At Waite Agricultural Research Institute—
Soils Adviser—Professor J. A. Prescott, M.Sc. (part time).
Soil Survey Officer—J. K. Taylor, M.Sc., M.Agr.Sc., B.A.
Assistant Soil Survey Chemist—H. N. England, B.Sc. (in training for subsequent appointment at Griffith).

7. Animal Problems.

At University of Sydney—
Parasitologist—I. Clunes Ross, D.V.Sc.

At Glenfield Research Institute, New South Wales—
Veterinary Officer—W. A. Carr Fraser, B.V.Sc. (on loan to the New South Wales Department of Agriculture).

At Nyngan Experimental Farm, New South Wales—
Veterinary Officer—C. R. Mulhearn, B.V.Sc. (on loan to the New South Wales Department of Agriculture).

At Department of Agriculture, Sydney—
Entomologist—K. C. Richardson (resigned 31st January, 1928).

At Department of Veterinary Science, University of Sydney—
Veterinary Officer—R. C. Cramp, B.V.Sc. (returned to New South Wales Metropolitan Meat Industry Board 29th February, 1928).

At Melbourne University Veterinary Research Institute—
Veterinary Officer—A. W. Turner, B.V.Sc.
Veterinary Officer—T. S. Gregory, B.V.Sc.
Veterinary Officer—D. Murnane, B.V.Sc.

At Adelaide Hospital Pathological Laboratory—
Veterinary Officer—C. G. Dickinson, B.V.Sc.

At Department of Agriculture, Western Australia—
Veterinary Officer—H. W. Bennetts, M.V.Sc., (seconded from Department of Agriculture, Western Australia).

8. Division of Animal Nutrition.

At the University of Adelaide—

Chief—Professor T. Brailsford Robertson, Ph.D., D.Sc.
Chief Assistant—J. Ward Walters.
Biological Officer—H. R. Marston.
Assistant—J. D. O. Wilson.
Statistical Recorder—G. W. Bussell (vice Miss K. B. Moore, resigned 7th November, 1927).
Typiste-Secretary—Mrs. E. V. Wilson.
Cadets—D. Graham, H. J. Lee, H. W. Wheeler.

At the Waite Agricultural Research Institute—

Field Officer—E. W. Lines, B.Sc.
Assistant Field Officer—A. W. Peirce, B.Sc.

At "Buln Gherin" Sheep Station, Beaufort, Victoria—

Field Assistant—A. R. Beggs.

9. Mineral Deficiency of Pastures Investigation.

At the Waite Agricultural Research Institute—

Agronomist—K. M. Fraser, B.Agr.Sc.
Analytical Chemist—R. E. Shapter, A.A.C.I.

10. Division of Economic Entomology.

Temporarily abroad—

Chief—Dr. R. J. Tillyard, M.A., Sc.D. (Cantab.), D.Sc. (Sydney), F.R.S.

Temporarily at Head Office—

Assistant Chief—G. F. Hill.

11. Division of Forest Products.

Temporarily attached to Head Office Staff—

Chemist—W. E. Cohen, B.Sc.

Research Laboratory, Brunswick—

Chemist—L. R. Benjamin, resigned 31st January, 1928.
Chemist—J. Somerville, B.Sc., resigned 29th February, 1928.
Chemist—T. Hodgkinson, B.Sc., resigned 22nd February, 1928.
Chemist—R. B. Jeffreys, B.Sc., resigned 28th January, 1928.
Laboratory Assistant—C. H. Killian, resigned 22nd October, 1927.
Laboratory Assistant—A. E. Wright.

Tannin Extract Laboratory, University of Western Australia—

Supervisor—Professor N.T. M. Wilsmore, D.Sc., F.I.C. (part time).
Chemist—D. Coghill.

12. Cold Storage Investigations.

At University of Melbourne—

Adviser and Investigator—Dr. W. J. Young, D.Sc., (part time).
Assistant Investigator—W. A. Empey, B.V.Sc.

13. Other Investigations.

Pottery Investigations (At Research Laboratory, Brunswick)—

Investigator—R. C. Callister, resigned 19th May, 1928.

Mineragraphic Investigations—

Investigator—F. L. Stillwell, D.Sc. (seconded to Development and Migration Commission).

2. *Finance.* The statement of expenditure from 1st July, 1927, to 30th June, 1928, is as follows :—

			£
1. Salaries and contingencies			12,865*
2. Remuneration of Chairman and Members of Council			2,599‡
3. Investigations—			
(i) Animal problems—	£		
(*a*) Cattle tick	816		
(*b*) Contagious pleuro-pneumonia and tuberculosis in stock	672		
(*c*) Parasitological problems	592		
(*d*) Caseous lymphadenitis	196		
(*e*) Paralysis in pigs	838		
(*f*) Haematuria in cattle	627		
(*g*) Kimberley horse disease	238		
(*h*) Braxy disease	530		
(*i*) Visit of Sir Arnold Theiler	1,113		
(*j*) Miscellaneous	282		
		5,904	
	£	£	
(ii) Animal nutrition—			
(*a*) Adelaide Laboratory—			
Salaries, &c. 7,007			
Capital 13,224			
	20,231		
(*b*) Mineral deficiencies of Pastures	2,312		
(*c*) Miscellaneous	567		
		23,110	
(iii) Entomological problems—			
(*a*) Division of Economic Entomology	1,813		
(*b*) Buffalo fly	550		
(*c*) Blowfly	710		
(*d*) Insect pests of dried fruit	262		
(*e*) Miscellaneous	391		
		3,736	
(iv) Plant problems—			
(*a*) Division of Economic Botany	1,360		
(*b*) Virus diseases at Waite Institute	935		
(*c*) Bitter pit in apples	176		
(*d*) Arid flora	258		
(*e*) Poison plants	312		
(*f*) Miscellaneous	294		
(*g*) Prickly pear	6,000		
		9,335	
(v) Problems of the irrigation settlements—			
(*a*) Research Station, Griffith—			
Salaries and incidentals 3,375			
Capital 1,038			
4,413			
Contributions and sales 1,502			
	2,911		
(*b*) Research station, Merbein 2,884			
Contributions and sales 759			
	2,125		
(*c*) Miscellaneous	28		
		5,064	

* The main items of expenditure under this heading are salaries of the Administrative Staff at the Council's head office; staff and upkeep of State Committees; staff at Australia House; travelling expenses of head-office staff, members of the Council, &c., and printing and general office expenditure. The sum of £12,865 was provided as follows:—

From Consolidated Revenue Fund	£4,365
„ Science and Industry Investigation Trust Account	8,500
Total	£12,865

‡ Provided from Consolidated Revenue Fund.

(vi) Soil problems—			
(*a*) Investigations at Waite Institute—			
Salaries, etc. ..	1,832		
Capital	1,500		
		3,332	
(*b*) Miscellaneous		205	
			3,537
(vii) Cold storage investigations—			
(*a*) Squirter disease in bananas ..		750	
(*b*) Meat freezing ..		497	
(*c*) Visit of Dr. F. Kidd		1,170	
(*d*) Adviser on cold storage		836	
			3,253
(viii) Forest products—			
(*a*) Paper pulp		2,288	
(*b*) Tannin extracts ..		3,551	
			5,839
(ix) Mining and metallurgy—			
(*a*) Clays and pottery		242	
(*b*) Mineragraphic investigations ..		464	
(*c*) Miscellaneous		35	
			741
(x) Radio research..			349
(xi) Unforeseen and urgent investigations			336
(xii) Library			1,116
(xiii) Catalogue of scientific periodicals			252
(xiv) Research laboratory, Brunswick			265
(xv) Miscellaneous			2,372
Total of Item 3			£65,199

Grand Total of Expenditure.

From Science and Industry Investigation Trust Fund	£73,699
From Consolidated Revenue Fund	6,964
	£80,663

XIV.—ACKNOWLEDGMENTS.

Due acknowledgment must again be made of the very valuable assistance so freely afforded by many organizations and individuals. The close co-operation that has been maintained with the Development and Migration Commission has continued to lead to valuable results.

It is also desired to make special reference to the various State Departments, particularly those of Agriculture, and to the Universities. The help these bodies have given in the direction of affording laboratory accommodation and the use of their other facilities has been invaluable. Special mention of it has been made in the relevant sections of the report. Other organizations including Federal Departments and independent bodies, have also been particularly helpful. Mention must also be made of the many private individuals, far too numerous to be named separately, who have at all times taken a keen interest in the work of the Council and afforded it much help.

Without the assistance of these organizations and individuals the Council would have been unable to make anything approaching the progress recorded in this Report.

APPENDIX.

A.—Personnel of the Council and of its Various Committees.

COUNCIL.

Executive.

G. A. Julius, Esq., B.Sc., B.E. (*Chairman*).
A. C. D. Rivett, Esq., M.A., D.Sc., (*Deputy Chairman and Chief Executive Officer*)
Professor A. E. V. Richardson, M.A., D.Sc.

Chairman of State Committees.

Professor R. D. Watt, M.A., B.Sc., (New South Wales).
Sir David O. Masson, K.B.E., F.R.S., &c., (Victoria).
Professor H. C. Richards, D.Sc., (Queensland).
Professor T. Brailsford Robertson, Ph.D., D.Sc., (South Australia).
B. Perry, Esq., (Western Australia).
P. E. Keam, Esq., (Tasmania).

Co-opted Members.

Professor E. J. Goddard, B.A., D.Sc.
A. E. Leighton, Esq., F.I.C.
Professor H. A. Woodruff, M.R.C.V.S., &c.

Secretary.

G. Lightfoot, M.A.

STATE COMMITTEES.

New South Wales.

Professor R. D. Watt, M.A., B.Sc. (*Chairman*).
E. C. Andrews, Esq., B.A., F.G.S.
Professor Sir Henry E. Barraclough, K.B.E., V.D., B.E., M.M.E., M.Inst. C.E., M.I.Mech.E.
R. H. Cambage, Esq., C.B.E., F.L.S.
Professor H. G. Chapman, M.D., B.S.
G. P. Darnell-Smith, Esq., D.Sc.
C. H. Hoskins, Esq.
F. Leverrier, Esq., K.C., B.A., B.Sc.
F. D. McMaster, Esq.
J. Nangle, Esq., O.B.E., F.R.A.S.
Professor J. D. Stewart, M.R.C.V.S., B.V.Sc.
G. D. Ross, Esq.

Victoria.

Emeritus-Professor Sir David O. Masson, K.B.E., M.A., D.Sc., LL.D., F.R.S. (*Chairman.*)
Professor W. E. Agar, M.A., D.Sc., F.R.S.
W. Baragwanath, Esq.
Professor A. J. Ewart, D.Sc., Ph.D., F.L.S., F.R.S.
W. R. Grimwade, Esq., B.Sc.
W. F. Cuming, Esq.
Associate-Professor W. N. Kernot, B.C.E., M.Mech.E., M.Inst. C.E.
Emeritus-Professor Sir Thomas R. Lyle, M.A., D.Sc., F.R.S.
H. A. Mullett, Esq., B.Agr.Sc.
W. E. Wainwright, Esq., A.S.A.S.M., M.Aust.I.M.M., M.Am.I.M.M.
L. J. Weatherly, Esq., M.A.
Associate-Professor W. J. Young, D.Sc.

STATE COMMITTEES—*continued.*

SOUTH AUSTRALIA.

Professor T. B. Robertson, Ph.D., D.Sc. (*Chairman.*)
E. H. Bakewell, Esq.
Professor R. W. Chapman, C.M.G., M.A., B.C.E., M.I.E.Aust., F.R.A.S.
R. A. Duncan, Esq.
Professor Kerr Grant, M.Sc., F.Inst.P.
W. A. Hargreaves, Esq., M.A., B.C.E., D.Sc., F.I.C.
W. J. Hill, Esq.
Professor T. H. Johnston, M.A., D.Sc.
Professor T. G. B. Osborn, D.Sc.
Professor A. J. Perkins.
L. K. Ward, Esq., B.A., B.E., D.Sc.

QUEENSLAND.

Professor H. C. Richards, D.Sc. (*Chairman*).
Professor H. Alcock, M.A.
J. D. Bell, Esq.
H. T. Easterby, Esq.
A. E. J. C. K. Graham, Esq.
T. L. Jones, Esq.
A. J. B. McMaster, Esq.
Professor T. Parnell, M.A.
Professor B. D. Steele, D.Sc., F.R.S., F.I.C.
W. L. Payne, Esq.

WESTERN AUSTRALIA.

B. Perry, Esq. (*Chairman*)
F. G. Brinsden, Esq., M.I.M.M., M.Aust.I.M.M.
T. E. Field, Esq.
J. D. Hammond, Esq.
S. L. Kessell, Esq., M.Sc., Dip.For.
Professor G. E. Nicholls, D.Sc., A.R.C.Sc., F.L.S.
Professor A. D. Ross, M.A., D.Sc., F.R.S.E., F.Inst.P.
E. S. Simpson, Esq., D.Sc., B.E.
G. L. Sutton, Esq.
Professor H. E. Whitfeld, B.A., B.E., M.I.M.M., M.I.E.Aust.
Professor N. T. M. Wilsmore, D.Sc., F.I.C.

TASMANIA.

P. E. Keam, Esq. (*Chairman*).
Sir Alfred H. Ashbolt, K.B.
N. P. Booth, Esq., F.I.C.
Professor A. Burn, M.Sc., B.E.
H. A. Curtis, Esq., A.M.Am.I.E.E., A.M.I.E.Aust.
Professor A. L. McAulay, M.A., B.Sc., Ph.D., F.Inst.P.
D. O. Meredith, Esq., A.Inst.M.M., M.I.E.Aust., M.A.C.S.
A. K. McGraw, Esq.
A. McIntosh Reid, Esq., A.I.M.E.
R. O. Shoobridge, Esq.
F. E. Ward, Esq.

STANDING COMMITTEE ON AGRICULTURE.*

Dr. S. S. Cameron, D.V.Sc., M.R.C.V.S., Director, Department of Agriculture, Victoria (*Chairman*).
E. Graham, Esq., Under-Secretary, Department of Agriculture and Stock, Queensland.
Professor A. J. Perkins, Director, Department of Agriculture, South Australia.
G. D. Ross, Esq., Under-Secretary, Department of Agriculture, New South Wales.
G. L. Sutton, Esq., Director, Department of Agriculture, Western Australia.
F. E. Ward, Esq., Director, Department of Agriculture, Hobart, Tasmania.

* In addition to the State officers indicated, various representatives of the Council act from time to time.

COMMONWEALTH RESEARCH STATION, MERBEIN—COMMITTEE OF CONTROL.

Dr. B. T. Dickson, B.A., Ph.D., Chief, Division of Economic Botany (*Chairman*).
Professor T. G. B. Osborn, D.Sc., University of Sydney.
Professor J. A. Prescott, M.Sc., Waite Agricultural Research Institute, University of Adelaide.

COMMONWEALTH RESEARCH STATION, MERBEIN—ADVISORY COMMITTEE.

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Printed and Published for the GOVERNMENT of the COMMONWEALTH of AUSTRALIA by H. J. GREEN Government Printer, Canberra.