1929.

THE PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA.

Laid on the table by Senator Reid

Pursuant to Statute
By Command
In return to Order

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

REPORT

TOGETHER WITH

MINUTES OF EVIDENCE

RELATING TO THE PROPOSED ERECTION OF

BOTANICAL LABORATORIES

AT

CANBERRA.

By Authority:
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F.734.

MEMBERS OF THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

(Sixth Committee.)

MALCOLM DUNCAN CAMERON, Esquire, M.P., Chairman.

Senate.	*House of Representatives.*
Senator John Barnes.	Percy Edmund Coleman, Esquire, M.P.
Senator Herbert James Mockford Payne.*	Josiah Francis, Esquire, M.P.
Senator Matthew Reid.	The Honorable Henry Gregory, M.P.
Senator Burford Sampson.†	David Sydney Jackson, Esquire, M.P.
	David Charles McGrath, Esquire, M.P.

* Resigned 14th August, 1929.
† Appointed 14th August, 1929.

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EXTRACT FROM THE VOTES AND PROCEEDINGS OF THE HOUSE OF REPRESENTATIVES, No. 17.

Dated 11th March, 1929.

6. PUBLIC WORKS COMMITTEE—REFERENCE OF WORK—ERECTION OF LABORATORIES AND AN ADMINISTRATIVE BLOCK FOR THE DIVISION OF ECONOMIC BOTANY, CANBERRA.—The Order of the Day having been read for the resumption of the debate upon the following motion of Mr. Aubrey Abbott (Minister for Home Affairs), That, in accordance with the provisions of the *Commonwealth Public Works Committee Act* 1913–1921, the following proposed work be referred to the Parliamentary Standing Committee on Public Works for investigation and report, viz.:—The erection of Laboratories and an Administrative Block for the Division of Economic Botany, for the Council for Scientific and Industrial Research, Canberra—

Debate resumed.

Question—put and passed.

LIST OF WITNESSES.

ERECTION OF LABORATORIES AND AN ADMINISTRATIVE BLOCK FOR THE DIVISION OF ECONOMIC BOTANY OF THE COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH.

REPORT

THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS, to which the House of Representatives referred for investigation and report, the question of the erection at Canberra of Laboratories and an Administrative Block for the Division of Economic Botany of the Council for Scientific and Industrial Research, has the honour to report as follow:—

INTRODUCTORY.

1. During the Great War the disorganization of British Industries caused by the comparative lack of attention paid to scientific methods and scientific research brought into great prominence the need for this work in the various parts of the Empire. After the war there was an almost universal move throughout the world for the greater application of science to industry; and this move in all countries has now spread from secondary industries to agriculture.

2. The first steps for the establishment of a Commonwealth organization to carry out scientific industrial research were taken in 1916, and a temporary Advisory Council of Science and Industry was appointed. In 1920 this body became the Institute of Science and Industry under the directorship of the late Sir George Knibbs. Towards the end of 1925 the Government convened a representative conference of leading Australian Scientific and Industrial authorities to advise as to the best way in which the Institute might be re-organized and its activities extended. About the same time it was arranged that Sir Frank Heath, then Secretary of the British Department of Scientific and Industrial Research, should visit Australia, and a report on the same subject was submitted by him on 27th January, 1926. Subsequently, by the *Science and Industry Research Act* 1920–26, the present Council for Scientific and Industrial Research was established early in 1926.

3. As at present organized, the work of the Council relates mainly to the primary industries, and falls into a few main sections or divisions; namely: The Division of Animal Nutrition; The Division of Economic Entomology; The Division of Economic Botany; and The Division of Forests Products. In addition some investigators have been appointed to carry out investigations on various diseases of animals, and ultimately it is the intention to organize a Division of Animal Health.

4. Since its establishment the staff of the Council has been working in collaboration with the various States in such State and University laboratories as it has been possible to secure for the time being. Apart from trespassing on the generosity and courtesy of the States, however, it is felt that the present system is unsatisfactory, and there is a loss of effort due to lack of co-operative work. Arrangements have consequently been made for the headquarters of the Council for Scientific and Industrial Research to be established in Canberra, and a building scheme has been prepared in order to house its various activities. The position chosen is in the area allocated for scientific purposes on the lower slopes of Black Mountain in the North-west of the city, and in proximity to the area reserved for the University.

PRESENT PROPOSAL.

5. The proposal now submitted for consideration is to erect, on portion of the area above indicated, laboratories for the Division of Economic Botany, together with an Administrative Block to be used conjointly by the Division of Economic Botany and the Division of Economic Entomology.

DESCRIPTION OF THE BUILDING.

6. The Administrative Block will be a two-storied structure having a frontage of, approximately, 72 feet by a depth of about 80 feet. The adjoining Laboratory Block, also of two storeys, will have a frontage of 132 feet by a depth of 44 feet. The Administrative Block will comprise:—

Ground Floor containing entrance vestibule and waiting lobbies, inquiry space, staircase to upper floor, offices for chiefs, assistants chiefs, and clerical staff, lecture room to seat, approximately, 70 persons, cinema projection and re-winding room, two rooms for records, a workshop, and shower accommodation for field workers;

First Floor containing vestibule and staircase, library and museum, and rooms for museum curator and librarian and assistants, and two rooms for records;
Flat Roof over the central portion, with staircase access.

7. The height of the ceilings on the ground floor will be 12 feet; of the rooms of the first floor 11 feet, from the floor to the galleries in the library and museum the height will be 9 feet; and from the galleries to the ceiling 9 feet.

8. The Laboratory Block is to contain 23 rooms for various scientific investigations, distributed over the ground and first floors, a staircase connecting the ground and first floors, and extending to the flat roof; also lavatory accommodation for men and women, a store, and cleaners' space. In the Laboratory Block the height of the ceilings on the ground floor will be 11 feet, and on the first floor 10 feet 6 inches.

9. The construction proposed is such as to render the building generally fire resisting, and will comprise reinforced concrete footings, external walls of brick finished cement rendered, main internal walls of brick, but certain partition walls will be of coke breeze blocks, interior cement plastered. Floors and flat roof will be of reinforced concrete. The floors of the Laboratory Block are to be finished in bituminous felt floor covering; those of the main rooms in the Administrative Block are to be finished in wood with the vestibules and lobbies tiled paved, and the lavatories tiled. The entrance doorway and steps to the Administrative Block are to be of stone. The joinery throughout is to be of approved Australian timbers, and the windows are to have steel frames and sashes. It is proposed to have a hot water heating system for all the main rooms, and electric light for all rooms and each entrance and exit. Provision is also made to serve the laboratory rooms with petrol gas.

ESTIMATED COST.

10. The estimated cost of the project as submitted to the Committee is set down at:—

	£	£
Botanical Block.		
Excavations	625	
Building and lavatories (including drainage, sewerage, plumbing and fittings)	17,100	
Water main	110	
Electric light installation	1,100	
Hot and cold water installation	825	
Heating and ventilation installation	2,600	
Petrol gas installation	450	
		22,810
Administrative Block.		
Excavation	330	
Building (including drainage, plumbing and fittings)	15,900	
Electric light installation	750	
Hot and cold water installation	135	
Heating and ventilation installation	2,500	
		19,615
Special Services.		
Kerbing and guttering in street (half cost)	72	
Concrete footpath in front street (half cost)	30	
Stormwater drainage to entrance driveway	225	
Kerbing and guttering to entrance driveway	150	
Allowance for preparation of grounds for planting based on the preliminary sketch and provision of entrance driveway (excavations only)	1,800	
Construction of footpaths as required	1,000	
		3,277
Contingencies and sundries		2,000
		47,702
Administrative charges on total at 6 per cent.		2,742
		50,444
Interest during construction (6 per cent for nine months)		2,180
Grand total		52,624

and the time fixed for completion, approximately, eighteen months from date of commencement.

COMMITTEE'S INVESTIGATIONS.

11. The Committee visited the site set apart for the proposed institution at Canberra, inspected the plans of the proposed building, and took evidence from representatives of the Council for Scientific and Industrial Research, and the Federal Capital Commission, the Director of the Waite Agricultural Research Institute, representatives of the various State Agricultural Departments, and from architects and others. Visits of inspection were paid to the Waite Agricultural Research Institute, Adelaide, and to the Experimental Farm at Kybybolite, South Australia,—and the Committee sought to inform itself generally of the value of the work proposed to be undertaken in the Botanical Laboratories suggested.

Work to be Undertaken.

12. It was stated in evidence that the problems to be dealt with in the proposed Botanical Laboratories may be grouped under the following headings:—

(*a*) Plant Diseases.
(*b*) Plant Breeding.
(*c*) Physiological Studies.
(*d*) Agrostology.
(*e*) Soil Biology.
(*f*) Plant Introduction.
(*g*) Weed Control.
(*h*) Poison Plants.

(*a*) *Plant Diseases.*

13. Studies are planned to determine the conditions of occurrence, dissemination, and possible lines of control of various diseases in plants which are affecting Australian production. Amongst them have been mentioned spotted wilt and phytophthora blight in tomatoes, mosaic and powdery scab in potatoes, mosiac and blue mould in tobacco, take-all, rust, and flag smut of wheat, anthracnose of beans, cork and bitter pit of apples, diseases of bananas, pineapples, &c.

In addition a survey is to be made of all plant diseases throughout Australia from which may be made an estimate of the total loss to the Commonwealth through plant diseases, and an effort made to effect an efficient control of them. The ravages of plant disease result in considerable economic loss to the Commonwealth, and as an instance it is stated that the occurrence of rust and smut in cereals are held to be responsible for a diminution of yield of 10 per cent. over the whole of Australia—corresponding to a loss of approximately £6,000,000 per annum. The discovery of a remedy for water blister in pineapples is estimated to be worth to the Commonwealth £10,000 a year, while further substantial savings could be effected by combating tomato wilt, bitter pit in apples, &c.

(*b*) *Plant Breeding.*

14. A great deal has still to be learned in regard to the structural characters, the inheritance of disease resistance, drought resistance, moisture of soil tolerance of many plants of commercial importance in Australia; and knowledge along these lines is necessary before breeding for the most profitable varieties can be entirely successful. During 1928, for instance, Australia had approximately 12,250,000 acres under wheat cultivation. Many of these areas are planted with varieties of wheat which are poor yielders, but which have had to be sown because a variety, which is a prolific yielder, and at the same time suitable to the climatic conditions prevailing in those areas, has not yet been evolved by modern scientific methods. An extra bushel per acre for the whole wheat producing area of Australia would mean a gain of approximately £3,000,000 (three million) per annum. The average yield of wheat for the last ten seasons is 12.41 bushels per acre, and the highest average yield in any one State during that time was about 23 bushels per acre. It is not improbable that with the expenditure of the necessary outlay on plant breeding research, the average yield for the Commonwealth could be raised to the present maximum yield of the best State, or even more. It is further claimed that the benefits which have been shown possible in wheat, as the result of plant breeding, can also be obtained in all other plants under cultivation.

In regard to wheat breeding, it has been stated that Farrer's work has probably added £1,000,000 a year to the value of Australia's wheat production during the past twenty years, and it is interesting to note that all this experimental work was carried out in what is now the Federal Capital Territory.

(c) *Physiological Studies.*

15. A great deal still remains to be known in regard to the nutritional requirements in our soils of the principal crop plants. It is also necessary to study more fully the relation between stock and graft, pruning and its effect on vegetative vigour, root development and yield; and perhaps the more important question of the behaviour of plants under investigations which result in a proper understanding between the plant and its environment. Knowledge in this direction should enable Australia to place the highest grade products on the foreign markets, and also to increase the yield of such products very materially.

(d) *Agrostology.*

16. Since Australia is dependent to such a large extent on its flocks and herds, it is claimed that as much research as possible should be given to the improvement of its pastures, and justifies an extensive investigation of the characters, growth habits, growth requirements, and qualities of native pasture and herbage plants to be found in the different climatic regions of Australia.

When it is considered that the United Kingdom carries 8,117,000 cattle and 24,592,000 sheep, it is not flattering to us to realize that Australia, with an area 25 times as great carries 11,963,000 cattle and 104,267,000 sheep. These numbers could be vastly increased and the quality of the products improved by scientific attention to our pastures.

The value of exports from Australia of pastoral products over the last five years averaged £73,676,436 per annum, and yet practically the whole of the sheep and cattle of the Commonwealth are maintained on native indigenous pastures.

Grasses must, therefore, be considered as Australia's greatest crop and outstanding source of wealth, and any work done to improve our pastures is obviously of paramount importance.

During the course of its investigations the Committee saw something of what has been done in the way of improving pastures when a visit was made to the Kybybolite Experimental Farm, near Naracoorte, South Australia. It was ascertained that this estate was purchased by the government at £2 17s. 6d. per acre, when it was very difficult to grow sheep of reasonable frame and health and high wool productivity on the land. The Committee, during its visit, saw well grassed paddocks carrying large numbers of fine looking sheep, and was informed that the carrying capacity has now been increased threefold or fourfold by the application of superphosphate and the planting of subterranean clover.

(e) *Soil Biology.*

17. An intimate knowledge of soil biology is one of the means of ensuring crop improvement. It is necessary to investigate the organisms constituting soil flora, their inter-relations with one another, their reactions to atmosphere, water, temperature, and depth, in order fully to understand the requirements of the crop. The Committee learned something of what has been done in this connection in South Australia during a visit to the Waite Agricultural Research Institute, Adelaide. Here an endeavour is being made to arrive at a sound basis for classifying the soils of Australia on uniform lines. Furthermore, a soil survey has been made of several important irrigation areas along the Murray, and it has been plainly shown that there are many types of soil on those irrigation blocks, and although water has been applied, and they have been settled, it is claimed that some of them are definitely worthless. It has been stated that if a proper soil survey had been made beforehand, much money would have been saved, and a great deal of disappointment on the part of returned soldiers and other settlers would have been avoided.

Again the Institute has demonstrated that there are certain diseases of oat plants in various parts of South Australia due to manganese deficiency. An application of 75lb. per acre of manganese sulphate on these areas will enable profitable crops to be raised, and without that sulphate the crop is practically a failure. It has also been shown that under certain conditions in high rainfall country fallowing may be dispensed with; that as a result of transpiration tests it is learnt that one inch of rainfall is capable of producing 3½ bushels of wheat; and that the quantity of rain that falls in South Australia is sufficient to increase the wheat yield by at least fifty per cent.

(f) *Plant Introduction.*

18. Parallel with constant efforts to improve our crops, it is highly desirable to secure for Australia any species from other countries which can be shown to be of value. Australia has already introduced a number of valuable plants such as kikuyu grass, Wimmera rye grass, subterranean clover, etc.; the orange, lemon, banana, pineapple, etc., are also introductions;

as a matter of fact most of our plants of economic importance are introductions. It is only logical to suppose that there are still many others that could be introduced with advantage, and it is urged that a concerted effort should be made to bring to Australia for trial and study any promising material, especially drought resisting pasture plants, for low rainfall areas.

19. In considering this question of plant introduction, the Committee made inquiries as to the possible danger of the conveyance to Australia of plant diseases, or of plants which might ultimately become pests in this country. An assurance was given, however, by representatives of the council for Scientific and Industrial Research, and by the Director General of Health, that the possibility of plant or insect pests being admitted to the Commonwealth is fully safeguarded, and the various methods to be taken to prevent their introduction are set down in a definite written agreement which exists between the Council and the Commonwealth Health Department. So far as can be humanly foreseen, therefore, it is considered that there is but little likelihood of pests being introduced.

(g) *Weed Control.*

20. In order to attempt the control of weed pests which are widely spread, surveys are necessary to determine the actual distribution of the plant, the intensity of occurrence in the areas of distribution, factors concerned in the spread, the presence or absence of parasites, etc. The importance of this work is obvious to those who have any knowledge of areas which have been rendered more or less useless by the spread of noxious weeds. In Victoria, St. John's Wort has devastated about 1,250,000 acres, and has also taken possession of parts of New South Wales. In Queensland again, 51,000,000 acres are said to have been rendered useless by prickly pear. Amongst other weeds, Bathurst burr, Noogoora burr, blackberry and Cape tulip are widely spread and are proving serious pests, so that anything that can be done in the way of their eradication is very necessary.

(h) *Poison Plants.*

21. Poison plant investigation work is already in operation in various parts of the Commonwealth, and in particular by the poison plants Committee of the Council. Full records of this work, together with type herbarium specimens of plants determined as poisonous will need to be kept by the Division of Economic Botany.

Notwithstanding what has been done, the poisonous properties of a great many of our introduced plants are as yet quite unknown. Sudden serious losses of stock occur, and it needs a botanical investigation in the district in which they occur before the identity of the plant causing the trouble can be definitely established. The benefit resulting from a study of possible poison plants has already been demonstrated along a stock route in the Northern Territory. It was customary, along this route, to lose anything up to 20 per cent. of the animals from plant poisoning. A study by a botanist was made of this danger zone, and the plant causing the trouble ascertained and eradicated to a distance of 75 yards on each side of the route. Today, provided proper care is taken, mobs of up to 3,000 cattle are passed along the route without the loss by poisoning of a single animal.

Necessity for Laboratories.

22. It is of course not intended, nor is it possible to plunge immediately into this scheme in its entirety. Some of the more pressing problems have already been commenced in various parts of the Commonwealth, but it is represented that the proposed buildings at Canberra are intended to serve as the centre for the whole scheme, and that when these divisional headquarters shall have been established and the full staff collected, the officers engaged will be able to give far more co-operation and assistance than is at present possible.

23. It was stated in evidence that without the laboratories proposed, the Division of Economic Botany cannot function in an efficient manner. The officers engaged for various duties are working under difficulties, and already the various Universities and State scientific organizations are finding that they cannot accommodate further work of the Division.

24. By an agreement arrived at in 1927 between the Council for Scientific and Industrial Research and the Directors of Agriculture in the various states, it was arranged that the Commonwealth should work on certain problems of research of more or less national interest, while the states restricted themselves to consideration of local and climatic, or what might be termed domestic problems.

A review of the programmes set themselves by the various Departments of Agriculture indicate the value of the work being carried out by the States, and they are now looking to the Commonwealth to carry out this fundamental botanical research work without which little further progress in Australian agriculture can be expected.

25. During the course of its inquiry mention was made to the Committee of the immense sums being expended in all agricultural countries on scientific investigation. The necessity of this is obvious when consideration is given to a statement made by the Secretary of the United States Department of Agriculture to the effect that the work of a million agriculturalists in that country is wiped out every year by the depredations of insect and fungus pests.

SITE.

26. The site proposed for the Botanical Laboratories is within the area set apart for scientific institutions within the Federal Capital, and is in conformity with the accepted plan of Canberra. From the building point of view, also, the site is eminently suitable. Inquiries made by the Committee elicited the opinion that certain disabilities exist in regard to the location of this activity at Canberra; the soil in the immediate vicinity of the proposed laboratories is not as suitable as might be obtained elsewhere; the Capital has not an agricultural environment; and there is the absence of a University. On the other hand Canberra is the administrative and political centre of the Commonwealth; there are advantages in having this establishment at such centre; and in any case, many of the experiments and investigations must of necessity be carried out where the problem of research undertaken presents itself. So that looking to the future, and taking all things into consideration, the consensus of opinion endorsed by the State Agricultural Departments is that with the growth of population at Canberra, and the eventual establishment of a University there, the site suggested for the laboratories may be regarded as being as suitable as any one place could possibly be for the headquarters of the Division of Economic Botany.

BUILDING.

27. The design of the building has been prepared after due consultation with the scientific personnel who will ultimately use it, and is regarded by the latter as being eminently suited to their requirements. From an architectural point of view it is of a simple and chaste design, and as such has the approval of the various architects who were asked to express an opinion in regard to it.

28. In regard to some details, however, the Committee is of opinion that economy might be effected. It was stated in evidence that provision is made for the utilization in the building of certain hollow block construction for the floors and roof which will involve the placing of an order in Sydney for about £1,000 worth of hollow concrete blocks. Seeing that there is an ample supply of necessary material locally for making concrete floors, the Committee considers that economy would follow the avoidance of hollow blocks at Canberra in favour of the employment of an equally good form of construction with concrete slabs for flooring, by means of which a saving of about 6s. per square yard, or £450 in all, could be effected—and recommends accordingly.

SUPPLY OF MATERIAL BY THE FEDERAL CAPITAL COMMISSION.

29. Consideration was given to the stipulation made by the Federal Capital Commission in the specifications that in connexion with the construction of this building certain items specified must be purchased by the contractor from the Commission. The opinion expressed generally by those competent to judge is, that as a rule contractors undertaking a work of this magnitude would, for the purchase of the materials required, be in quite as good a position as the Federal Capital Commission, in which case there would be added to the cost of the material the interest and overhead charges necessarily added in the case of stores kept by the Federal Capital Commission for a period—which would, to this extent, increase the cost of the building. On the other hand it may be an advantage for the Commission to relieve itself of an accumulation of stores of which it cannot economically dispose otherwise, and the Committee agrees to the stipulation in the specifications in this instance although in principle it disapproves, as being unnecessary and uneconomical, of the continuance of the system.

The decision arrived at by the Committee in connexion with this matter is shown by the following extract from its minutes of proceedings:—

Mr. Gregory moved—That the Committee disapproves of the principle of the Federal Capital Commission requiring contractors to purchase material from it, as being uneconomical and unnecessary.
Seconded by Senator Sampson.
The Committee divided on the motion—

AYES (6).	NOES (2).
Senator Reid.	Senator Barnes.
Senator Sampson.	Mr. Coleman.
Mr. Cameron.	
Mr. Francis.	
Mr. Gregory.	
Mr. Jackson.	

and so it was resolved in the affirmative.

SUPPLY OF CONCRETE.

30. Although the designing architect of the Federal Capital Commission stated in evidence that there was no obligation on the contractors to use in this building concrete made by the Federal Capital Commission, the Chief Commissioner expressly stated that a provision would be included in the specifications that concrete would be mixed by the Federal Capital Commission at a central depot from which contractors would be required to draw their supplies. This question was discussed at some length with various prominent architects, and the weight of evidence indicated that the system was unusual, fraught with danger should any considerable time elapse between the mixing and the placing of the concrete in position, and that, generally, any advantages claimed for the scheme would be outweighed by the disadvantages and dangers attendant upon it. Under these circumstances, the Committee is not prepared to recommend that the proposal be adopted.

COMMITTEE'S RECOMMENDATION.

31. After full inquiry into the scope of the proposed laboratories and a careful consideration of the representations received from the various State Directors of Agriculture, the Committee realizes the importance of the work devolving upon the Council for Scientific and Industrial Research and the very great good to Australia that may be expected to result from the successful carrying out of the various problems of research undertaken. The Committee, therefore, is unanimously of opinion that the establishment of the proposed laboratories for the Division of Economic Botany suggested, are fully warranted, and, subject to the reservations mentioned above, recommends that the erection of the necessary buildings should be proceeded with as early as practicable.

M. D. CAMERON,
Chairman.

Office of the Parliamentary Standing Committee on Public Works,
Parliament House,
Canberra, 28th August, 1929.

MINUTES OF EVIDENCE.

(*Taken at Canberra.*)

THURSDAY, 14TH MARCH, 1929.

Present:

Mr. M. CAMERON, Chairman;

Senator Barnes	Mr. J. Francis
Senator Payne	Mr. Gregory
Senator Reid	Mr. McGrath.
Mr. Coloman	

Sir *George Alfred Julius, Chairman of the Commonwealth Council for Scientific and Industrial Research, Melbourne,* sworn and examined:

1. *To the Chairman.*—I am an engineer by profession, and my present position is that of Chairman of the Commonwealth Council for Scientific and Industrial Research. I am aware that the committee are investigating the proposal to establish botanical and entomological laboratories at Canberra. Three years ago the council was instructed to investigate certain problems affecting Australian industries, and, so far as practicable, to work in conjunction with the existing State organizations. Until our own building and equipment were provided that was the only course available to us. We had already completed arrangements with all the States, and we now have co-operative work proceeding in every State with the exception of Tasmania, although there are several of our officers working there with the facilities that are available. We are also in active co-operation with five of the State Universities, where we have our representatives working in the laboratories and using the equipment as far as is practicable. We are now feeling the need for the establishment of central laboratories to enable extensive study of vital problems affecting more particularly our primary industries. In this connexion I may mention that the most important directions in which investigations are being conducted are in entomology, economic botany, and animal health. In Adelaide we already have an animal nutrition laboratory erected on ground adjoining the Adelaide University. In that case we are working under an arrangement with the Adelaide University under which our staff is able to utilize the equipment at the University and also has the right to confer with professors and others at that institution. They also have the right to utilize certain apparatus. One of our principal reasons for establishing the animal nutrition laboratory in Adelaide was because Dr. Brailsford Robertson, who is now chief of our Division of Animal Nutrition, was at that time Professor of Physiology in Adelaide, and also because the Waite Agricultural Institute, presided over by Dr. Richardson, and with which we are doing co-operative work, is established in that city. At present research in connexion with animal health is carried on in laboratories scattered throughout the Commonwealth from Perth to Brisbane. In connexion with our entomological and economic botany work, we already have some officers engaged, and others are arriving from different parts of the world. We have been able, as a result of advertisements in Australia and elsewhere, to get together a staff which we hope will be able to render very efficient service. These men are at present working in such State or university laboratories as we have been able to secure for the time being. Our greatest difficulty at present is the loss in effort which we sustain as the result of a lack of co-operative work. We have some men in Melbourne, Sydney, and Perth engaged upon economic botany, but there is a definite loss owing to the absence of contact, the absence of the necessary equipment, and provision for its proper housing. There is an urgent need for the establishment of a divisional laboratory for entomology and the necessary insectaries. Up to the present we have completed satisfactory arrangements with the Director-General of Health, who is responsible for the administration of the quarantine regulations, to permit us to bring certain parasites into Australia under quarantine. These are placed under quarantine in insectaries in Canberra, and are under the control of entomologists who are conducting examinations and research work under conditions which prevent them having in any way a detrimental effect. These two insectaries, which are nearly completed, are on the slopes of Black Mountain. A division for economic botany is urgently needed. In regard to entomology, I may explain that when in Great Britain a year or so ago, I was in intimate touch with British departments and particularly with the Empire Marketing Board in an endeavour to get some recognition of our efforts. In this they gladly acquiesced. They admitted that, as far as practicable, all research work associated with the great problems that affect us, a producing country, should, as far as possible, be carried out on a co-operative basis. There were certain aspects of investigation in relation to, say, wool that could be dealt with more satisfactorily in the country of production, and others, such as in relation to the weaving and spinning of woollen yarn at such places as Bradford, where there is already valuable machinery which can be used in investigation work. That system has been followed up very largely, and the Empire Marketing Board will make available to the council during the next five years a sum amounting to about £130,000. According to a letter I received from England last week, that Board will possibly, also, when we complete our plans in the matter of animal health, give us material assistance. This assistance is forthcoming because it is recognized that certain problems of Empire importance can best be studied in Australia. Britain is to pay a share. In the matter of woollen research we are asking the British authorities to undertake certain investigations on our behalf because it would obviously cost us perhaps hundreds of thousands of pounds to install the necessary plant. In the matter of fuel research, with which, I understand, however, the committee is not at the moment concerned, I may explain that the establishment of a Fuel Research Laboratory might cost from £200,000 to £250,000. At present there is a Fuel Research Laboratory at Greenwich, where Australian students have, for the last three years, been graduating. It is the policy of the council to keep our men in intimate touch with the fuel research work which is in progress in extensive laboratories in America, Britain, Germany, and France. Under this system we can be kept advised of the latest developments and apprised of any results that may possibly be of use to us in Australia in the more effective utilization of our coal deposits. In this connexion I may mention the work being done by German scientists in the direction of obtaining oil from

brown coal. This is a tremendously important work, *which has not yet reached an economic stage.* At present it is better for us to derive benefit from the research work which is being carried on in other countries in the matter of fuel research, than to attempt to establish an enormously expensive laboratory here, and one which we would probably find it almost impossible to staff. The extraction of oil from brown coal is economically possible only under certain economic conditions, the most important of which, possibly, is the profitable use of all the by-products. In the matter of entomological research, the Empire Marketing Board decided to make us a monetary grant over a period of five years, provided that we contributed an equivalent amount. This grant was to be made for the purpose of assisting extensive study into certain *problems which affect not only Australia*, but other portions of the Empire. Dr. Tillyard, when in England, conducted very thorough investigations, and we have, at present, five students at Farnham Royal and in France, engaged on entomological work, and undergoing training in order to enable them to take up their work here. In connexion with research into such problems as caseous lymphadenitis, buffalo fly, and blow-fly pests, as well as the problem of noxious weeds, the Empire Marketing Board has been becoming somewhat restive. This has been due, I think, to the fact that although the grant to Australia is in the vicinity of £130,000, yet we are not getting ahead with the work as fast as they desire. Australia is very well represented on the Empire Marketing Board. We are, of course, only too anxious to extend our policy of team work, and utilize the services of experts to the best advantage. The Empire Marketing Board feels somewhat restive, as, up to the present, *Australia has scored at the expense* of some of the other dominions, and, that, whilst we were not ready, others were. The Government were made aware of the facts, and were informed that we were in treaty with the Empire Marketing Board to get a substantial grant towards Empire research in matters of irrigation, which is also of great importance to Australia. At present a committee is sitting in England to determine whether an Empire irrigation investigation shall be located in Australia, the Punjab or Palestine. Sir John Russell, when in Australia, *heard a great many arguments that from an Empire* stand-point, it would be desirable to have such a research station in Australia. We are of course, anxious to work in with the board, because, apart from the financial assistance it would render, we desire general Empire co-operation. If they regard our research work in any direction to be of real Empire significance, then our research workers are greatly encouraged and helped. The position in regard to economic botany is very serious. We have the assistance of Dr. Dickson, who is head of the division, Dr. Angell, from Canada, Dr. Johnson, from America, Mr. Macmillan, from Queensland, and also Mr. Carne, from Western Australia. In consequence of the assistance rendered by the Sydney, Melbourne and other universities, we have been able to get laboratory accommodation of a kind in which these men can conduct their investigations. But it is of the greatest importance that they should be able to extend their operations in a properly equipped building. At present, in our Entomological Division, we are vitally concerned in the buffalo fly pest, which may become more serious than cattle tick. Again, in the Animal Health Division it is necessary to give close and urgent attention to a disease known as caseous lymphadenitis, which is found in sheep, and which may place Australia's export meat trade in an extraordinarily bad position. At a meeting, held in Sydney, a fortnight ago, we met the executive of the Meat Industry and Graziers Association, and ascertained, that, on an average, 60 per cent. of the sheep over five years old, at present slaughtered, and used for export purposes, might be condemned. It may be said that, as that percentage is found only in sheep over five years of age, our export trade may not be seriously affected, but it must be remembered, that, as we breed largely for wool in this country, the bulk of the sheep slaughtered may be over that age. We are, therefore, faced with the fact that 60 per cent. of the carcasses may have to be absorbed in the domestic market. It is difficult to determine what the effect on the domestic market may be when it is found that we are using meat which some say is unfit for human consumption. So far, we have been unable to gather a vestige of evidence in support of the theory that it in any way makes the meat unfit for human consumption, but Britain, our chief market, now refuses to accept meat so affected. The bacillus causing the disease, so far as we at present believe, is picked up from the soil by the mouth and carried in with the food. It makes itself evident in the carcase in the form of yellow pustular lumps sometimes as big as one's thumb. The existence of this disease has been known for years, but no one knows how to deal with it. Evidently it is on the increase, and meat inspectors can, by running their hand across the carcase, locate these lumps when they are close to the surface, and remove them. When they are deepseated, that cannot be done. At present, there is a definite campaign in Britain in connexion with foods. Thus there is an embargo against the unnecessary use of disinfectants for preserving food, such as boric acid as a butter preservative, which has seriously affected the butter industry in Victoria. Now South Wales has definitely solved that problem, and knows the way out of the difficulty, although it has cost a lot of money. We were once under the impression that caseous lymphadenitis was caused by a grass seed puncture, but we are now convinced that the disease enters the animal through the mouth. The problem is so serious that it calls for a concentrated attack if we are to avoid trouble and loss which, in Australia, may amount to millions of pounds. As members of the committee are doubtless aware, the buffalo fly is a serious menace to Australia. It attacks the cattle and irritates them to such an extent that they are eventually driven mad. We have definite proof that the buffalo fly is present in Java, Timor, and India. It was introduced, so far as can be determined, through the Northern Territory, and, unfortunately, it has now got across into Queensland and into pastoral country in North-western Australia. So far there is no record that its existence is a menace in the east. We have been in touch with a Dutch scientist, who informed us that they had never conducted any investigations in the direction of overcoming the pest because it had never worried them. Possibly this is owing to the density of population in the east or because the buffalo fly pest has its natural enemies there, which were not introduced into Australia when the fly came here. At present, we have an officer conducting investigations at Darwin and another, who is leaving for Java next week. We have located three possible parasites which we will obtain under quarantine, and if satisfied that they are innocuous, we will use them in an endeavour to overcome the pest. We believe that it breeds in the dung of the animals, but we are not sure whether the breeding takes place also in the dung of native animals. We believe that very probably it has an enemy in other countries which was not introduced into Australia with the buffalo fly. In this regard, the pest may be in the same category as the prickly pear which was introduced into Australia without a parasitic pest accompanying it. We have also recently been informed

by the manager of the Wyndham Meat Works that he will do anything he possibly can to assist us in connexion with eradication of buffalo fly, which, at present, is seriously interfering with the cattle industry. In my opinion, the problem might have been foreseen, and tackled earlier. There are hosts of problems to be studied on the botanical side, some of which we are engaged upon at present. We are at present investigating "water blister" in pine-apples, which may threaten the extinction of the pine-apple industry. There is also "squirter" disease in bananas. We have been working on the "water blister" disease in pineapples, and have definitely located the cause, and from the tests which have been conducted, I think we have got a remedy. We are also engaged on work in connexion with many other problems which have to be faced in different parts of the Commonwealth. In connexion with such problems as "water blister" in pineapples, we are co-operating with those engaged in the marketing of this product, who are allowing us to inspect their shipments and have found in some cases that 80 per cent. of the pineapples from Queensland are affected.

Investigations have also been conducted into a disease affecting potatoes, but the trouble is that our organization is not sufficiently complete to enable us to concentrate on this and other problems. As regards the location of the laboratories now under consideration, we are satisfied that Canberra is a suitable centre. It is most desirable to bring men to a point where they can work in close co-operation. We regard the area to be provided and the situation generally as suitable. There is a tremendous amount of culture work which can be done only at a central station. The centralization of our activities will not in any sense result in a duplication of effort. We will not, for instance, be undertaking work which is at present being conducted at the Waite Research Institute in Adelaide, but will work in intimate touch with that institution, which is, for instance, in its Entomological Division now actively engaged in investigations into the lucerne flea and pea mite pests. Attention is being devoted there to those problems which are of the greatest economic importance to South Australia. The State establishments in which some of our officers are now working will not be closed when our new premises are completed at Canberra, but our men will not then be located in temporary laboratories and compelled to work with, perhaps, inadequate equipment and in unsuitable surroundings. The State laboratories will not be closed, as the work being performed in them will not in any sense be duplicated by our department. The present proposal is to have a division for economic botany and another for entomology, between which will be housed facilities such as a library and museum which will be common to both divisions. Later, when the occasion arises, two other divisions—a duplication of those now proposed—will be erected elsewhere on the same area. One division which is under consideration at present and upon which a decision has not been reached, is a forest products branch. The head of that division recently returned from England and America and is at present considering the question of the best location for such a division. Obviously it is desirable, apart from other considerations, to have such a division established at Canberra, where the Forestry School is functioning and from which our officers will be able to get assistance, particularly in the training of men. A division for research in the matter of animal health has also to be considered, in connexion with which we had a visit from Sir Arnold Theiler, who inspected a possible site for outside work. Canberra is regarded as a suitable site for this branch of research. At present arrangements have been made only for the bare entomological laboratories and not for a completed central block. From memory I think the cost of the entomological and economic (botany sections combined is about £60,000. It must be remembered that one-half of the cost of one section is to be borne by the Empire Marketing Board. Ultimately a central administrative block must be provided. The administrative work is now carried on from Melbourne. There is another important factor which has an important bearing upon this question. Ultimately, a post graduate research university for research work after students have graduated will possibly be established an institution which should be conducted in co-operation with our workers who, in many cases, could act as lecturers. The post-graduate work could be done in our laboratories. That is an aspect which must be considered in connexion with the establishment of future divisions in Canberra. I understand that approximately 50 acres will be placed at the disposal of the Council. I consider that area sufficient. The only division which requires a large area is that which will deal with animal health and which, for obvious reasons, cannot be located in the city proper. Possibly from 500 acres to 1,000 acres outside the city limits will be necessary, and already a site which, according to experts, is considered entirely suitable, has been inspected. I consider that sufficient space for our activities has been provided. In view of the co-operation which should exist between our Council and the University, the buildings of the Council and the University should be adjacent. That is why a block adjoining the university reservation was selected. The work undertaken in our laboratories will not in any sense be dangerous or objectionable to residents. Some of our botanical work can be conducted in the existing nurseries at Yarralumla. We are now utilizing the nurseries in connexion with our work, but it is not likely that any of our plots will be located there.

2. *To Mr. Gregory.*—A Committee was appointed some time ago to prepare a report in connexion with the establishment of a university in Canberra. This Committee was appointed largely in response to recommendations made by the Council for Scientific and Industrial Research, and when a definite proposal for the establishment of a university is desirable, it will be submitted. There should be complete unity between the two institutions. There is not the slightest desire on the part of the Council to interfere in any way with various State activities. We are all working in co-operation and there is no likelihood of a duplication of effort. The whole layout and equipment of the buildings have been most carefully considered, not only by the principal officers of the Council, but by other eminent authorities whom we have had the privilege of consulting. The only objection to the establishment of administration in Canberra is the inconvenience associated in the moving from a capital city. Canberra must ultimately become a great scientific and educational centre. We shall not be handicapped by the absence of a university, but when one is established the work of the two institutions can, in some directions, be co-ordinated. The construction of the entomological division is being proceeded with in order to honour our promise to the Empire Marketing Board. The proposed structure, in a sense, will be merely a shell, but it is so designed as to enable it to be added to from time to time without affecting its appearance from an architectural point of view. Lighting and ventilation have been carefully considered in connexion with the planning of the building, which is regarded as satisfactory in every sense. We took the opportunity of consulting other authorities, including Sir John Russell and Sir Arnold Theiler, and the plan which we are considering is the one which, in the opinion of those competent to judge, is most suitable for the purpose.

Externally the building is as plain as practicable. It had been urged that our structure should be situated towards the front of the university reserve, but to have done so would have meant erecting it on one of the main thoroughfares. We felt that sufficient money was not available for the erection of a building in such a prominent place, and we, therefore, decided to build on the back of the university site where our work can be carried out very effectively and where a comparatively inexpensive structure can be erected.

3. *To Mr. J. Francis.*—I have studied the reports of Sir Frank Heath, portions of which relate to subjects which could be studied by our animal health and nutrition section. A committee has been sitting for three years and every endeavor made to get the dairy experts of the Commonwealth to agree on a common line of action. Unfortunately a very definite difference of opinion has developed in connexion with dairy work in Australia. The result has been that a few weeks ago, when we were asked to determine the whole question, we suggested that the first essential was to obtain what might be termed a picture of the industry in Australia and obtain information as to the directions in which New Zealand has improved upon our practice. If that is done, we may determine in what direction we can assist dairy research and then link it up with our animal health and nutrition divisions. We have not issued any reports on dairy research. The Government have been notified of the stalemate that has been reached. Professor Wadham, of the Melbourne University, has been making inquiries on our behalf for three months and has obtained a good deal of valuable data, and it is possible that a comprehensive report will be made this year.

4. *To Senator Reid.*—Our principal laboratory work will eventually be carried out here. This will also be a centre for the storing and developing of cultures required in connexion with our work. The museums and libraries will also be centred here, but field work will be carried on in different parts of Australia where diseases and pests are prevalent. The facilities available in Canberra for outside work are as suitable as they would be in any other centre. The use of special soils is necessary in connexion with biological work. Certain weeds must be grown within the insectaries where parasites have to remain in quarantine, and in such cases special soils have to be used. Suitable soil can be obtained within four miles of Canberra. The Australian Institute of Anatomy, under the control of Professor MacKenzie, will be of assistance only in the direction of providing facilities for the further education of certain members of our staff. It is not known whether the buffalo-fly travels with cattle. Already we have four men at work studying the life-history of the buffalo-fly; but as yet they have not obtained any definite information to show whether it travels with cattle or with native animals. We have no definite information as to how it breeds. Men are at work on the Queensland border to endeavour to solve that problem. We are also tackling it at the Darwin end, where it is very bad, and where we should be able to obtain definite results. Investigations are also being conducted into the blow-fly pest, which is one of the most difficult problems that science has to face. We have a man at present working at Nyngan in collaboration with the New South Wales Government studying the habits of the blow-fly. We have also been working in conjunction with the British and New Zealand authorities in relation to the introduction of a parasite to overcome this pest. In Western Australia the presence of a certain type of wasp proved a definite deterrent to the blow-fly. The parasite we have obtained from Great Britain is also of the wasp species. There are wasps in the northern rivers of New South Wales which may be suitable, and at present we are making efforts to extend the area in which they appear to thrive. One of the greatest difficulties in connexion with the introduction of wasps is that we have to import them from foreign countries and persuade them to become accustomed to our climatic conditions. At present we are obtaining some supplies from New Zealand which appear to be a success. I have discussed with pastoralists in New South Wales the loss which occurs as a result of the blow-fly menace, and I have been informed that in a bad year it would amount approximately to £4,000,000. They were exceptionally bad in the early part of 1928.

5. *To Senator Barnes.*—The Council at present employs a staff of between 50 and 60 persons, but as our work develops and the accommodation and equipment is more in keeping with our requirements, we shall require double that number. We are gradually increasing our staff from within Australia when practicable, and also from other countries. In connexion with animal health and nutrition the Australian pastoralists are assisting us in our experimental work by making available land, animals and fodder. We have several very capable trained scientific females on our staff whose energies are devoted, of course, principally to laboratory work.

7. *To Mr. McGrath.*—It is estimated that the economic botany division will cost approximately £50,000. The building is so designed that additions can be made without affecting it architecturally.

8. *To Mr. Coleman.*—The results in connexion with the eradication of prickly pear are exceptionally promising. Mr. Swain, a Canadian entomologist, who attended a recent conference in Canberra, at my request visited certain areas in Queensland affected by prickly pear, and he informed me that, in his opinion, it was the biggest piece of work he had seen in the direction of biological control. When asked whether he thought our methods would be successful, he said that, so far as he could say, they would be. No one, of course, can predict what may happen. There is no doubt that under the present system the prickly pear is being effectively eradicated. This year the Prickly Pear Board hope to distribute 300,000,000 eggs, which are laid in such a convenient form that they can be easily gathered and distributed. We do not know, of course, how soon the parasite may itself become parasitized. Mr. Dodd introduced the bugs from Paraguay, bred them, freed them from all parasites, and then, after proving them innocuous, turned them adrift. It may be only a matter of time before they will become parasitized. So far the insects are doing amazing work and the results are extraordinarily promising. One of our greatest problems is to be sure that this insect does not attack anything else. We have a most rigid quarantine arrangement and the tests are most exacting. We are taking every precaution.

9. *To Senator Reid.*—The cacto blastis was obtained from Paraguay. At present they are free from parasites, but we do not know how long they will remain so.

10. *To the Chairman.*—The Committee can rest assured that, in the opinion of the Council, the area of land, location and design of the building are in every sense satisfactory. Owing to the importance of the work which is being undertaken, and of the disadvantages under which we are operating, I trust the Committee will regard this proposal as one of great urgency. There are many important problems requiring immediate attention, but owing to the conditions under which we are doing our work, they cannot now receive attention.

(Taken at Canberra.)

MONDAY, 18TH MARCH, 1929.

Present:

Mr. M. CAMERON, Chairman;

Senator Barnes	Mr. J. Francis
Senator Payne	Mr. Gregory
Senator Reid	Mr. Jackson
Mr. Coleman.	Mr. McGrath.

Walter Hayward Morris, Designing Architect, Federal Capital Commission, sworn and examined.

11. *To the Chairman.*—I am aware of the proposal to construct a Botanical Laboratory at Canberra, and was concerned in the preparation of the plans. They were prepared after consultation with the officers of the Council for Scientific and Industrial Research, and were approved by them. The plans have also been approved by the Advisory Committee of Public Taste, to the Federal Capital Commission. The proposed buildings have been considered in their relation to the other buildings to erected for the Council for Scientific and Industrial Research. The buildings proposed to be erected for the Council for Scientific and Industrial Research at Canberra, may be devided into two sections—

(*a*) that devoted to administration and instruction;

(*b*) that devoted to research.

The administrative block consists of the following:—

(1) Ground floor, containing entrance vestibule and waiting lobbies, inquiry space, staircase to upper floor, offices for chiefs, assistant chiefs and clerical staff, lecture room to seat approximately 70 persons, cinema projection and rewinding rooms, and two rooms for records, a workshop, and shower accommodation for field workers.

(2) First floor, containing vestibule and staircase, library and museum and rooms for museum curator and librarian, and assistants, and two rooms for records.

(3) Flat roof to the central portion with staircase access.

Laboratory block, containing 23 rooms for various scientific investigations to be carried out distributed over the ground and first floor, staircase connecting ground floor and first floor and extending with access to flat roof. Lavatory accommodation for men and women, a store, and cleaners' space.

The construction proposed is as follows:—

Reinforced concrete footings, external walls and main internal walls of brick, reinforced concrete floor and flat roofs, exterior brick walling finished cement rendered. Interior cement plastered. Certain partition walls to laboratory section in coke breeze blocks, floors to laboratory block to be finished in bituminous felt floor covering. The floors to the main rooms in administrative block finished in wood; vestibules and lobbies tile paved; floors to lavatories to be tiled. Entrance doorway and steps to administrative block to be of stone.

The ceiling heights are as follows:—

Administrative block, ground floor 12 ft.

First floor, to rooms 11 ft.
to library and museum galleries 9 ft.
from galleries to ceiling 9 ft.

Laboratory block, ground floor 11 ft.
first floor 10 ft. 6 in.

The joinery throughout to be in approved Australian timbers. Windows throughout steel frames and sashes.

General construction is such as to render the building fire resisting.

A hot water heating system is to be provided to all main rooms. Electric artificial light is to be provided for all rooms and to each entrance or exit.

Provision has been made to serve the laboratory rooms with petrol gas.

Following is the estimated cost of the proposal:—

Botanical Block.

	£	s.	d.	£	s.	d.
Excavations	625	0	0			
Building and lavatories (including drainage, sewerage, plumbing and fittings)	17,100	0	0			
Water main	110	0	0			
Electric light installation	1,100	0	0			
Hot and cold water installation	325	0	0			
Heating and ventilation installation	2,600	0	0			
Petrol gas installation	450	0	0			
				22,310	0	0

Administrative Block.

Excavation	330	0	0			
Building (including drainage, plumbing and fittings)	15,900	0	0			
Electric light installation	750	0	0			
Hot and cold water installation	135	0	0			
Heating and ventilation installation	2,500	0	0			
				19,615	0	0

Special Services.

Kerbing and guttering in street (½ cost)	72	0	0			
Concrete footpath in front street (½ cost)	30	0	0			
Stormwater drainage to entrance driveway	225	0	0			
Kerbing and guttering to entrance driveway	150	0	0			
Allowance for preparation of grounds for planting based on the preliminary sketch and provision of entrance driveway (excavations only)	1,800	0	0			
Construction of footpaths as required	1,000	0	0			
				3,277	0	0
Contingencies and sundries				2,000	0	0
				47,702	0	0
Administrative charges on total at 6 per cent.				2,742	0	0
				50,444	0	0
Interest during construction (4 per cent. for nine months				2,180	0	0
Grand total				52,624	0	0

Provision is made for the supply of petrol gas, owing to the difficulty of obtaining coal gas for use in the laboratories. Each of the sinks in the laboratories will be supplied with both hot and cold water. The hot and cold water installations to the laboratories are being undertaken under one contract. Other cold water services are included in the building costs. A septic tank will be provided for the disposal of sewerage, because the main sewer line has not yet been extended to serve the area on which the buildings will be erected. An extension will be made when conditions warrant it. It is possible that a residential area will be opened in the locality of the proposed new building to accommodate its staff. I estimate that the work of constructing the two blocks will occupy about eighteen months. Tenders have not yet been called for this work. So far, only preliminary drawings have been prepared. It should not take more than a month or six weeks from the date of approval for work on the botanical section to commence. It will take that long to prepare the working drawings. Tenders could not be called until

proper working drawings have been prepared. Thereafter a period of two weeks should be sufficient for the receiving of tenders. The work would be advertised in Sydney, Melbourne, and Canberra. Tenderers would be supplied with quantities, so that a fortnight should be sufficient for them to submit prices. I prepared the plans for the Entomological Laboratory, the work on which is now proceeding. I think the contract price for that work was £17,000 for the building, exclusive of heating installation, hot and cold water services, petrol gas, and electric light and power. The work was commenced at the end of January, and should be completed in August of this year. It is difficult to say whether the proposed building will provide sufficient accommodation for a given number of years. The Council for Scientific and Industrial Research does not know when extensions may be necessary. It is satisfied with the present proposal. The building has been designed to permit of economical expansion without destroying the architectural effect. The council considers that a uniform depth of 18 feet is sufficient for the laboratories. We have arranged that the internal partitions shall be of coke breeze concrete, which is light and easily removable. The whole of the area between the exterior walls and the central corridor will be left clear, so that the internal walls may be removed from time to time as found necessary to meet requirements. Whatever change is made, each room will be fully equipped with benches, sinks, electric light, and power, heating, and hot and cold water. The area has been subdivided into a number of units 22 feet square. The whole building will comprise a number of such units. The building now proposed will comprise an area six units long by two units wide; or 132 feet by 44 feet. After corridor space has been deducted that will leave six laboratories each about 18 feet deep. Any extension would be two units wide by as many units long, as circumstances demand. Alterations could be made economically, because the exterior walls would not be affected. It is proposed to have a reinforced concrete roof, of hollow block construction, covered with a layer of bituminous felt. The building will be graded from a central ridge. The exterior walls will be of brick, cement rendered. The windows have been arranged to meet possible alterations of the internal partitions. They have been set close together at intervals of 5 feet 6 inches on centres. The laboratories will be well lighted. The provision for lighting meets with the approval of the Council for Scientific and Industrial Research.

12. *To Senator Reid.*—The window arrangement will meet the practical requirements of the laboratory, as well as conform to the architectural requirements. Every window will have a concrete lintel. Internal walls of coke breeze concrete are light and can be carried on the concrete floor. The blocks will be 3 inches thick and will be laid like bricks, with the exception that they will be laid on edge. The roof construction will be the same as that proposed for the Institute of Anatomy. There will be one or two lantern lights, which, however, will not be visible from the ground. All the windows will have steel frames. The material to be used for the floor coverings has been inspected by the members of the Council for Scientific and Industrial Research, and has their approval. It will adhere to the concrete and form a permanent covering.

13. *To Mr. Jackson.*—The proposed building will be a considerable distance from the Institute of Anatomy, so that the different exterior finish will not clash with the sandstone finish of that building. The Advisory Committee of Public Taste to the Federal Capital Commission has approved of the plans and finish of the proposed building.

14. *To Senator Payne.*—The estimated cost of services to the proposed building includes some initial excavations to give an even frontage ground line. For internal walls coke breeze blocks are in more or less general use. They are easily removable. They probably cost less than blocks made of concrete, and they have the added advantage of being much lighter. The blocks could be made either in Sydney or in Canberra. Sufficient coke to make them could be obtained from the power house at Canberra.

15. *To Mr. Gregory.*—Tenders have already been called for work in connexion with the entomological section. Generally, the plans and specifications for this building will be similar to those which have been prepared for the entomological section. The plans for the building now proposed are as yet only in the preliminary stage, but I have given a summary of the materials to be used and the type of construction. I could supply the committee with a copy of the specifications for the entomological section, and the commission's list of quantities; but not the figures supplied by the contractors. I could not say offhand the price per cube of the proposed building, but the information is obtainable at the office. A flat roof has been suggested for two reasons—first, the scientists desire a flat roof, because they wish to carry our some experiments on the roof; and, secondly, it will make future extensions of the building less costly, because no consideration will need to be given as to the effect of such extension in regard to gables, mitres and hips. A flat roof would probably cost a little more than a pitched one of slate. There is no great difficulty in making a flat roof waterproof. The beams and pillars would not have to be altered to provide for a slate roof. A pitched roof could be put on the building without any alteration of the internal arrangement. The exterior of the building will be cement rendered, with the exception of the entrance doorway, and steps to the administrative blocks, which will be of stone. Steel frame windows, besides being fireproof, have narrower frames, and, therefore, provide more light than frames of wood. Wooden frames would be cheaper, but not so permanent. I prefer steel frames even if the first cost is a little higher. The effluent from the septic tank would flow into Sullivan's Creek between the proposed building and the Institute of Anatomy. It will not cause any trouble. If other systems have proved disagreeable, it has been due to faulty treatment. It is proposed to construct a double chamber tank, so that while one is being cleaned out, the other is in use. To prevent chemicals from the laboratory from destroying the bacteria, neutralizing chambers will be installed where the pipes emerge from the laboratories. The cost of the septic tanking installation is included in the estimate. A fortnight should be sufficient time for Sydney and Melbourne contractors to submit tenders. Copies of plans and details of quantities would be sent to Sydney and Melbourne. When inviting tenders for the entomological block, we stipulated that certain materials must be purchased from the commission. Those materials were mentioned in the specification. The object is to require tenderers to obtain from the commission only those materials of which it has large dead stocks. Other materials they may purchase where they choose. The stipulation that concrete made by the commission must be used applies only to certain road construction. It does not apply to this building. In some previous contracts tenderers have been required to obtain the materials for making concrete from the commission, but they have not had to purchase mixed concrete from us. If found necessary or desirable, the period for receipt of tenderers could be extended.

16. *To Mr. Jackson.*—The kind of timber to be used in the floors has not yet been decided. There will not be a great deal of flooring timber required. In estimating the cost of the flooring we allowed for Australian timbers which we knew would not exceed the estimate.

17. *To Senator Payne.*—The commission has considerable stocks of timber on hand.

18. *To Senator Reid.*—The commission has never supplied mixed concrete to tenderers. Most of the lintels used in Canberra are made on the job by contractors.

19. *To the Chairman.*—I shall supply a list of unit prices for various materials, including the cost of fixing. Handling charges are, of course, proportionately more when the quantities are small.

(Taken at Canberra.)

WEDNESDAY, 20TH MARCH, 1929.

Present:

Mr. M. CAMERON, Chairman;

Senator Barnes	Mr. J. Francis
Senator Payne	Mr. Gregory
Senator Reid	Mr. Jackson
Mr. Coleman	Mr. McGrath.

John Howard Lidgett Cumpston, M.D., D.P.H., C.M.G., Director-General of Health for the Commonwealth, sworn and examined;

20. *To the Chairman.*—I am aware that this committee is inquiring into the proposal to erect laboratories at Canberra for the Division of Economic Botany of the Council for Scientific and Industrial Research. I have not been officially consulted in regard to the proposal, although I have had many discussions with the Council for Scientific and Industrial Research as to its desirability. I have not seen the plans of the building which it is proposed to erect. Although my department is not concerned in the matter it is definitely interested, as it has the responsibility of the administration of plant quarantine, and of preventing the introduction into Australia of plant diseases. That involves very important and difficult problems and entails a very heavy responsibility. Prior to the introduction of federal quarantine in Australia, certain serious diseases gained admission to the country. Fortunately, we cannot trace the introduction of any further disease since the establishment of federal quarantine. I refer entirely to plant diseases. That work has involved a difficulty of its own, as my department has had to be extremely severe in dealing with the importation of plants, seeds and stocks. It is possible that it has been more severe than would have been necessary had it possessed more complete machinery for safeguarding the methods and degree of importation. It has long felt the desirability of the establishment of a bureau such as that suggested. The bureau could make available scientific evidence upon which to base decisions affecting the importation of new plants, and would afford a place where new varieties of stocks and seeds could be grown under skilled supervision. When it was seen that they were free from disease they would be released. My department, therefore, welcomes the establishment of the proposed institution, as its cooperation will ensure that Australia will not lag behind other countries in the development of new varieties. Hitherto, hesitation and difficulty have existed in connexion with the introduction of new varieties having been developed in countries where plant diseases nonexistent in Australia are prevalent. Australia should be enabled to keep abreast of other countries. This country is at present developing new varieties peculiar to Australia, but the United States of America is far ahead in the matter of citrus fruits, and is developing new varieties rapidly. Australia cannot, with its present facilities, cope with the importation of those new varieties.

I see nothing in the proposal to which my department can take exception, nor do I think that the activities of the Council for Scientific and Industrial Research in Canberra will prejudice the health or the comfort of the inhabitants of this city. Experiments such as those with blowflies, which necessitate the use of carcases, will be conducted under conditions so carefully safeguarded that they will result in neither offence nor danger to the community. The possibility of plant or insect pests being admitted to the country is very fully safeguarded by a definite written agreement, which exists between the Council for Scientific and Industrial Research and my department. So far as can be humanly foreseen there is little likelihood of pests being introduced.

I am acquainted in a general way with the site which has been suggested for the botanical laboratory. I understand it is to be under the slopes of Black Mountain, which, I consider, is a splendid location. It is hoped that, apart from the very important aspect of growing and developing new plant varieties, there will be a close relation between the work carried on in the laboratory and that performed by my department. At present the quarantine activities of my department are seriously handicapped through the absence of a reference library. The botanical laboratory, of necessity, will have a library, to which my department will have access, and that will remove the need to purchase expensive books to assist us in our scientific investigations. The laboratory will also investigate the distribution of Australian pests and diseases. One of the difficulties which has confronted my department is that a consignment of seed may be presented for importation which is partially affected by pests already in Australia. The question then arises as to how severely it is necessary to restrict the acceptance of that consignment. That involves a decision as to the importance of the particular pest in its relation to Australia. The laboratory would be able to provide an answer almost immediately. Again, my department finds itself still somewhat uncertain as to the methods of disinfection desirable in connexion with plants presented for importation. The botanical laboratory could assist very much in such matters. I think, therefore, that its establishment will very materially increase the efficiency of my department.

21. *To Senator Reid.*—My department has a director of the division of plant quarantine, who has had an extensive training and is a permanent officer of the Public Service. I do not think that the establishment of the Botanical Bureau will widen the field of inquiry of my department as that is very definitely defined. My department deals only with the administration of quarantine and does not touch the wider scientific aspect. It and the Council for Scientific and Industrial Research may be said to be partners, each with its definite field. I have already had some preliminary discussions with Dr. Dickson as to the possibility of introducing new varieties of plants, and in that way it is possible that the scope of activities of my department may be widened.

No fixed period is stipulated during which a new plant must be kept in quarantine. It all depends upon the plant. For the most part, my department requires a growth of one complete annual cycle. If the new plant comes through in the form of seed it must be grown through to the seed again, so that any possibility of danger may be detected. Unfortunately, my department has not very good facilities for that work, and the experiments are carried on mostly at private premises under close supervision, or in State establishments. The proposed botanical laboratory should provide very much greater facilities and be a great help to my department. The only direction in which it could be of assistance in the matter of the importation of animals would be on the entomological side. But the behaviour of insects covers so wide a field that it is more than likely that my department will be able to obtain assistance from the laboratory, and Dr. Tillyard's immense entomological knowledge will be of great use.

22. *To Mr. Jackson.*—My department has no authority over State departments in ordinary health matters, but it has a considerable range of constitutional powers in regard to plant quarantine if the Government chooses to exercise them. The botanical laboratory would have scarcely any bearing on general health matters. My department has found that the establishment of various scientific bureaux has definitely led to a better understanding with the States. I have in mind the establishment of such bodies as *the Federal Health Council, and serum and other* laboratories. The work of my department is mainly in connexion with the quarantine of plants, but it also has sole control of the quarantining of persons. I am unable to deal extensively with the relations which existed between the States as a result of the influenza epidemic of 1919. I gave detailed evidence to the royal commission that inquired into the subject, and I think that it would be better for that commission to interpret any evidence in its own way. There can be no doubt that the State departments will welcome the establishment of the botanical laboratory. Undoubtedly, the more co-operation that exists, the easier it will be for us to attain an ideal condition of affairs in health matters.

23. *To Mr. McGrath.*—I think that the Federal Capital City is the best place in which to establish the botanical laboratory. Its establishment here will facilitate the activities of my department, which has already moved to Canberra, as the two departments will work alongside each other.

24. *To Mr. Gregory.*—The officer of my department dealing with the quarantine of plant life will not be *ex officio* an officer of the proposed laboratory. I think that, on the whole, it is better that it should be so. In practice the matter is of no importance, because the relation of my department with the Council for Scientific and Industrial Research are continuous, and we are constantly fully discussing problems on a basis of most complete understanding. The procedure adopted in connexion with the importation of plants or seeds is this. My department has a list of plants which are prohibited. By exclusion of these, the remainder are admissible. If a plant comes in which is within the admissible group it is examined by the officer, say at Fremantle, for the presence of certain specified diseases and parasites. If it is found that *they are not present, but that traces of others, which* are also specified in a separate list, are present, the officer disinfects the plant and informs the importer. Should a prohibited disease be present the importer is informed that he cannot import that plant. Due to the existence of a certain type of blight, the department will not permit the importation of pears, or any parts of pears, from Japan. But if a reputable nursery man expresses a desire to import special varieties of pear pips from that country, my department indicates that it does not wish to prevent that course, and allows the admission of a small quantity of pear pips, which are grown under close official supervision for one complete year. If it is discovered that the plants are free from disease, the importer is *allowed to propagate* the plant. In future, new varieties of plants will be imported, their growth checked for a year, or two years, if necessary, and they will then be passed out for propagation. That will be but *a small part of the proposed activities of the* laboratory. I have had discussions with Dr. Dickson for the past month, and he indicates that they propose to survey the whole range of plants, especially economic plants, and will, on their own initiative, import considerable varieties for experimental work. We have devised a procedure which will sufficiently protect us on the legal and constitutional sides. The laboratory will not only experiment with plants, vegetables and fruit, but will extend its activities to fodder, grasses, and so on. The past experience of my department justifies me in feeling confident that we shall be able to safeguard the interests of the community in these matters. From time to time the department has sanctioned the importation of a very large range of prickly pear parasites, which, have, so far, proved to be safe. It has at its disposal the experiments of the world, and if any mistake is made it will be due to human error. If a new parasite is *introduced to destroy pests*, it is investigated with the same thoroughness as is any plant which is submitted for importation. The Council for Scientific and Industrial Research has agreed that no importations may be made *without the approval of my depart*ment. Actually that is the legal position, and there is no option, but no friction ever arises over the matter. Not only that, but when any release is made it is done only with the approval of my department. Everything is done deliberately to safeguard the interests of the community.

25. *To Mr. Francis.*—I am satisfied that every reasonable precaution will be taken in carrying out the work of the botanical laboratory. My department has actually laid down, in writing, every step in the movement, which has been very carefully considered. I welcome the establishment of the laboratory, which should be very much to our advantage.

THURSDAY, 21ST MARCH, 1929.

Present:

Mr. M. CAMERON, *Chairman*;

Senator Barnes	Mr. J. Francis
Senator Payne	Mr. Gregory
Senator Reid	Mr. Jackson
Mr. Coleman	Mr. McGrath.

Sir John Henry Butters, M.Inst.C.E.; M.Am. Soc. C.E.; M.I.E.Aust.; Chief Commissioner, Federal Capital Commission, sworn and examined.

26. *To the Chairman*—I am aware that the Public Works Committee has been asked to report on a proposal to establish in Canberra a laboratory for the study of economic botany, as part of the work of the Council for Scientific and Industrial Research. The site for this building was chosen after consultation with the *executive of the Council for Scientific and Industrial* Research. No site was marked on the Griffin plan for this building, but if it is erected here it will not conflict in any way with the plan. This particular site was chosen because it is desirable that the *building should* be close to the university, without in any way detracting from the value or reducing the area of the university site itself. Eventually, this laboratory will be used in connexion with university work. The site is sufficiently close to the university for the purposes for which the building will be used. The erection of the building on the site selected will not involve any large expenditure on special road construction, or on the provision of water and light services. For sewerage, it is proposed for the present to install a septic *tank*. Later, when the transfer of public servants now under contemplation is set in train, it will be necessary to put in the north-west intercepting sewer, with which this laboratory can be connected. Until that is done, *however, a septic tank will serve quite well.* The *road* giving access to this site is already made, while the water service is now available. A lighting service will have to be installed, but that will not be very expensive. I do not think that it would have been advisable to choose a more central site. The work to be done will involve the use of small experimental plots of land, insectaries have been established, and small kilns will be set up. It is necessary, therefore, that there

should be a fair amount of room, and that the building should not be in too close proximity to others. A number of residences will be built in this area when the further development, which is proposed, takes place. Probably twenty or thirty houses will be required for the staff connected with the laboratory, but there is no immediate necessity to proceed with their construction. Practically the whole of the surrounding area will be built on when the contemplated transfer of public servants is completed. It is proposed within *the next five years to bring up a further 7,000 people*, comprising civil servants and their families. The area between Northbourne-avenue and the university site will be developed when those people arrive. It will probably not be necessary to start on this building programme for another two years, nor will it be essential to build any residences, even in connexion with this laboratory, for some time. We are now planning a small sub-division which will fit in with the large subdivision to be made later. This laboratory will not be completed for eighteen months. However, we can, at any time, put up cottages to meet the demands of the officials who will be associated with the institution. I do not think that it is of any vital concern whether we develop new residential areas, or extend the development of those already begun. Our desire is to develop the Territory so as to suit the people living here. Within the next four years it is expected that all the needs of residents will be met. If officials associated *with the laboratory particularly wish to have their* residences near the building, their wishes can be met. Officials on high salaries and those on low may, if they so desire, have their houses situated near the laboratory site. Our Advisory Committee on Architectural Design was consulted about the plans for this building, and approved of them. It is intended that the building shall be a unit of the permanent group of scientific buildings. It is advisable, I think, that a building of this character should be faced with cement. Some of the old Roman buildings, which were faced with cement, are still in existence. It is difficult, of course, to compare present cement with Roman cement, but I do not think we need entertain any fear about the permanence of cement-*faced buildings. The work would be done very care*fully, and cement facings can always be satisfactorily maintained. I do not think that a high-class brick building with stone embellishments would be justified for this purpose, and it would be much more expensive. It would not improve the actual economic value of the building for the purpose for which it is designed. Cement treatment is all that the site really requires architecturally. No such reason exists in this case for facing the building with stone as exists in the case of the Institute of Anatomy. This building is far removed from the central group.

27. *To Mr. Jackson.*—When comparing the difference in building costs as between Canberra and Sydney or Canberra and Melbourne, we can dismiss almost everything except the difference in freights and wages. Labour is perhaps not quite so efficient here for the reason that we do not get the best men, because the very first-grade men are able to obtain plenty of employment in their own towns. The added cost of building from this cause, however, is relatively unimportant.

28. *To Senator Payne.*—This area will not be in great demand for residential purposes. To the north and west it will be developed much in the same way as the area to the west of Northbourne-avenue. We have designed a small sub-division to the north-west of the proposed laboratory site, making provision for about twenty houses. If further accommodation is needed, we can extend the sub-division. The rate of development of this area will govern the extension of sewerage services, but there is no occasion to extend them yet. I do not think that it would cost more than £500 to install a septic tank for the laboratory. All the mains from the building could be brought to a point where they could dovetail later into the sewerage reticulation.

29. *To Mr. Gregory.*—The site for this building is outside the university area of 167 acres, which is ample for all possible university needs. Later on, the lowlying ground in this vicinity will have to be drained. When a large storm-water drain is put through *connecting it with the creek, this will be a useful area.* The development of the university should take place from the direction in which this building is to be placed, the entrance being straight off University-avenue. *Ultimately, when things settle down, the local adminis*trative offices for the Capital will probably be situated somewhere on London Circuit. That, however, will be a long time yet. Personally, I think that the hospital site is as good as could be chosen, and is better than that marked by Griffin on his plan. His hospital site might, with advantage, have been placed closer to the university, because a medical school will certainly be established here sometime. I do not think that there is any risk of the sewage from the laboratory invading the lower areas, and becoming offensive. It could be treated in such a way as to obviate all danger of that. The complete specifications for this building have not yet been prepared, but they will be furnished to the committee *as soon as they are finished. The specifications for the* entomological block, which is now under construction, are complete, and those for this building will be practically the same. There are several reasons why bricks manufactured at *Canberra* are more expensive than those made in Sydney. Broken manufacturing time is one reason, though not the most important. Wages here are 12 per cent. higher than in Sydney, and, on top of that, our material costs us much more to select because of the presence of limestone. Also, we must manufacture by the semi-plastic process, which costs roughly, a £1 a 1,000 more for burning. The machinery needed for that process of manufacture is more expensive to buy in the first place, and costs much more to maintain than does that for the ordinary dry-pressed brick. Wages here are fixed by special territorial awards issued by the territorial tribunal. Up to the present it has not been possible to keep the brickworks going continuously. We have endeavoured to do so as *far as possible, and have at present a very large stock* of bricks made in an endeavour to level the work out. However, it has not been possible to keep an even demand for bricks in a place like this, where the building programme is controlled by the exigencies of the Treasury. It is hoped now that we shall be able to proceed with a steady building programme over a period of five years. But, of course, if the Treasury suddenly cuts down our expenditure, the whole programme will have to be re-cast. As in the case of the Institute of Anatomy, the contractor for this building will be required, under the specifications, to purchase certain of his requirements from the Commission's stores; but this will be restricted to purchases from our surplus stocks. If the stores are closed down in twelve months' time, and the work on the building continues for eighteen months, we could then tell the contractor that he was free to buy elsewhere, and if there is any truth in the suggestion that material can be bought cheaper outside, so much *the better for him. The specifications merely say that* the contractor shall purchase from the stores if required.

30. *To Mr. Francis.*—I cannot say what quantity of stores will be left after making provision for the erection of the Institute of Anatomy. The quantity is being steadily reduced all the time. Last June, stocks were valued at £110,000; that amount has now been reduced to £80,000. Supplies are required for the entomological block, the Institute of Anatomy, for a certain

number of cottages, and also for engineering works in progress. The stock is not being replaced, because we wish to get down as soon as possible to a maintenance basis. It has been necessary to keep a stock so as to protect the Government against monopoly. For the foundations and floors of this building, it is proposed that the concrete shall be mixed at a central depot from which the contractor would be required to draw supplies. That provision will be included in the specifications. This system has worked quite well on the works with which I have been associated in Tasmania. It has been done also in some municipal work, not only for road-making, but on buildings also. It is common knowledge that concrete can be transported quite well over distances which require half-an-hour's journey from the place of mixing to the place of using. For the bulk of the work which we shall be doing in Canberra for the next ten years, concrete from a central depot can be transported in less than half an hour. The advantage of the system is to ensure that there can be no recurrence of the sort of thing which happened in connexion with the foundations for the main administrative block. By mixing at the central depot, we can have our own experts on the job, and know what is going on. There can be no possibility of bad concrete being used. It is true that the alteration in the mixture for the administrative block was approved by the architect in charge of the work, but he was not our architect, and he was not under our control. Concrete mixing should be under the control of an engineer, not an architect. By mixing concrete at the central depot, the work can be done cheaper.

31. *To Senator Reid.*—Apart from the advantage that we are able to supervise the work at a central depot, it can be done more cheaply in that way than by mixing the concrete at each separate job. For one thing, all the mixing machinery is concentrated at one place, and this compensates for the cost of carting the mixed concrete. Even when the mixing is done on the job, the materials must be transported from a depot. It is no more expensive to cart the concrete from the depot to job, than to cart the materials for mixing the concrete. In fact, it does not cost so much. It takes practically a yard and a half of constituent material to make a yard of concrete. The weight of the water used is not great, and, in any case, it is the yardage which counts in transport costs. Concrete bulks less than the constituent materials, because in broken stone there are 40 per cent. of voids, into which the sand fits. Then there are practically 40 per cent. of voids in the sand as well. In all important contracts we propose to make it a condition that the Commission shall supply the concrete for the foundations. If our brickyard is running steadily, we can produce bricks here for £4 15s. a 1,000, and that allows for paying 5½ per cent on the capital invested, and making provision also for wiping out the capital cost within a reasonable time. It would cost us roughly £9 a 1,000 to deliver bricks here from Sydney, and our bricks are, on the whole, definitely superior in quality. Generally speaking, the contractors have expressed themselves as being very well satisfied with the way they have been treated by our stores branch, which has been a great convenience to them. Of course, they could have got almost equal service from private firms, if such firms had happened to be here. It is difficult, however, to induce two firms to commence operations in this place. If only one starts, it has, virtually, a monopoly. The bulk of the building to be done here for some time will be Government building, and we cannot see our way to burn our boats, and place ourselves entirely at the mercy of private firms. As a business proposition, we consider it a good thing for the Government to have its own stores. For big building jobs, it would be more satisfactory for us to be able to draw straight from a supply depot, because we could buy on a large scale. It is necessary, however, to keep the store going for maintenance purposes, and the existence of the store was very necessary during what I might describe as the monopoly period. We have had some complaints from contractors that the charges made by the Commission for stores have been higher than they could have been obtained for from Sydney, but in every case, when we have investigated the complaints, we have found that there was nothing in them. When we require supplies for our stores, we call tenders in the open market, and everyone can compete. We then supply the contractor at cost price, plus expenses. It has to be remembered that there are certain administrative charges to be met, and that we are running what amounts to a retail business, as compared with the wholesale houses in the cities. It has not been made compulsory in every case that contractors should purchase their stores from us. The reason for its being made compulsory in some instances was this: Our programme was suddenly reduced through the vote being cut down by £250,000, and it was necessary to delay the completion of our programme in respect of workmen's cottages and otherwise curtail it. We had a big stock of timber and other supplies on hand, ready to go on with the work. We are now using the only expedient within our power to ensure the use of these stocks, and to reduce our total stocks to the level at which we want them. Personally, I believe that the system requiring contractors to draw their supplies from the Commission's stores is a definite aid to the small builders, enabling them to compete on a better footing. That, however, is only incidental. This laboratory building will not be out of harmony with the university building. I understand that residences near the laboratory site will be needed, not only for the under-officers, but also for some of the professional men attached to the institution. These men have intimated that, because of the nature of the research work in which they will be engaged, they prefer that their homes be situated reasonably close to the job. We do not stipulate that the residences shall be near the laboratory; all we say is that if the persons concerned wish to live alongside the place, we shall provide the necessary facilities. We do not, as a matter of principle, ask people to live alongside their work. Some people think that it is a good thing to get as far away as possible from their place of employment. We leave those matters to the people themselves. Practically the only difference between the residences which we would erect for the professional men attached to this institution, and those for the under-officers, would be in the matter of size. The same locality would be suitable for both types of houses. I have not heard anything to the effect that the gauze being used on the insectaries is of such small mesh that it does not allow the light to come through. The gauze was purchased by the entomological experts dealing with the matter, and I presume that they know their job. In any case, the buildings will have a glass roof.

32. *To Mr. Francis.*—When the last annual report of the Commission was issued, there was a staff of 39 attached to the stores branch, besides a staff of nine, including a controller of stores, and five clerks, attached to headquarters. During last month the staff has been reduced by at least six, so that there are now not more than 42. I cannot say, from memory, even approximately, what the total wages and salaries amount to. These wages and salaries are charged against the cost of the stores. Although we have to meet charges with which private contractors would not be confronted, I am satisfied that, as a general rule, we can supply the contractors with material as cheap as they could buy it for themselves. Even private contractors have certain charges to meet in buying their materials. It must be remembered that we have not the facilities here that exist in Sydney for daily deliveries. Unless we buy our supplies by the truckload, the cost goes up out of all proportion. As far as possible, we do buy in truckloads.

33. *To Mr. Gregory.*—Our designing architects are not instructed to conform to any particular style of architecture, but are free to carry out their own ideas. This building, for instance, features a different style of architecture from anything previously attempted here. No particular type was specified in the Griffin plan. When designing new buildings, the plans are developed by our architects, and then submitted, as in this case, to the Committee of Design. The members of that committee are free to suggest any alterations they like; we look upon them as friends and advisers.

34. *To Mr. Francis.*—All the permanent buildings which we have recently designed possess well-marked architectural distinctions. For instance, the Institute of Anatomy is different from any of the previously designed buildings, and this building will be a departure from the styles already employed. While the individual styles are different, all the buildings are designed in such a way as to blend with, and form part of, the general plan.

35. *To Senator Payne.*—When the Commission took control there were already on hand large stocks of building timber. Much of it was used in the construction of Parliament House. About two years ago we laid down large stocks of joinery timber such as black bean, hardwood, and maple, so that it might be seasoned for the required period. It is not easy to buy properly-seasoned timber in the open market. The practice of holding large stocks of timber had been adopted before the Commission began to function, and it was a wise practice. As soon as we saw that we were cutting heavily into the stocks, we replenished them with supplies of first-class joinery timber. Seasoning is one of the great troubles here, and has a serious effect upon building costs. The Commission's stores branch sells stores to any one who needs them and can purchase their requirements locally as wanted. I have been assured that the present staff of about 42 attached to the branch is not unduly large to handle a stock valued at £80,000, even though the Commission itself is one of the largest customers. I am assured by the officers who are acquainted with the position that the costs are not unduly high compared with those in private firms doing the same class of work. I am not, of course, comparing the stores branch with the ordinary retail hardware store, although we even do a good deal of that class of business. If persons are unable to get their supplies elsewhere, they can come to us, and be supplied even in small half-dozen lots. We have to deal with a multiplicity of small matters, as well as with large orders. We have a very good man as controller of stores, and a very good accountant attached to the staff. Only recently we had the whole thing reviewed by Mr. Commissioner Gould. I can assure the committee that costs are being continuously forced down.

36. *To Senator Reid.*—The stores branch does the buying for all the Commission hotels and hostels and for the electricity department, and also purchases the material for roads, footpaths, and other construction work. It also acts as a department associated with the Tender and Contract Board. At least 75 per cent. of the goods going out of the store are used by the Commission itself, in the course of its work. Therefore, it is not true, as might have been inferred from my replies to Mr. Francis, that the whole cost of running the stores branch is loaded on to the goods sold to the contractors.

37. *To Mr. Jackson.*—I cannot say off hand what the monthly turn-over of the stores branch is; it varies so much from month to month.

(Taken at Melbourne.)

WEDNESDAY, 17TH APRIL, 1929.

Mr. M. CAMERON, Chairman;

Senator Barnes	Mr. Gregory
Mr. Coleman	Mr. McGrath.
Mr. J. Francis	

Dr. Albert Cherbury David Rivett, Chemist, Deputy Chairman and Chief Executive Officer for the Council for Scientific and Industrial Research, sworn and examined.

38. *To the Chairman.*—The proposed laboratories and administrative block which are to be built at Canberra are required to house the Division of Economic Botany of the Council for Scientific and Industrial Research. In the main building, it is proposed to have laboratories and equipment for carrying out research into plant problems. These problems may be grouped under the following headings:—

(1) *Plant Diseases*—

(*a*) *Virus Diseases.*—Studies are planned to determine the conditions of occurrence, the dissemination, and possible lines of control of virus diseases. The following diseases at present of importance to Australia come under this heading:—Spotted wilt of tomatoes, potato mosaic, which is especially interesting to Western Australia, and tobacco mosaic.

(*b*) *Cereal Diseases.*—There are still many unsolved problems in connexion with take-all, foot rot and flag smut of wheat, rust and smuts of cereals generally, maize diseases, &c.

(*c*) *Fruit and Fruit Tree Diseases.*—Such problems as bitter pit and cork of apple, have for many years baffled investigators and the Division of Economic Botany is investigating these, chiefly in Western Australia. In addition, there are diseases of peach, plum, orange, grape, banana, &c., awaiting investigation in some phase or other.

(*d*) *Vegetable and Special Crop Diseases.*—There are numerous maladies of importance in vegetable and crop plants such as anthracnose of beans, phytophthera blight of tomato, powdery scab of potatoes, blue mould of tobacco, &c.

In addition to the above, a survey is to be made of all plant diseases throughout Australia. Unless such a survey is available it is impossible to estimate the seriousness of any outbreak which may occur. When the complete history of a particular disease in Australia is available, it will be much more possible to tackle the problem of control. It is intended that the survey shall, to begin with, take the form of an index, giving data on the incidence of disease, the conditions of this incidence, rate and means of dissemination, the cause, the economic effect on the crop, control measures, &c. The index when complete is to be made available to all mycologists in Australia. The compiling of the initial basis upon which the index can be founded will require the review of all available references to disease and casual organism, and will require at least two years to complete. Mr. Brittlebank is engaged on this work.

(2) *Plant Breeding*—

Plant breeding work, involving selection and propagation, studies of the primary cells, inheritance, group relations and technique, will be undertaken as a means of improvement of crop and other plants. A great deal has still to be learnt in regard to the structural characters, the inheritance of disease resistance, drought resistance, moisture and soil tolerance of many plants of commercial importance to Australia. Knowledge along these lines is necessary before breeding for the most profitable varieties can be entirely successful.

(3) *Physiological Studies*—

A great deal still remains to be known in regard to the nutritional requirements in our soils of the principal crop plants. This can only be determined by experiment. It is also necessary to study more fully the relation between stock and graft, pruning and its effect on vegetable vigor, root development and yield. A study of seed dominancy and seed germination of pasture plants is necessary to assist in the problem of the regeneration of our exhausted native pastures. Perhaps the most important of the problems which come under this heading relate to the study of plants under irrigation conditions and in salty areas.

(4) *Agrostology*—

The importance of pastures justifies an intensive investigation of the characters, growth habits, growth requirements and qualities of native pasture and herbage plants to be found in the different climatic regions of Australia. Where susceptible of improvement, measures to ensure that improvement should be studied.

(5) *Soil Biology*—

An intimate knowledge of soil biology is one of the means of ensuring crop improvement. It is necessary to investigate the organisms constituting soil flora, their inter-relations with one another, their reactions to atmosphere, water temperature and depth, in order fully to understand the requirements of the crop.

(6) *Plant Introduction*—

Parallel with constant effort to improve our present crops, it is highly desirable to secure for Australia any species from other countries which can be shown to be of value. Australia has already introduced a number of valuable plants such as kikuyu grass, Wimmera rye grass, subterranean clover, &c. Obviously also the orange, lemon, banana, pineapple, &c., are introductions. The field is as yet far from being exhausted of its possibilities, and a concerted effort should be made to bring to Australia for trial and study any promising material. Especially is this the case with regard to drought resistant pasture plants for low rainfall areas.

(7) *Weed Control*—

In order to attempt the control of weed pests, which are widely spread, for example prickly pear and Noogoora burr, surveys are necessary to determine the actual distribution of the plants, the intensity of occurrence in the areas of distribution, factors concerned in the spread, the presence or absence of parasites, &c. Collection of the above information in regard to the principal weed pests is considered as quite essential, before much can be done towards eradication.

(8) *Poison Plants*—

Poison plant investigation work is already in operation in various parts of the Commonwealth, and in particular by the poison plants committee of the council. Full records of this work, together with type herbarium specimens of plants determined as poisonous, will need to be kept by the Division of Economic Botany.

This is a brief outline of the general lines of work upon which the Division of Economic Botany will be engaged. Although a certain amount of this work will not, of course, be in operation in the proposed laboratory buildings at Canberra, the latter are intended to serve as the centre for the whole scheme. The administrative block is required to house the library, the herbarium and offices for the clerical staff connected with the division. The library should in a short time grow to be a large one. The bibliographical needs of a staff designed to undertake the work outlined above will be great. The output of literature from the division will be considerable, and this will facilitate the building up of a large exchange system with workers in other parts of the world. The material received in this exchange will have to be adequately housed. In regard to the herbarium, the collection and adequate preservation of specimens of native flora, as well as type specimens of all cultivated plants are essential to the proper working of the division.

Without the laboratories the Division of Economic Botany cannot function in an efficient manner. Already the various universities and State scientific organizations are finding they cannot accommodate further work of the division. The various State departments of agriculture are looking to the division to carry out fundamental botanical research work without which little further progress in Australian agriculture can be expected. At a meeting of the Standing Committee on Agriculture (which is composed of the permanent heads of the State Departments of Agriculture and representatives of the council) held as recently as December, 1926, the desirability of the division carrying out extensive investigations such as those it has in mind was affirmed.

It is impossible, in the absence of a plant disease survey, to give any accurate estimate in figures of the total annual loss to the Commonwealth through plant diseases. There is not a cereal, vegetable or fruit crop which is not liable to attack from disease. Our present state of knowledge in regard to a great many of these diseases is far too elementary to allow of efficient control. Rust and smut in wheat are held to be responsible for a diminution in yield of 10 per cent. over the whole Commonwealth, corresponding to a loss of £6,000,000 per annum. During the past year Australia had approximately 18,000,000 acres under cultivation. Of this area, about 12,250,000 acres were under wheat. Many of these acres are planted with varieties which are poor yielders, but which have had to be sown because a variety, which is a prolific yielder and at the same time suitable to the climatic conditions prevailing in those areas, has not yet been evolved by modern scientific methods. An extra bushel per acre for the whole wheat producing area of Australia would mean a gain of £3,000,000 per annum. The average yield for the last ten seasons is 12.41 bushels per acre and the highest yield in any one State during that time was about 22 bushels. It is not improbable that with the expenditure of the necessary outlay on plant breeding research, the average yield for the Commonwealth could be raised to the present maximum yield of the best State or even more. Benefits which have been shown possible in wheat as a result of plant breeding, can also be obtained in all other plants under cultivation. Investigations which result in a proper

understanding between the plant and its environment should enable Australia to place the highest grade standard products on the foreign markets, and also to increase the yield of such products very materially. The value of the net exports of pastoral products over a period of the last five years averaged £79,000,000 per annum. Practically the entire sheep and cattle population of the Commonwealth is maintained on native indigenous pastures. Grasses must, therefore, be considered as Australia's principal crop and outstanding source of wealth, and any work done to improve our pastures is obviously of outstanding importance. Judging from the experience of other countries, the introduction of new and promising economic plants is likely to lead to results of great commercial significance to Australia. Many of our plants of economic importance to-day are introductions. It is only logical to suppose that there are still many others that could be introduced with great advantage. Two specific instances can be quoted of the areas which have been rendered more or less useless by the spread of noxious weeds. In Victoria, St. John's Wort has devastated about 250,000 acres, and it has also taken possession of parts of New South Wales. In Queensland approximately 51,000,000 acres are rendered useless by prickly pear. Among other weeds, Bathurst burr, Noogoora burr, blackberry and Cape tulip have spread over great areas, and are proving serious pests. Anything which can be done in the way of eradication is very necessary. The poisonous properties of a great many of our introduced plants are as yet quite unknown. Sudden serious losses of stock occur, and it requires a botanical investigation in the district before the identity of the plant causing the trouble can be definitely established. The benefit resulting from a study of possible poison plants has already been demonstrated along a stock route in the Northern Territory. It was customary along this route to lose anything up to 20 per cent. of the animals from plant poisoning. A study by Professor Ewart, of the Melbourne University, was made of the danger zone, the plant causing the trouble ascertained and, with the help of native labour, it was eradicated to a distance of 75 yards on each side of the route. To-day, provided proper care is taken, mobs of up to 3,000 cattle are passed along the route without the loss of a single animal. It is, of course, impossible to plunge immediately into the scheme of research work in its entirety. Some of the more immediate problems have already been commenced in various parts of the Commonwealth. When the divisional headquarters are established and the full staff collected the officers engaged on these will be given far more co-operation and assistance than it at present possible.

The various rooms are allocated as follows:—Room 1.—Laboratory for Chief of Division. Room 2.—Plant Pathology Laboratory.—In this laboratory, work will be done on virus diseases, bacterial diseases, diseases of fruit-crops, physiological diseases, and general pathology. Actually we should have several laboratories for these studies, but we are contenting ourselves for the time being with the one large laboratory. Room 3.—Chemistry Laboratory.—In this room, all the chemicals will be kept and the necessary chemical studies involved in our work will be carried out. Rooms 4 and 5.—Physiology.—In these rooms, physiological work dealing with the introduction of crop plants, with the nutritional requirements of possible introductions, studies on the physiology of diseased plants, &c., will be carried out. Room 6.—Fumigation and Drying Room.—This is necessary for the treatment of material before storage of plant parts introduced from elsewhere. Room 7.—Ground floor store room. Room 8.—In this room the preparation and storage of media will be carried out. Here will be found the necessary sterilizers for the preparation of the various kinds of media. Rooms 9 and 10.—Preparation room and laboratory for plant genetics.—Here the material will be brought in from the experimental plots and well studied. Room 11.—In this room, pedigree stock from the plots will be stored in insect-proof cases. The records concerning these will be kept in a fireproof safe in this same room. Room 12.—Incubator Room.—This room will contain a series of incubators at temperatures ranging from near freezing point to about 40 deg. Centigrade so that organisms may be maintained and studied at any given temperature according to their physiological requirements. Here will also be maintained the pure culture collection of organisms for Australia. Room 13.—Laboratory for the Deputy Chief. Room 14.—Plant Introduction.—This rather large laboratory will be used for studies of introduced plants, seeds, &c. In this room also will be stored a part of the original shipment and a representative portion of the first and second year harvests from the testing-out plots. Rooms 15, 16 and 17.—These are allocated to tobacco investigation, as an office for the Director, an office for his secretary, his typiste and records, and a laboratory in which work directly connected with tobacco will be done. Work on the pathology, physiology and genetics of tobacco will be carried out in the respective laboratories belonging to these sections of the division. Rooms 18 and 19.—Photographic studio and dark room for the division. Room 20.—Store room for the upper floor. Room 21.—Economic Botany Laboratory.—Here will be carried out studies with weeds, poison plants, &c. Room 22.—Spare laboratory. Room 23.—Agrostology Laboratory.—Here will be carried out studies on native grasses and fodder plants and also on such as are thought worthy of introduction.

It is intended that the block of buildings to be known as the administrative block which is to join the buildings of the divisions of economic botany and economic entomology shall be used conjointly by these two divisions for administrative purposes, and to house a common library and museum. This block of buildings is proposed to be of two stories as is the case with the main buildings. The ground floor will be for administrative purposes only, and will contain, near the entrance, offices for the chiefs, the deputy chiefs, and the clerical staff of each division. There will also be a small central lobby or waiting room and an inquiry room which will serve for both. At the back will be a lecture room capable of holding about 84. This will have a dais at one end, and projecting and rewinding rooms for films at the other. To each side of the lecture hall will be records rooms in which the letter files for each division will be kept. A small portion at the back of the building is taken up by a store and carpenter's shop. Showers are also to be installed at each side for the use of the field workers. The first floor is divided completely into two—one half to be for the museum, with a portion at the end partitioned off for the curator and members of the museum staff. This museum will contain both the herbarium and entomological collections. The corresponding half of the upper floor will hold the joint library. This half again consists of a central part with ends partitioned off for the librarian and library staff. The museum will contain probably only working specimens, and if a National Museum is established at Canberra material with which we have finished will be handed over to it. I am satisfied with the layout of the proposed administrative buildings.

The first steps for the establishment of a Commonwealth organization to carry out scientific industrial research were taken in 1916. The need for such organizations in the various parts of the Empire had been brought into great prominence during the early years

of the war by the disorganization to British industry caused by the comparative lack of attention paid to scientific methods and scientific research of British as compared with German manufacturers. One of the features of the post-war period is the almost universal move throughout the world for the greater application of science to industry, and this move has in all countries now spread from secondary industries to agriculture. In Australia, the temporary Advisory Council of Science and Industry held its first meeting in 1916. By the middle of the subsequent year the temporary body had completed the preparatory work for which it was specifically appointed, but as the necessary action for the establishment of the permanent organization was not taken until 1920, the temporary body remained in existence until that time. The temporary Advisory Council then became the Institute of Science and Industry under the directorship of the late Sir George Knibbs. The work initiated by the temporary Advisory Council was continued and developed by Sir George Knibbs but—with one or two exceptions, notably the work on paper pulp and contributions to the prickly pear investigations in Queensland—no funds were made available to enable him to embark on the many new important activities he advocated. Towards the end of 1925, the Government convened a representative conference of leading Australian scientific and industrial authorities, to advise as to the best way in which the institute might be re-organized and its activities extended. Shortly after, the Government also arranged to have Sir Frank Heath, then Secretary of the British Department of Scientific and Industrial Research, visit Australia and report on the same thing. Largely as a result the present Council was established by its act, the *Science and Industry Research Act* 1926-26, early in 1926. Fresh problems are constantly confronting us; but the statement which I have made is, I think, broad enough to include most of the activities of the Council. It is difficult to say, with any degree of accuracy, what the various plant and animal diseases are costing Australia; but as I have already shown, rust and smut in wheat are held to be responsible for reduction in the yield of 10 per cent. over the Commonwealth and represent a loss of approximately £6,000,000 a year. As regards the value of plant breeding, I have stated also that an extra bushel of wheat per acre for the wheat-producing area of the Commonwealth would represent a gain of approximately £3,000,000 a year.

39. *To Mr. McGrath.*—It is difficult to estimate what is saved by the eradication of a plant disease, because it costs money to achieve that end. For example, the complete eradication of bunchy top in bananas would mean probably the destruction of many plantations. The saving effected by the eradication of the pest may be regarded in that case as being equivalent to the value of the industry to Australia.

40. *To the Chairman.*—Many investigations into plant diseases are being carried on in the several States. Bitter pit in apples is being inquired into in Western Australia in co-operation with the State University and the State Department of Agriculture. Quite good work is being done there by Dr. Dickson and Mr. Carne, formerly an officer of the Western Australian Agricultural Department. He has now joined our staff and one of our officers has gone over to the State Department. In South Australia, we are carrying out experiments for the regeneration of pastures at Koonamore Station, which had been heavily over stocked, with the result that the salt bush land in parts had been eaten almost out. In Adelaide also, we have been investigating the cause of tomato wilt, with, I am glad to say, satisfactory results.

41. *To Mr. McGrath.*—Tomato wilt is known in other countries and we have the benefit of what information has been obtained by scientific investigation with regard to it. I may add that the number of inquiries which we receive from other countries concerning the work that has been done in Australia is surprising, in view of the fact that scientific investigation has been carried on in other countries for so many years. One would have thought that problems which are troubling us would have been dealt with elsewhere long ago.

42. *To the Chairman.*—Investigations into viticultural problems are being carried out at Merbein. We have taken over the work which was being done by the Mildura Vineyards Protection Board. One half of the expenditure is borne by the Commonwealth, and one half by the growers. The State Rivers Commission is providing us with free water. At Griffith, in New South Wales, we are doing laboratory work in connexion with citricultural problems, and we are getting substantial help from the New South Wales Water Conservation Commission. The State Government is assisting to the extent of £2,500 a year, and is supplying water free. Investigations into the cause of blue mould in tobacco are being conducted by Dr. Dickson and Dr. Angell. The cause of water blister in pineapples has been discovered. This disease is known in other countries and from inquiries which Dr. Dickson made we have ascertained that it is due to a fungus which apparently gets into the pineapple after it has been cut. The sterilization of the knife or the dipping of the stalk into a sterilizing solution is the remedy. This discovery ought to be worth nearly £10,000 a year to the Commonwealth, because some of our shipments have been affected to the extent of 80 per cent.

43. *To Mr. McGrath.*—Details of this discovery have not yet been made known to the growers, because we wish to be absolutely certain. We cannot afford to make an announcement and afterwards to confess that we were not quite sure.

44. *To the Chairman.*—Another field of investigation has to do with the Noogoora burr which is causing a lot of trouble in Queensland. Apparently this burr is known in Kansas, United States of America, where scientific investigations are being made with a view to its eradication. We are getting what information is available from that State where a man will be searching for parasites for about five months from June next. I need only mention our investigation into the prickly pear problem. There is a vast amount of information available in all the States concerning numerous plant diseases. Mr. Brittlebank is compiling information concerning all these matters. It will be about two years before that work is finished. We are carrying out investigations in connexion with poison plants in Sydney in collaboration with the State Department of Agriculture and the Sydney University. Valuable veterinary work is being done in Glenfield, and the chemical work at the university.

45. *To Mr. McGrath.*—Our object is to avoid overlapping wherever possible; but it would be unwise to attempt to centralize all scientific work in one institution such as the Council for Scientific and Industrial Research.

46. *To the Chairman.*—Our investigatory work into plant breeding is only at its beginning and I cannot say much about it yet. Mr. McMillan, who was at Gatton College in Queensland, has joined our staff and we have made arrangements with the Gatton College to co-operate in research with regard to maize. Mr. McMillan is visiting the various States to find out what is being done. We have also been carrying out investigations in regard to hops in Tasmania, and the pea mite. Our botanical staff numbers eleven. Work is being carried out at different centres, but the majority of our staff is engaged at the Sydney University, where we have rooms in the Department of Botany. Owing to the present unsatisfactory arrangements for the equipment and accommodation of our staff we are not getting more than half the possible value out of their work. When the proposed new buildings are erected and when everything is ready our staff will number about 30 technical officers, but much of their work will be done in the field in the different States. The central staff will consist of administrative officers, records clerks, typists, and a number of gardeners.

47. *To Mr. McGrath.*—I think it would be a good plan to invite university graduates to do research work at Canberra, when the buildings are ready. No doubt they will be glad of the opportunity to extend their knowledge and possibly we shall be able to get their services for a nominal sum. In my opinion, the soil in the Federal Capital Territory is not suitable for certain classes of research work; but in the circumstances, I do not think we can do better.

48. *To the Chairman.*—I am satisfied with the site. Apart from the disadvantage due to the inferior quality of the soil the association of other activities will be extremely useful, and I have no doubt that we shall be able, by blending soils, to get what we want there. We are having tests made of soil from the bed of the Molonglo and from other areas in the Territory. I believe we shall be able to get what we want by blending. I am satisfied that, looking at the proposal from all points of view, we cannot do better than to centre all our botanical and entomological activities at Canberra. The Council, after careful consideration, has decided that the present proposal is the best, and it has approved of the plans of the proposed buildings. Whether the laboratories will be sufficient for our needs will depend very much on how much money Parliament makes available; but I believe our requirements as regards accommodation in these two sections of work will be met for at least ten years. The buildings, with the exception of the administrative block, have been so designed as to permit of extension in the future should that be necessary. The Council is not yet in complete liaison with scientific investigators in Great Britain and other countries; but it is our intention to work in close co-operation with similar bodies in Britain and elsewhere. We are endeavouring to avoid duplication of work that is being done in the different States, and to this end have appointed a Standing Committee of Agriculture, comprising the permanent heads of States Departments of Agriculture. This committee meets twice a year to consider proposals for separate or joint investigations. We have drawn up a complete list of all the investigations that are being carried on by the several State departments. This list is circulated and in this way every State knows what another State is doing. Formerly they did not always have this information, and consequently there was a certain amount of unnecessary duplication. I do not suggest that if one State department is conducting a particular inquiry, another State should not engage in the same work. Frequently it is an advantage to have two sets of people investigating the same subject. For example, both the Melbourne and the Brisbane universities are inquiring into problems directly affecting the banana industry, including maturation in transport, and the Committee of Direction on Fruit Marketing is contributing to the cost. The committee supplies the fruit, and the University of Melbourne provides the space and some of the plant; the Council meets all other costs. The investigations into the prickly pear problem are being conducted by the Commonwealth Prickly Pear Board which is working independently of the Council for Scientific and Industrial Research. The Commonwealth bears one-half the cost; the other half is borne equally by the States of New South Wales and Queensland. The members of the board are Mr. Power (Queensland; Mr. G. T. Ross (New South Wales), and Mr. Lightfoot (representing the Council for Scientific and Industrial Research), with Professor Goddard as a co-opted member. The board is, to all intents and purposes, independent of the Council. It has its own officers and employs its own entomologists. The Council is co-operating on the mycology side of the problem, and the services of Dr. Dickson are at the disposal of the board. It is estimated that from 50,000,000 acres to 60,000,000 acres of land is infested with prickly pear in Queensland, and that it was increasing at the rate of 1,000,000 acres a year. It is claimed that the spread of prickly pear has been checked, so we may assume that, on a conservative basis of value, say 5s. an acre for the land reclaimed or saved, the work of the board represents a saving to the Commonwealth of £250,000 a year. The question of soil treatment is being dealt with by the Council in association with the Waite Institute in Adelaide, and I think that before long we shall be able to arrange for a joint division of this field of investigation which promises to become of vital importance. At present we are not carrying out research work in connexion with rice. We contemplated doing so, but discovered that the New South Wales Department of Agriculture was interesting itself in the matter, so after a conference we decided to leave the field to that department, and thus avoid overlapping. With regard to tobacco mould there is already a research committee at work the members of which are Dr. Dickson and Mr. Slagg. We propose to place the whole of our facilities at the disposal of the investigators. Up to the present we cannot claim to have made any material progress in this inquiry. The Council does not concern itself with the economic side of the various problems which it is investigating, or proposes to investigate. If satisfactory arrangements can be made with the various States, the Council contemplates launching research work concerning the use of fertilizers for the top dressing of pasture land. This work is at present being done by the several State Departments of Agriculture so we must be careful not to intrude unless our entry into the field is likely to be to the advantage of all concerned. In my opinion, Canberra is not a suitable field for experiments in top dressing of pastures, though certain types of investigations can be carried out there. This work, to be of any value, must be done in different localities. We are considering the problem from the other side. By this I mean that we are endeavouring to find out in the division of animal nutrition what is required by the sheep to build up its wool, and having arrived at definite conclusions from that point of view, we shall investigate grasses and fodders. It is, in my view, important that we should consider the regeneration of exhausted native pastures, which have been grazed continuously over a long period and have been depleted of their phosphate or iodine contents. The extraction of these soil constituents by the grazing of sheep and cattle must be pretty considerable every year, and unless means are taken to return these elements to the soil, the pastures must become exhausted.

49. *To Mr. Gregory.*—We have not estimated the probable cost of our building accommodation for the first ten-year period; but the estimated cost of the present building is £52,624. Forest products will be our next consideration, but building accommodation will not be so extensive, because to a large extent work on forest products will be conducted in sheds. It is contemplated that experiments for the treatment of wood pulp will be carried out on a laboratory scale in

Canberra; but we suggest that work on a commercial scale should be left to private commercial organizations. The administrative cost of the laboratories will depend largely on the amount of work which we are called upon to do; but I believe that our total annual *expenditure* will be at least £20,000 a year. We are not receiving any assistance from Great Britain with regard to botanical research, but we will share with Britain the cost of entomological work. Investigations are being carried out in connexion with potato mosaic, a disease that has made its appearance in producing districts south of Perth. Investigations in plant breeding are being made by the several State Departments of Agriculture, and it will be necessary to avoid undue over-lapping. The dissemination of scientific information is an extremely difficult problem. At the inauguration of the Commonwealth, agriculture was left with the States, so we have to be extremely careful in anything we do now so as to avoid overlapping. Our first step was to call a conference with the State departments to discuss with them the proposed field of scientific investigation to see if we could come to some working arrangement with them. Our proposal was to undertake research on *fundamental problems, because experience has shown* that State officers often find it difficult to concentrate on long-distance work because of the serious interruptions due to their manifold routine duties. All extension work, we suggested, should be left entirely to the States, and I think we should honour that agreement. By this I mean that if, and when we get results from our research work, it should be handed over to the States, and by them disseminated to the people. We issue about 2,500 copies of all pamphlets and bulletins; but that is not always the best way to advise producers of results achieved by research work. What is wanted more than anything else is demonstration work in the field. The States having the organization should be expected to be responsible for the dissemination of all information gained.

50. *To Mr. McGrath.*—I have been connected with the Council for Scientific and Industrial Research since 1926. Originally Mr. Julius, Mr. Newbiggin and I were working as a part-time committee. At that time I was the professor of chemistry at the Melbourne university. At the end of 1926, it was suggested that I should devote the whole of my time to this work, and I obtained leave of absence from the university to do it. At the end of 1927 I resigned from the university staff to take up Commonwealth work. When the work in Canberra is properly organized there should be less occasion to appoint special committees in the several States to carry out investigation work; but I should be reluctant to interfere with such bodies as the Prickly Pear Board which is doing so well. It may seem remarkable that investigations in Australia should be necessary concerning introduced pests, but when we consider what is happening in other countries we are forced to the conclusion that the fight is a never ending one. The insects section of the entomological bureau in the United States of America has been in existence for probably 25 years, and yet it is admitted that insect pests in that country are as bad to-day as they were 25 years ago. The conclusion is that with the increase in commercial interchange new pests are being introduced all the time, and that unless "scientific investigations aiming at control are being made continuously, production will fail and mankind will go under. We have not yet made an inquiry into the cause of powdery scab in potatoes. That disease is prevalent in other places. One of the functions of the entomological section will be to inquire what is being done elsewhere to combat it. Investigations into the buffalo fly pest come within the scope of the Council's work. We are carrying out research on the biological control side. Two entomologists are leaving Sydney for Java to pick up the threads of work which has been done there for us in one of the Dutch institutes. They will visit Timor, where the climate is similar to that in Northern Australia, and the hope is that they will find out what is keeping the *buffalo fly in check there. The next step* will be to obtain parasites and, if it can be demonstrated that they will do no harm in Australia, to erect an insectary at Darwin or Wyndham in which to breed the parasites and then release them. I doubt that a better place than Canberra could be selected for a laboratory. Australia is so big that no one place could be expected to meet all its requirements with regard to soil and climate.

51. *To Mr, J. Francis.*—Up to the present, there has been no friction between the Commonwealth and the States as regards scientific research work, and we must be careful that there is no cause for dissatisfaction on either side. We have reason to believe that the work done in the proposed laboratory at Canberra will be satisfactory to all the States. Personal contact with State officers will do much to remove any cause of friction. We receive regularly an enormous number of scientific publications from the United States of America. As time goes on we hope to improve our relations with scientific institutions in that country by making them more personal between our investigators and theirs. Members of our staff are living in practically all the States. Though the soil in Canberra is not entirely suitable for certain phases of our work, we would have the same experience in any other centre. Canberra is probably not very suitable for tobacco growing, but we shall be able to conduct experiments there for the eradication of blue mould. We have not yet made any laboratory investigations with regard to the dairying industry, because of the risk of duplication; but Professor Wadham has completed an inquiry into the dairying position in Queensland, New South Wales and Victoria. His conclusions will be published in the form of a pamphlet at an early date. As far as we can see, Canberra is a suitable site for the botanical laboratories. Whatever disadvantages we may suffer at first will gradually disappear in time when other laboratories, and when the National Museum are established. The plans of the proposed buildings have been approved by the Council. In my opinion, they provide for all our requirements for some considerable time. If, later, we ask for additional accommodation it will be our duty to show that it is justified.

(*Taken at Melbourne.*)

FRIDAY, 19TH APRIL, 1929.

Present:

Mr. M. CAMERON, Chairman.

Senator Barnes	Mr. J. Francis
Senator Payne	Mr. Gregory
Mr. Coleman	Mr. McGrath

Donald Alexander Swanson, Master Builder, sworn and examined.

52. *To the Chairman.*—I have perused the specifications for the erection of the entomological laboratories at Canberra. In the absence of personal knowledge of the locality it is difficult for me to state what should be the cost of such buildings, because so much depends

upon the cost of materials, cartage and other important factors. I have considered carefully the schedule of rates set out in the specifications; but, as I have just stated, it is not possible to express a definite opinion about prices because I have no knowledge of local conditions. For instance, sand and gravel is charged 6s. per yard at the pit, but no distance is stated. On the whole I am surprised to know that the work can be done at the rates quoted, but of course the schedule is not a contractor's estimate, which might be somewhat higher. I note that bricks are quoted 105s. per 1,000 at the kiln, whereas in Melbourne they are quoted at 67s. at the kiln. This item would make brick work in Canberra much more costly than in Melbourne, but the actual cost of brick work per rod would depend on the price of cement and sand on the works. I note also that bricklayers' wages are put down at 23s. 6d. a day and labourers' wages at 17s. 10d. a day. In Melbourne we pay bricklayers the same rate per day for a week of 44 hours, and where the men live beyond a radius covered by a 4d. tram fare the men get tram fares also. The following are the average rates for labour and materials on similar construction work in Melbourne:—

Excavation, 9s. to 10s. per cubic yard.
Concrete in trenches, 55s. per cubic yard.
Concrete floors (6 inches thick), 10s. per super yard.
Reinforcement generally, 17s. 6d. cwt.
Brickwork in cement mortar, £33 per rod.
Floor framing, hardwood, 5 in. x 3 in. bearers, 4 in. x 2 in. joists, &c., 30s. per 100 feet super.
Flooring, 6 in. x 1 in. baltic, 50s. per square.
Flooring, 4 in. x 1 in. tallowwood, not used here.
Flooring, 4 in. x 1 in. jarrah, £5 5s. per square.
Fibro plaster, including cover battens, from 5s. per super yard.
Ordinary doors and frames, 4s. 6d. per super foot.
Plasterer—
Cement render, ½ inch thick, 4s. per square yard.
Water supply—
¾ inch G.W.I., pipe, 10d. per foot.
½ inch G.W.I., pipe, 8d. per foot.
Painter—
4 coat with lead and oil, 2s. 3d.
2 coat with water paint, 1s.
2 coat with lead and iron on ironwork, 1s. 3d.
Glazier—
26 oz. sheet glass, 1s. 2d. per foot super.
3/16 inch plate glass, 3s. and upwards per super foot.

I consider that the policy of the Federal Capital Commission in requiring contractors to purchase certain materials from the Commission is not wise. A number of items in building construction must be provided for on a *percentage basis, but it is far better to allow the* contractor a free hand in the purchase of bricks, timber, materials for concrete, and other items. It is likely that he will be able to buy to better advantage in the open market. It is possible that the higher cost of bricks at Canberra may not be due entirely to the higher rates of wages prevailing there. Sand and gravel cost 6s. per yard at the pit. In Melbourne we pay only 2s. a yard at the pit. I understand that in Canberra the sand has to be washed. This, no doubt, accounts for some portion of the increased cost. If a contractor could buy all his materials in the open market he would probably purchase some lines from Sydney, and perhaps would do better than by buying from the Commission. In my opinion, a fortnight, the time allowed for tendering for a job like this, is too short. Tenderers require time to gather all their information concerning the probable cost of materials. A tenderer from Melbourne, for example, would have to make inquiries as to costs of materials in Sydney and could not, within the time allowed, complete his inquiries. Three weeks or a month would be a fair time to allow in calling for tenders. I understand that the Commission proposes to have all the concrete mixed at a central depot, from which it will be supplied to the contractor. I have never heard of such a system before. The usual practice is to mix the concrete on the job and run it into the formes as quickly as possibly. If mixed concrete is carted any distance the movement in the waggons will cause the finer materials to settle before it is placed in position, and consequently the concrete will be inferior. I have seen a fair amount of work done with hollow concrete blocks, especially at the seaside, but I have not actually used that method of construction. I have examined that class of work carefully and I am not enamoured of it. A fair amount of shrinkage takes place and I have been advised that it is not waterproof. Judged by the schedule which, as I have explained, can *hardly be regarded as a contractor's estimate*, there appears to be very little difference in Melbourne and Canberra costs apart from bricks and sand.

53. *To Mr. McGrath.*—I have no personal knowledge of Canberra conditions so I cannot offer any comparison between the quality of Canberra and Melbourne bricks. I can, however, say that if Canberra bricks are better than those which are supplied for Government jobs to Melbourne they must be very good. Melbourne stock bricks are excellent in quality and cost only 67s. a thousand at the kiln as against 105s. a thousand in Canberra at the kiln. Special bricks for fine finishing work cost £5 10s. a thousand in Melbourne, but not many are used, and seconds are 4s. a thousand cheaper than stock bricks.

54. *To Mr. Francis.*—I consider that Melbourne stock bricks used on Government jobs in this city are equal to any manufactured in Australia. I doubt if they can be improved upon. Certainly they are better than any I have seen in Sydney. I believe that the policy of the Commission in requiring contractors to purchase certain materials from the Commission, and the Commission's proposal to deliver mixed concrete on the job will limit the field of competition among contractors. I should prefer to tender without any such restrictions. It is possible that if they are *continued*, in time the tenderers will be only those contractors who are living and working in the Federal Capital. As a consequence, there is a probability that building costs will increase. If a contractor is able to purchase to greater advantage in the open market he should not be prevented from doing so. It is not necessary, to ensure uniformity in concrete mixture, to have the material mixed from a central depot. Effective supervision by a competent clerk of works should ensure uniformity in concrete mixed on the job.

55. *To Mr. Gregory.*—I agree that in regard to certain classes of materials, such as ironmongery, &c., it is wise to stipulate prices so as to ensure the use of first class materials. In Melbourne cartage of bricks costs about 4s. a mile per thousand. I have never before heard of any proposal to mix concrete at a central depot and deliver it on a job some distance away. The Melbourne and Metropolitan Board of Works has carried out many big jobs in this city and it has never thought of adopting that practice. We also have done a great deal of work in Melbourne and suburbs and never had any occasion to handle concrete in that way.

56. *To Mr. McGrath.*—If concrete is mixed at a depot and carted some distance to a job, its quality must be affected because of the tendency of the cement to set before it is actually poured into the formes.

57. *To Mr. Gregory.*—It would be possible but, I suggest, also very expensive, to mix concrete at a depot and convey it in a revolving vessel some distance to a job. To insure uniformity in mixture I should prefer the mixing of cement on the job under expert

supervision. The cost of facing buildings with sandstone or other material depends entirely on the thickness of the stone facing. We have brought sandstone from Sydney for this purpose. A stone facing 4 inches thick costs about 7s. or 8s. per super foot. I am familiar with the Mount Gambier limestone. It is not suitable for facing work. There is practically no good standstone in Victoria except the Stawell deposit, and that is exceedingly hard. It is more expensive to work than granite, and because of the grit in it men do not care to work it up. Stone facing for public buildings improves their appearance, but it cannot be compared with bonded stone work. I have never used tallowwood. I agree that it is one of our finest timbers, but it does not come to Victoria. I would prefer it to jarrah. We use a good deal of Tasmanian oak for floorings. It is better than the Victorian timber.

58. *To Senator Payne.*—The short time allowed for the preparation of tenders is an inducement to contractors to increase their prices so as to be on the safe side, because in the majority of cases a tenderer cannot complete his inquiries within a fortnight. I have never had any difficulty in Melbourne about uniformity in the mixture of concrete. We prepared the big dome for the public library and lifted it into its place within a few minutes after it was mixed. I had some experience, a few years ago, with concrete blocks mixed with coke breeze, and I found that there was a fair amount of shrinkage in it. It was regarded as faulty for partition work and was abandoned. On average villa work a bricklayer lays about 700 bricks a day. That is about all we can depend upon now and we tender on that basis. I admit that it would be advantageous for the Commission to buy certain materials in bulk and specify that contractors must obtain their materials from the Commission. Possibly the Commission can buy in bulk at a cheaper rate than can be secured by small contractors. I have not used Tasmanian myrtle for flooring, but I have used it for other purposes and discontinued it because it warped so badly. I was not aware that the floor in Dunlops' buildings was put down in Tasmanian myrtle. If it is giving satisfaction I should not like to offer an opinion against it. Possibly the timber I used was not properly seasoned. At all events I did not use it again. Latterly granite has been used for the facing of a number of buildings in Melbourne—notably the T. and G. building in Collins-street, and the Savings Bank building in Swanston-street. A stone faced building is much better than a plastered building, but it cannot be compared with stone masonry properly bonded in. I have no fault to find with the practice of facing buildings. To the uninitiated they look all right and serve their purpose. Permanent public buildings in the Federal Capital should be erected in stone properly bonded in.

59. *To Mr. Francis.*—We have had a fair amount of experience in flat roof construction in Melbourne. The Commonwealth Bank in Collins-street, the Athenaeum upon which we are now working, and several other buildings erected by us have flat roofs. We put down first of all thick concrete slabs, then coke breeze concrete and four layers of bitumen and felt. I prefer bitumen and felt to Neuchatel asphalt, which has a tendency to creep. We allow a fall of about 1 inch or 1½ inches in 10 feet.

60. *To Mr. Gregory.*—I have seen gravel used on top of the bitumen and felt, but that system is not adopted in Melbourne now. I imagine that gravel is used to keep out the heat. The system I have described has been employed here for the last twelve or fifteen years, and the flat roofs treated in that way appear to be the same now as when they were constructed. I consider that the short time allowed for tendering for this building will tend to prevent outside tenderers from submitting prices.

(Taken at Melbourne.)

SATURDAY, 20TH APRIL, 1929.

Present:

Mr. M. CAMERON, Chairman;
Senator Barnes | Mr. J. Francis
Senator Payne | Mr. Gregory
Mr. Coleman | Mr. McGrath.

William Arthur Mordey Blackett, architect, sworn and examined.

61. *To the Chairman.*—I am a member of the Canberra Advisory Committee, the object of which is to advise the Federal Capital Commission with regard to the erection of Commonwealth and other public buildings in Canberra. Usually the views of the Advisory Committee are voiced by the chairman or deputy chairman, but there is no objection to individual members being asked for their opinion. I have seen the plans of the botanical section of the laboratories proposed to be erected at Canberra. The plans have been prepared by the architect to the Federal Capital Commission and the Advisory Committee has been consulted with regard to them from time to time. The botanical section is similar in design to the entomological section except that there is also provision for the administrative offices and library. As far as is reasonably possible, the Advisory Committee makes recommendations as to equipment and construction in detail, paying special attention to insulation and general services. The design of the proposed buildings has been approved by the committee. If necessary, it may be extended to meet future needs. An object of the committee is to ensure the development of designs which will permit of future extension, and group harmony; the buildings in question have been treated with that object in view. I have not had personal experience of the Imes Bell hollow concrete block construction, but I understand it is extensively employed in various places. Provided hollow concrete blocks are approved of by the Fire Underwriters Association there should be no objection to their use. They are, to a certain extent, sound-proof and heat resisting. The Advisory Committee has not had an opportunity to scrutinize the building specifications for the botanical laboratory. It is not the practice for the committee to look over the specifications before buildings in Canberra are commenced, but usually the committee offers suggestions as to materials that should be used. My committee has confidence in the architect to the Federal Capital Commission.

62. *To Mr. McGrath.*—If this committee thinks it advisable it might suggest to the Federal Capital Commission that the Advisory Committee should have an opportunity to examine the specifications before tenders are called. We then might be able to make some comments. It would not take very long to do that.

63. *To the Chairman.*—I approve of the use of an approved bitumen and felt fabric for floor covering in the laboratories. I have had material of this type down in my drafting room for over twenty years, and it is still in excellent order. It wears better than linoleum and has the advantage that in winter time it is not so cold. It keeps the feet reasonably warm. I approve of the proposal to face the buildings with cement. I consider stone facing would be too expensive and would not be justified. It is possible to get quite good expression in modern treatment in cement. I agree that the zoological building should be faced with stone, because that will be one of the more important permanent public buildings in Canberra. Treated in cement, the botanical laboratories will be in keeping with later buildings erected in that locality. A fortnight for tendering should be sufficient, because all the quantities have been taken out for the information of tenderers. I can leave Melbourne for Canberra and return in 44 hours, and I assume that others could do the same, so as to inspect the site and obtain necessary particulars. The cubic foot cost of a similar building in Melbourne would work out at about between 1s. 6d. and 1s. 9d. I understand that the Federal Capital Commission proposes to have the concrete mixed at a central depot and delivered on the job. This practice is finding favour in America. It is being adopted to ensure absolute uniformity of mixture and strength. I believe it is possible to get a higher average of strength in this way, provided that the time between mixing and placing in situ is within, say, twenty minutes. With regard to other items, such as door locks, furniture, &c., I presume that the Federal Capital Commission buys in bulk and by compelling contractors to purchase from it, in that way ensures a uniform standard in fittings. We adopt much the same practice. In our specifications we provide that the architect shall select all the appertenances to a building. We say that we are the best judges of quality and type and know best what will harmonize. It is part of an architect's training to buy articles and fittings at the most reasonable price consistent with quality. An architect is trusted perhaps more than any other person in the community with the expenditure of other people's money. If the system is a good one in its application to the erection of privately-owned buildings, I see no objection to it in Canberra. It should be in the interests of the building owner—in this case the Commonwealth Government. The practice is to allow a certain amount for what are known as percentage items, and if expenditure is below the sum allowed, to credit the owner of the building with the amount saved. Provided the Commission's buying is on right lines, the practice of compelling contractors to buy materials from the Commission should be of advantage to the Commonwealth. I should, of course, recommend a hardwood for the flooring. I understand that tallowwood flooring in the Sydney Hospital has been in use for 70 or 80 years, and I know it is an excellent timber; but it is not used in Victoria. It is advisable to pour the mixed concrete into the formes as quickly as possible, but delay of half an hour is neither here nor there.

64. *To Mr. Francis.*—If the Commission's proposal is adopted and if mixed concrete from a central depot shows a tendency to sedimentation in transit to the building, it could be brought back to its original state by re-agitation.

65. *To the Chairman.*—I should not like to dogmatize as to what length of time could, with safety, be allowed between the time of mixing the concrete and placing it in position. We always specify that it shall be deposited as quickly as possible. I suggest that more definite views on this subject be obtained from the university authorities.

66. *To Mr. McGrath.*—If concrete mixture shows a tendency to sedimentation it could be brought back to its original state by re-agitation provided that initial set had not taken place.

67. *To the Chairman.*—From information which I have received, I gather that building construction engineers in America are satisfied that they are getting a better average of strength in concrete mixed at a central depot, and transported to the job. Personally, I would be prepared to pay a little more for concrete to ensure absolute uniformity in the mix. If the Federal Capital Commission adopts this course I presume that measures will be taken to control the output of mixed cement so as to prevent delay in placing it in position. I expect a depot will be established on the banks of the Molonglo so it should not take long to cart the mixture to the building.

68. *To Mr. Francis.*—If it is considered that a fortnight for tendering does not allow sufficient time for contractors to prepare their tenders, the time could be extended to three weeks. We have no difficulty in Melbourne when we allow a fortnight for tenders. Without knowing what is the turnover, I should not like to express an opinion concerning the percentage charged by the Commission to contractors for materials supplied. If the Commission has considerable stocks in hand I can imagine that it wishes to dispose of them, and perhaps this course is in the best interests of the taxpayers.

69. *To Mr. Gregory.*—As far as I am aware, the Advisory Committee has not had a consultation with the Council for Scientific and Industrial Research with regard to this building. We are concerned only with proposals put before us by the Federal Capital Commission, but we did consult with Dr. Colin MacKenzie over the building to house his gift to the nation. Members of the Advisory Committee give up a great deal of their time to advise the Federal Capital Commission. We are not responsible for the design of these buildings. The particular function of the Advisory Committee is to see that all public buildings in Canberra harmonize with the general scheme for the capital city of the Commonwealth. When inviting tenders for buildings of similar dimensions in Melbourne, we usually allow two or three weeks for tenderers to submit quotations. It would be an advantage if prospective tenderers from Melbourne or Sydney had ample time to prepare tenders; but in many cases a contractor figures only on the quantities. Some of them do not look at the drawings. If they know the nature of the ground there is very little difference in tendering for buildings in Canberra or Melbourne; though of course a tenderer would have to satisfy himself as to transport charges. Up to a certain point I approve of the policy of the Commission in purchasing stocks in bulk and requiring contractors to buy from it. There is much to be said in favour of the proposal to supply mixed concrete and mortar from a central depot, subject to qualifications as to time from mixing to placing. Public buildings are different from private buildings. People expect government buildings to last for an indefinite period. Therefore it is advisable to ensure uniformity and a high standard of quality in all the materials. In our specifications we provide sometimes that some items shall be procured from a certain warehouse which we know stocks the lines which the owner of the building wishes to have. I am satisfied that the mixing concrete at a central depot will make for uniformity in the strength of the mix, and perhaps also be more economical. It may be carted in ordinary motor trucks to the job. The agitation in transit should prevent any tendency to sedimentation.

70. *To Senator Payne.*—I agree that, if the Commission has large stocks of building materials in hand, they should be utilized. Whether this course will be in the interests of the country depends on what the buying organization of the Commission has been able to accomplish. There might be weak points in the system. It is difficult to get hold of a man with a trained sense in buying. The disadvantage I see in the system is that if any of the materials supplied prove to be unsatisfactory they cannot be condemned by the Clerk of Works. Probably it would be advantageous to allow more than a fortnight for tenderers. A big contractor may be absent from his place of business when tenders were advertised, and so miss an opportunity to put in a price. I think building sand costs 12s. 6d. a cubic yard in Melbourne. Concrete blocks made of coke

breeze are favoured for both strength and lightness for interior work. Personally, I prefer terra cotta lumber. Slight cracks may appear over the partition walls, but they are easily pointed up and the saving in cost as compared with cement concrete is substantial on account of the flexibility of re-allocation of room areas when found necessary.

71. *To Mr. McGrath.*—Hitherto we have always specified that concrete must be mixed on the job, but I know that mixing at a central depot is finding favour in America for the reason that it gives more control over the mix.

72. *To Mr. Gregory.*—Steel reinforcing rods for concrete work can be bought in the open market. The purchase of such materials from the Commission would not necessarily be a guarantee of quality. Sometimes private tenders are obtained for fabricated reinforced material to ensure uniformity in strength. In such cases we specify the name of the supplier of the fabricated steel. This might suggest that there has not been open tendering, but the advantages of the system are apparent. Architects always endeavour to ensure the use of first class material.

73. *To Mr. Francis.* I agree that a contractor who knows his business should be able to buy building materials to better advantage than a storeman employed by the Federal Capital Commission.

74. *To Mr. McGrath.*—If the storeman is experienced he should be able to buy in bulk at advantageous prices, but it is difficult to get a man with the necessary training.

(Taken at Melbourne.)

WEDNESDAY, 24TH APRIL, 1929.

Present:

Mr. M. CAMERON, Chairman;

Senator Payne	Mr. Gregory
Mr. Coleman	Mr. Jackson
Mr. J. Francis	Mr. McGrath.

John Smith Murdoch, Director-General of Works and Chief Architect, Department of Works, sworn and examined.

75. *To the Chairman.*—I have not been associated with the proposal to erect a botanical laboratory in Canberra, but I had an opportunity, yesterday, to examine the plans and specifications. I have a general knowledge of the proposed site, and am satisfied that the design of the building can conform with future educational buildings to be erected on the land reserved for that purpose. The design presents no extravagant features. It is simple, and, as a believer in simplicity in architecture, it has my approval. I commend the idea to face the building with cement. I have come to the conclusion that facing with sandstone in Canberra, or for that matter anywhere else, is not advisable. Buildings such as Parliament House, Melbourne, and the Treasury building, which are regarded as amongst the most chaste in the Commonwealth, have been erected in our own lifetime, and the manner in which they are fretting away is, to say the least, depressing. A cement-faced building is in its way quite as good from an architectural point of view, and, what is more important, it is permanent. Stone-faced buildings become decrepit-looking structures in 50 or 60 years. The Public Works Committee, in my judgment, acted wisely when it recommended that the permanent administrative offices in Canberra should be faced with granite. Even the Stawell stone, which is regarded as amongst the most durable in Australia, begins to fret in a comparatively short time. I know of no good reason why we should continue to use sandstone for the facing of public buildings. Parliament House, Canberra, is cement faced, and it looks well. I am aware that it was a practice of the Federal Capital Commission to require contractors to purchase certain materials, such as sand and bricks, from the Commission; but I did not know that the Commission compelled contractors to purchase other materials in the same way. If, as has been stated, the Commission, anticipating a very heavy building programme, now holds large stocks of building materials of all descriptions, it may be advantageous to require contractors to purchase it, and in this way dispose of the stocks. I do no approve of this as a general principle. It seems that if the Commission purchases stocks of materials and stores it, interest on expenditure must be added to the price, and in this way the cost to the contractor must be to that extent higher than the open market rate. I see no good reason for the intervention of another middleman between the supplier and the consumer. In my opinion, a private contractor can buy his supplies in the open market as advantageously as can the Commission. As a rule contractors are as keen as any person who might be employed by the Commission to purchase supplies in the best market. If the Commission holds large stocks, the interest charged on capital cost must have the effect of increasing the price of materials to the contractor.

76. *To Mr. McGrath.*—If stocks are held by the Commission it is good policy to get rid of them by requiring contractors to take them off the Commission's hands. This would be better than sending them back to the merchants at Sydney, or wherever they were bought.

77. *To the Chairman.*—If the Commission were doing a considerable amount of work by day labour there might be a good reason for the accumulation of stocks of materials; but as a general principle I think I would avoid it. I consider that at least one month should be allowed tenderers to put in a price for a building of the dimensions now before the committee. If the Federal Capital Commission advises only a certain number of contractors that a particular work is to be advertised, its action is not good in principle, because a contractor in Perth should have an equal opportunity with a contractor in Sydney or anywhere else to tender for Commonwealth work. The proposal of the Commission to supply mixed concrete from a central depot is a novel one. I have never heard of it before; but before expressing a definite opinion as to its wisdom or otherwise I should like to hear what is to be said in favour of it. If concrete is mixed at a depot and transported to a job some distance away, it will deteriorate. As a matter of fact, immediately water is introduced into the dry material the concrete commences to set. If the wet mixture is transported even a short distance to a job the heavier masses immediately begin to gravitate from the lighter masses. Construction works usually provide for the mixing of concrete on the spot. Certain road contractors who have, say, half a mile of concrete road to make might install their plant about the middle of the road, and deliver the mixed concrete where required; but concrete for road purposes does not demand quite the same care as concrete intended for suspended floors or for the walls of a building. I feel sure that if it is mixed at a depot and delivered wet on the job it will deteriorate. Unless the system has advantages of which at present I know nothing, I can see no good purpose in the proposal.

78. *To Mr. J. Francis.*—The quality of concrete mixed on a job should be ensured if the work is properly supervised.

79. *To Mr. McGrath.*—I understand there were supervising officers watching the mixing of concrete for the foundations of the permanent administrative offices in Canberra, about which a complaint was made last year.

80. *To Mr. J. Francis.*—The specification as regards the proportions of sand and metal to be used in those foundations was altered, but not as regards the amount of cement to be used.

81. *To the Chairman.*—I am acquainted with the Innes Bell system of hollow concrete blocks for floorings, but have never employed it. I have ascertained from an examination of the plan that it is proposed to employ hollow block construction for the floors and roof. I understand that it is proposed to place an order in Sydney for about £1,000 worth of concrete hollow blocks. Seeing that there is an ample supply of material locally for making concrete floors, I consider economy would follow avoidance of hollow blocks at Canberra. I estimate that the price for these block floors works out at about 27s. per square yard, and that concrete slab for flooring, which in my opinion would be quite as good, would cost only about 21s. per square yard, so if slabs were substituted there would be a saving of about 6s. per square yard on that item. The blocks, I understand, are 10 inches high, and it is proposed to lay 3 inches of concrete on top of them, so that the total thickness will be about 13 inches. A 7-in. solid slab concrete floor reinforced in the usual way will be quite as good. I believe that one advantage claimed for the hollow concrete blocks is that they ensure superior insulation.

82. *To Mr. J. Francis.*—For public buildings I favour always the less costly method of construction, consistent, of course, with efficiency. I notice that the lower floor is to be suspended. It seems to me that it would be cheaper to fill in with soil and put down a solid concrete floor. I estimate that if solid concrete is substituted for the hollow blocks provided for in the specification, there will be a saving of £480 in the total cost of the building, which, I understand, is estimated at £52,000. I should not like to express an opinion as to the probable cost of a similar building in Melbourne, but in general terms it may be said that building costs in Canberra are from 10 per cent. to 15 per cent. above Melbourne prices. Bricks and other material are dearer in Canberra, and the labour output is not perhaps quite so high there as in Melbourne. I consider that an efficient contractor can buy his supplies in the open market as advantageously as the Commission can. If the Commission has a large accumulation of stores, it would certainly be to the advantage of the Commission to get rid of them by requiring contractors to buy them from the Commission. Personally, I disapprove of the continuance of a stores branch at Canberra in so far as general supply of building material is concerned. It seems that the less intervention there is between the man who manufactures material and the man who uses it, the better the position should be as regards cost. There should be no difficulty in ensuring uniformity of concrete mixed on any particular job. Immediately water is introduced to a concrete mixture sedimentation begins, and no time should be lost in placing it in position. I cannot say why the specifications provide for a suspended ground floor. It is possible that the scientists who will use the building require a certain space under the floor for a particular object; but if it is wanted for pipe channels they can be provided for when a solid concrete floor is being laid. A solid floor would be more economical than concrete blocks. In round figures, the saving would be about 6s. per square yard.

83. *To Senator Payne.*—My observations concerning sandstone facing for buildings in Melbourne have led me to the conclusion that mouldings fret more rapidly than does plain work. St. Paul's Cathedral was built about 40 years ago with stone, and it has fretted very appreciably. Unless sandstone is treated frequently with silicia of soda or some such material, its life will not be more than 100 years. One of the most thoughtful men to give consideration to this matter was the late Colonel Vernon, at one time Government Architect in New South Wales. That was his opinion, and it is borne out by other authorities. Many of the older buildings in Sydney, built about 100 years ago, have practically decayed. It is the duty of a clerk of works to supervise the mixing of concrete on all jobs. We never put a yard of concrete into any public building unless the mixing is done under expert supervision. I can see no advantage in the proposal to mix concrete at a central depot. I have never before heard of a proposal to mix concrete in that way. I doubt that the use of hollow blocks is recommended in order to ease the strain on the walls of the proposed building. They are strong enough to take more than the weight which is likely to be put upon them. One advantage I see for the use of solid concrete floors instead of hollow concrete blocks is that the whole of the material is available locally, and the whole of the expenditure for labour and material will be in Canberra itself. Off hand, I would not mind saying that a further saving could be made by dispensing with metal and using river gravel only for the concrete mix. Gravel is less than half the price of metal. On the big telephone exchange in Brisbane we got stuck up for blue metal, so we used water-worn gravel instead, with quite satisfactory results. It makes a magnificent concrete. Another contractor on the Bank of Australasia in Brisbane used the same material. We have used water-worn gravel for a post office in Wagga. Tests have shown that there is a remarkable affinity between water-worn gravel, cement, and sand. When mixed together they become practically one substance. Water-worn gravel is used largely for concrete pavements. It stands a great deal of wear, and is in every respect satisfactory. I notice also that the specifications provide for steel windows at 12s. 6d. per square foot. The price is high. For a bank which we are building in Brisbane we are paying 9s. 6d. for steel windows supplied by a contractor in Melbourne. They are sprayed with zinc and bronze and erected for the price mentioned. I have come to the conclusion lately that the use of steel windows in public buildings is unnecessary. They give a considerable amount of trouble. In many cases we cannot get them made locally. As far as possible, I like to obtain all materials in the place where a building is erected, and I fail to see why we should not revert to the use of timber for window framings. The use of steel for window frames is now something of a fetish with architects; but I am breaking away from the practice. I propose to utilize jarrah frames and window sashes instead of steel for a bank which we will build in Perth. For the new telephone exchange in Hobart we used steel window frames, and had a great deal of trouble with them. They had to be obtained from Melbourne, and got distorted in transit, so they were not at all satisfactory. Timber would have been cheaper and, in my judgment, better. There is little risk of fire in a public building that is not adjacent to other buildings, so I fail to see why we should not, wherever possible, use timber for our window frames. Timber is employed in David Jones' big building in Sydney, also for Parliament House, Canberra. I am confident that considerable economies would be effected by reverting to the use of timber. The price for steel-framed windows for this building is set down at 12s. 6d. a foot. I am sure that one

could put in timber frames for probably one-half the price. It is possible to get steel frames at about the same price as timber, but I would not recommend their use in first class buildings. A good class steel window frame costs considerably more than a timber frame. There is provision in the specifications for timber flooring to the corridor on the ground floor. The price quoted for tallowwood, 4 x 1, £4 4s., and for jarrah, £4 17s. 6d., is about the market rate. I have used a considerable amount of Tasmanian oak and myrtle for flooring. Both are good timbers, and if the Tasmanian millers could supply the demand with good quality material they could sell their product readily enough. I notice also that there is provision for the use of New Zealand timber for laboratory fittings. I am sure that Australian timbers would be quite suitable. Probably the scientists who will use the building have asked for fittings to be made of New Zealand kauri.

84. *To Mr. Coleman.*—I assume that Dr. Tillyard has suggested to the committee that the laboratory benches should be constructed of kauri. It is probable that he likes that timber, and was unaware, when he made that suggestion, that Australian timber would probably suit as well. I entirely approve of the specifications providing for a bituminous felt and gravel roof. I would not recommend the use of Neuchatel asphalt. It is not a British product. If we are to use imported asphalt let us go to Trinidad for it; but bituminous felt and gravel make a good roof. In Sydney asphalt is used in preference to gravel. In Melbourne asphalt is less extensively used. I understand the objection urged against it is that it creeps. I regard the roof covering at Parliament House, Canberra, as good. The roofs I saw in American were usually put down in those materials. In Melbourne for some years the practice has been to use malthoid or rubberoid; but they deteriorate rapidly in the sun and weather, unless they are painted every two or three years with a bituministic paint or covered with gravel.

85. *To Mr. McGrath.*—The department drew the plans for Parliament House, Canberra, but the work was carried out by the Federal Capital Commission. I am aware that there have been complaints concerning the roof. That was because the contractor did not make a good job, with the result that the water got through the joints in the material. It is hoped, of course, that for all future work we shall have the services of a more efficient contractor. If bituminous felt is put down properly, and then covered with gravel, it will most likely never give any trouble. I have never before heard of the proposal to supply concrete mixed at a depot some distance away from a job. If, as Mr. Blackett say, this new practice is finding favour in America, I assume that it is mixed and supplied in a dry form. The practice as I know it is to mix on the job, and place the material into position as quickly as possible. I have always taken the stand that sandstone facing should be avoided at Canberra in those buildings which are to be regarded as permanent. Experience has shown that stone frets after a time, so I cannot see the advantage of continuing to use it. I think that a contractor can purchase material in the open market as advantageously as can the Commission. It is the practice for all architects to specify certain percentage items, which are selected by the architect within the price range allowed in the specification. I understand it has now been concluded that the Fairy Meadow deposits cannot profitably be utilized for buildings in Canberra and regret this very much.

86. *To Mr. Jackson.*—I should hesitate to make any recommendation that would delay the construction of the buildings to house Dr Colin MacKenzie's gift to the nation. The botanical laboratory will be an entirely different class of building from the zoological building, and expressed in cement will not interfere with the aesthetic features of the university group of buildings.

87. *To Mr. Gregory.*—Sandstone deteriorates more rapidly at the base of a building, owing to evaporation and absorption of moisture from the ground. But there is marked fretting at the main cornices. When resting in its natural position it is sealed at top and bottom by the joints; but in overhanging cornices exposed to the atmosphere it scales rapidly on the underneath side. The top portion of the stone may be protected from weather with a covering of some bituminous substance; but underneath it commences to efflorese, and gradually it frets away. If a building is to be faced with sandstone I would suggest that there be a facing of other material for a height of at least 3 feet from the ground. As a rule, we allow a fall of 2 inches in 12 feet for flat concrete roofs with bituminous felt and gravel coating. Theoretically, concrete begins to set immediately water is introduced to the mixture.

(Taken at Melbourne.)

TUESDAY, 30TH APRIL, 1929.

Present:

Mr. M. CAMERON, Chairman;

Senator Barnes	Mr. Gregory
Senator Payne	Mr. Jackson
Mr. Coleman	Mr. McGrath.
Mr. J. Francis	

Samuel Sherwen Cameron, Director of Agriculture, Victoria, sworn and examined.

88. *To the Chairman.*—I am aware of the proposal to establish botanical laboratories at Canberra in connexion with the Council for Scientific and Industrial Research. A number of scientific investigations are being conducted by the Council in co-operation with my department. As far as possible, precautions have been taken to prevent unnecessary duplication of this class of work by the Council and the various State Agricultural Departments. This matter was a subject of close consideration about two years ago. At a conference between the Council and the several State Departments of Agriculture an attempt was made to set a line of demarcation between work which can be more properly conducted by the State departments and investigations which can more effectively be carried out by the Council. The following resolutions were adopted at the conference:—

1. This conference is of the opinion that in view of the number and magnitude of the problems confronting the agricultural and live-stock industries of Australia, Commonwealth participation in agricultural research is desirable.

2. The field for the investigation of agricultural problems is almost unlimited in scope. In this field there are many problems which are regional or national in range or scope, fundamental in character, and which require concentration of effort and highly specialized research for their solution. These problems are specially suited for investigation by the Commonwealth.

3. The research problems confronting the agricultural and live stock industries may be classified broadly into three categories—(i) Investigation of the principles governing the practice of farming and the rearing and feeding of stock; (ii) the production of new varieties or breeds of plants or animals; (iii) the investigation of diseases of plants and animals with a view to control.

(1) *Investigation of Principles underlying the Practice of Agriculture and Live-stock Husbandry.*—This group of problems covers an exceedingly wide range, namely, soil problems, plant biology, production of farm crops, introduction of new plants and animals, plant nutrition (including improvement of pastures, dairying, horticulture, apiculture, animal nutrition, and agricultural economics). Investigations in this field, which are more or less of a fundamental character, and which are national in scope, should be conducted by the Commonwealth, whilst problems of a more or less local character, and which involve the application of existing knowledge, should be undertaken by the State Departments of Agriculture.

(2) *Production of New Varieties or Breeds of Plants or Animals*—

(i) Plants.—Much valuable work has been accomplished by various State Departments of Agriculture, and many new and valuable varieties of wheat have been produced which have already led to a considerable increase in wheat production. This work should be encouraged and extended to include other farm crops which have not been subjected to such extensive work. Two distinct types of problems are involved:—(a) Plant genetics. An investigation of the botanical, morphological, and other characters of plants grown in Australia, and an investigation of the genetic factors involved in disease resistance. (b) Plant breeding.—The application of scientific principles to the systematic improvement of existing varieties. The former group of problems (plant genetics) should be carried out by the Commonwealth; the latter (plant breeding) should be carried out by existing organizations.

(ii) Animals.—A somewhat similar division of problems may be made regarding animals:—Animal genetics.—The genetic analysis of the economic characters of live stock, including the meat quality and milk yield of cattle, wool quality and yield of wool and carcass of sheep, egg and meat quality and yield of poultry and the like, constitute a group of research problems which are of national importance and require highly specialized research for their solution, and form an appropriate field for Commonwealth investigation. Animal breeding.—The application of existing knowledge and principles to the breeding and improvement of farm animals. This field of work should be left to existing State Departments of Agriculture.

(iii) Disease and its Control.—The field work in connexion with diseases in plants and animals is vast, and must increase with intensification of production.

Plant Diseases, Plant Pathology and Entomology.—The problems associated with the disease in plants may be divided broadly into two fields—(i) investigation of the life history of the casual organism, the mode of infection and conditions of attack, with a view to suggesting control measures; (ii) the application of known principles to the elimination of insect, fungus or other pests within definite regions. The former problems are specially suited for Commonwealth investigation, while the latter should be carried out by the State institutions.

Animal Diseases.—Investigation of work on animal diseases might be regarded as within the sphere of the Commonwealth, and they should be conducted in association with the States as regards field work.

4. The Council for Scientific and Industrial Research could render a service to the agricultural institutions of the Commonwealth by acting as a clearing-house for information on research projects in progress in State institutions and universities. The States should supply information on research projects in hand or contemplated, and the Commonwealth should supply the States with similar information regarding its projects in agricultural research.

5. The Commonwealth could also render a service to Australian agriculture by issuing a Journal of Australian Scientific Research, which would afford a means for the publication of papers on agricultural science, which are too technical for inclusion in State departmental journals, or which are not of sufficient international importance to be included in the scientific journals abroad.

6. In view of the great number of Australian agricultural problems remaining unsolved and the great difficulty experienced by the State Departments of Agriculture in obtaining suitably trained investigators, it is recommended that the Council should adopt a scheme which will enable the universities to attract students to the Faculties of Agriculture and Veterinary Science by notifying that appointments will be available for suitable men on the completion of their University course or towards the completion of such.

7. We consider that the ways in which the Council for Scientific and Industrial Research can best serve Australia in the matter of agricultural advancement are by the establishment of a relationship of co-operation and collaboration with the State Departments of Agriculture, the universities and other institutions concerned with agricultural and live-stock interests. It is understood that such co-operation would be compatible with the independence of individual organizations undertaking research activities.

8. It is desirable that the phases of agricultural research indicated above should be carried out as far as possible with State departments and universities, and that such practice should be encouraged, but when found impracticable it may be necessary to create new institutions.

9. To effect the desirable co-operation and necessary collaboration indicated throughout this memorandum, it is considered that the Council should bring into existence a Standing Committee on Agriculture, comprising the permanent heads of the State Departments of Agriculture and representatives of the Council, such Standing Committee on Agriculture to act as the advisory and consultative body on matters relative to agricultural and live stock research undertaken by the Commonwealth.

NOTE.—Many of the investigations mentioned in this report, and particularly those in regard to animal genetics, involve prolonged research from which results of economic importance cannot be expected for many years.

This conference is of the unanimous opinion that the institution of a tropical agricultural research station in Australia is essential as a forerunner of the successful and economic development and settlement of the tropical parts of Australia and the Mandated Territories, and recommends the Council for Scientific and Industrial Research to approach the Commonwealth Government with a view to securing a special grant enabling the Council to accept the offer made by the Empire Marketing Board for the purpose of founding and maintaining such a station.

This conference recommends that the Council for Scientific and Industrial Research takes steps to secure an estimate of the probable cost and annual expenditure which would be involved in the erection, equipment, and conduct of such tropical agricultural research station, with a view to securing a special grant from the Commonwealth Government.

Certain problems have an interest common to the whole of Australia, while others are confined to local or climatic zones. Some problems are regional; others are Commonwealth-wide. Having determined that certain problems have an interest in common to the whole of Australia, the conference resolved that a Commonwealth organization could more efficiently conduct fundamental investigations and research in respect of such matters, and that the States were better equipped to secure the application of results flowing from any such fundamental research conducted by the Council. I regard the establishment of the botanical laboratories by the Council of Scientific and Industrial Research as a step in the right direction. Officers of State Agricultural Departments are doing what may be regarded as emergency work. They may be engaged upon an investigation of a particular subject, when suddenly there is a demand for an immediate inquiry into some more pressing problem. At the same time they have to carry out a great deal of routine and inspectorial work. The conference felt that a Commonwealth organization, relieved as it would be of a great deal of routine duties that have to be performed by State officials, could more satisfactorily and more quickly solve many of the problems that are troubling us to-day. I happen to be the chairman of the Standing Committee on Agriculture, which, as is indicated in the resolutions which I have read, comprises the heads of the State Departments of Agriculture, with certain other members, including professors of agriculture in our universities and representatives of the Council for Scientific and Industrial Research. The Standing Committee meets twice each year to consider matters that are submitted to it by the Council for an expression of opinion as to the lines of investigation to be adopted. The Council is guided by the views expressed by the Standing Committee and the arrangement is working very well, indeed. Personally I have great confidence in the scheme, and I feel that, if this link between the

and if it is well painted with a residual oil such as calol,

Commonwealth organization and the State departments is maintained intact, the joint work of the Commonwealth and State organizations would be quite satisfactory to Australia. The relations between my department and the Council for Scientific and Industrial Research are quite cordial and I am anxious to see that nothing interferes with the smooth working of the scheme. I have for some years felt the need for some such organization to which the State Departments of Agriculture could turn in their dilemma, in the confident hope that the central organization could carry on and extend the work which they had been doing. There are sure to be difficulties, and possibly a little friction, between the Commonwealth and State authorities, but the difficulties should not be insuperable. Possibly there will be interference by the Commonwealth organization in certain directions; on the other hand, it is likely that sometimes the State authorities may consider that the Commonwealth organization is neglecting work which it should undertake; but I am satisfied that the advantages accruing from the entry of the Council into this field of research will far outweigh any of its disadvantages. I have had doubts concerning the wisdom of centralizing the whole of the work in Canberra. There are two schools of thought as to the conduct of research work. One holds the view that it should be conducted in the particular locality affected by a specific problem; the other favours a central location. I think it is agreed that a considerable amount of investigational work must be done in the locality where the problem exists. Another suggestion is that there should be specialized laboratories in each State, fully equipped to deal with local problems. I am thinking particularly of tropical diseases in plants and animals. I agree that there must be a central organization, and since Canberra is the Seat of Government, it might as well be established there as elsewhere in the Commonwealth. In some respects the soil and climate of Canberra are not the most suitable that could have been chosen; but in any case soil investigations will have to be conducted in all parts of Australia, and such work can best be directed from the central establishment. My department has carried out a considerable number of investigations into plant and animal diseases, including "take-all" and "flag smut" in wheat, the root borer and various stem rots in fruit, bitter pit in apples and various problems relating to the storage and transit of fruit, also blue mould in tobacco, as well as the eradication of certain weed pests, particularly hoary cress; whilst in animal diseases we have given considerable attention to tuberculosis, abortion in cattle, and other problems. But ours is largely emergency work. For example, we might have sudden trouble with thrips in our orchards, and have to attack it straight away. Thus investigational work on a particular problem is seriously interfered with by a sudden demand to deal with another pressing problem. We have a well-equipped chemical laboratory, and we have conducted a number of investigations at the Government cool stores into difficulties associated with the storage and transport of perishable products. These numerous problems are seriously affecting production throughout Australia. In some seasons they might be responsible for a reduction of from 30 to 40 per cent. of crop estimates. I can say definitely that in some seasons flag smut in wheat reduces production by 5 or possibly 10 per cent., and rust may be responsible, in a season favouring it, for a similar falling off. It is impossible to do other than guess at the aggregate loss caused by the numerous plant and animal pests that cause so much trouble to our primary producers. The function of the Standing Committee on Agriculture is to consider projects put forward by the Council for Scientific and Industrial Research relating to agricultural problems. I believe that work along the lines indicated will result, eventually, in a material increase in productivity throughout Australia. I agree with the views of Dr. Rivett as to the need for rejuvenating Australian pastures. My department has really been responsible for the rapid spread of the practice of top-dressing pasture land. We conducted a number of experiments between the years 1912 and 1918 and demonstrated that top dressing with superphosphates substantially increased the carrying capacity of pastures. It is claimed by some that the carrying capacity of certain areas has been doubled. That may be true in some cases. I have no hesitation in saying that not only will top dressing with superphosphates increase the carrying capacity of land, but it will also improve the character of the herbage. But there is a great deal more to be done in the treatment of pastures by top dressing. Certain facts which are emerging from our experiments need to be studied. I refer particularly to the tendency to increase growth of certain varieties of clover when top-dressed. It is possible that the varieties that are increasing in growth are not the best kinds of clover. Subterranean clover responds very rapidly to top dressing. White clover, on the other hand, does not come on so readily. Prior to the use of superphosphates as a top dressing, subterranean clover had its own suitable soil. It has been shown, also, that some grasses go out under top dressing, including certain approved varieties like the wallaby grass. It is now a question whether we should not use some form of nitrogenous manure on land that has become phosphate satisfied. It is obvious that, if land which is deficient in phosphate is top-dressed with superphosphate, it becomes satisfied, and it may then be in a condition that calls for treatment by some other plant food. Our experience is that the best results under top dressing are obtained in districts with a rainfall of 20 inches and upwards.

89. *To Mr. Gregory.*—Without entering the arena of politics, I could not say whether the Commonwealth Government is justified in launching an elaborate proposal for scientific research into botanical and entomological subjects. I think, however, that the Commonwealth is fully justified in spending much more money on agriculture than it has done hitherto. For many years the Commonwealth has been benefiting in revenue from the efforts of State Governments to advance the science of agriculture. Every increase in the average of wheat production means an addition to Commonwealth revenue by way of income and land taxation, as well as through the customs. Prior to the establishment of the Council for Scientific and Industrial Research, the Commonwealth had not contributed to expenditure by the States in this field of investigation, and even now the expense incurred by the Commonwealth is comparatively small in comparison with expenditure by the States. I paid a visit to America in 1924, and I came back firmly convinced that it would be wise for the Commonwealth Government to follow the lead of the United States of America and Canada in establishing a Commonwealth department of agriculture. This course has been adopted by the Union of South Africa. The United States of America Department of Agriculture is a world-famed organization. The beneficial effect of its investigational work upon agriculture in the States is incalculable. It cannot be that 120,000,000 of people in the United States of America, as well as the 8,000,000 or 10,000,000 in Canada, are entirely wrong in establishing a Federal department of agriculture, and that the 6,000,000 people in Australia are right in refraining from adopting the same policy. I am hoping that the Council for Scientific and Industrial Research will

be alive to the importance of issuing publications from time to time, giving the fullest information to the public concerning research work that has been carried out. At present a large proportion of the accumulated and accumulating knowledge of the State departments is never imparted to the people for lack of publicity and propaganda facilities. Our vote for printing is altogether inadequate, and during a year of financial stress it is further curtailed, so that our publicity is quite disproportionate to the amount of work we are doing. At present the Council for Scientific and Industrial Research publishes a journal quarterly. Probably later it will become a monthly publication. Recently an invitation was given to State departments to submit for publication articles dealing with work that is being done by State officers. It is desirable that publications issued by the Council for Scientific and Industrial Research should be forwarded to every newspaper in the Commonwealth. At present the Council has not what may be termed a publicity department. I have no doubt that, as its work extends, more attention will be given to propaganda and publicity. Up to the present it has not been thought desirable that the Commonwealth organization should engage in propaganda dealing with research work done by any of the States. I believe that the State departments are better equipped to carry out propaganda; but they are hampered by lack of funds. I should like to make it clear that, as regards this particular phase of State activity, I am expressing merely my personal opinion. The State departments are better fitted to conduct propaganda work; but the Commonwealth Government might assist by subsidizing the States for this particular purpose. In Victoria, for example, we have between 150 and 200 district officers in personal contact with farmers in all parts of the State. They are in a better position to know how best to use propaganda material than any officers of a central organization could be. Amongst our officials are 33 dairy supervisors, whose special duty it is to get into contact with dairymen by making farm to farm visits. Propaganda literature, to be of value, must be distributed with discrimination. It must be sent to those people who have a particular need for it, and I suggest that it would be impossible for a clerical staff in Canberra to carry out this work to the best advantage.

90. *To Mr. Coleman.*—We have adopted various methods to get in touch with the farmers in Victoria. My experience in the department extends over 25 years, six as Chief Veterinary Officer, and nineteen as Director of Agriculture. For some time lectures were popular. The department subsidized those agricultural societies that arranged a series of lectures every year. This scheme worked well for a time, and it was possible to arrange for a series of lectures extending over a month in different districts. As interest waned the syllabus was cut down to a fortnight, and finally to a week. We next turned our attention to demonstrations in the paddocks. This also worked well for a time. Then we established what were known as field-days at experimental farms or at local farmers' places, where work had been carried out under departmental direction. Latterly we have been taking advantage of wireless broadcasting, but we find that the Better Farming Train, the latest effort, is quite the best scheme. It is difficult to get in close contact with the average farmer. Lectures for a time proved valuable, but farmers as a class are diffident people, and it is difficult to get them to take part in a discussion. This, perhaps, is the most heart-breaking experience of all agricultural lecturers. We found that the best way to help the farmer was to send experts on to his farm and discuss his particular difficulties on the spot. Our dairy supervisors are so organized that each man has about 400 farms under his care. In some cases his district embraces two municipalities, the area depending upon the density of the cow population. These supervisors come into personal contact with all the farmers, and in this way are able to spread knowledge. I should hesitate to say that a district with a 10-in. rainfall is safe for wheat-growing purposes. A 7-in. rainfall in the growing season may result in a complete success, or, on the other hand, a complete failure. Everything depends on the manner in which the land has been treated. An adequate rainfall in the growing season will not make up for inefficient treatment of the land between times. I believe, however, that we are evolving types of wheat that will make wheat-growing fairly safe in the drier areas of Australia, as well as types of wheat suitable for the coastal belt. In Victoria we are attempting to develop wheat specially suitable for the Wimmera, the Mallee, the north, and the coastal districts.

91. *To Senator Payne.*—The agricultural bureau system has been developed very successfully in South Australia, and more recently it has been adopted in New South Wales. An agricultural bureau may be described as an association of farmers who meet at regular intervals, say once a month, for the reading and discussion of papers prepared by members and dealing with particular work on their farms. Sometimes departmental officers attend these meetings to deliver lectures and promote discussions. The bureau is exceedingly valuable as a means for the dissemination of knowledge. It has done a great deal for the advancement of farmers' interests in South Australia. The farmers in that State are well abreast of modern practices everywhere. They were the first to use superphosphate. About three years later this practice was adopted in the Wimmera and again three years later in the northern portion of Victoria and later still in New South Wales. Usually about twelve years elapse before what is an approved farming practice in South Australia becomes general in New South Wales. At one time the department regularly received a large number of requests from farmers for soil analyses; but the demand has now fallen off, largely because it came to be realized that very little practical good resulted from treatment suggested by chemical analysis of the soil. Actually a chemical analysis of soil does not necessarily indicate the proper method for its treatment, either by the use of fertilizers or cultivation. To be of real value, consideration has to be given to moisture content, physical characteristics, and other factors which are not fully understood by the average farmer. The subject of soils is now receiving careful attention at the Waite Institute, in South Australia, and I have no doubt that it will do a great deal of good work for our primary producers.

92. *To Mr. Coleman.*—The various State Departments of Agriculture arrange for an interchange of opinions in regard to research work. Conferences are held at intervals to deal with special subjects. To some extent State officers are informed of the results of any Commonwealth-wide research work.

93. *To Senator Barnes.*—We are in a position to furnish advice to farmers concerning all branches of production. The blow-fly pest has been troublesome in this State, but the remedial measures are now well known to all sheep men, and are practised generally. The object which the department has in view is to discover an efficient remedial measure of a less exacting nature than the present approved practice. The use of blow-fly traps has been known for the last twenty years. Information concerning the construction of these traps has been broadcast in all agricultural journals, and still we have the blow-fly.

94. *To Mr. Coleman.*—The use of the blow-fly trap will certainly minimize the pest. I do not wish it to be inferred that I am deprecating the employment of such devices. All I am saying is that they will not rid the country of the pest.

95. *To Senator Barnes.*—We have prepared schemes for the layout of farm buildings and subdivisions of farms. These have been published in the *Agricultural Journal*, and they may be obtained by intending settlers on request. We find there is not much demand for this class of information, because farm areas have to be treated differently according to the location, aspect and site. Possibly they would be useful for settlers in the Mallee, where farms are similar in area. We found that whilst the system of lectures was novel, we would have a satisfactory attendance of farmers; but gradually their numbers dwindled, and after a time farmers attended only those lectures that dealt with certain aspects of farming in which they were particularly interested.

96. *To Mr. McGrath.*—My department is in touch with scientific research work in other parts of the world, by means of exchange of literature and bulletins. If our officers are engaged in a particular research they also enter into correspondence with experts doing similar work in other countries, so as to add to their knowledge. We have access to any information that the Council for Scientific and Industrial Research could get; but I suggest that it should be the function of the Council to gather information irrespective of whether it was interested in a particular subject. State departments, on the other hand, confine their attention to matters of particular interest to their State. We have not the corky scab in potatoes in Victoria. Tomato wilt has done a great deal of damage to production in this State, and we have carried out investigations in both the field and laboratory to discover the cause. We have been doing this work for the last ten or twelve years without any appreciable success. The disease is prevalent in other countries where investigations have also been made. Recently some success was claimed at the Waite Institute, but before any definite opinion can be given, tests will have to be tried out in the field. Thrips also cause a great deal of trouble in our orchards. We can clear an orchard of thrips, but in 24 hours it will be re-infested, as the thrips affect ordinary bush flora as well as cultivated flora.

97. *To Mr. Jackson.*—I doubt that a scheme for the distribution of literature by a central publicity department would be acceptable. A central organization would not have the necessary local knowledge to ensure the distribution of the kind of information required by farmers in a particular district. Suppose, for example, that a central organization had important literature dealing with corky scab in potatoes. How could the clerks know what particular district would require that information? It is true that a farmer could write for it, but as a rule a farmer does not care to do that. I suggest, therefore, that information gathered by a central organization can be more effectively distributed by a State department. I quite approve of the establishment of the botanical laboratories. I think also that the Commonwealth Government might with advantage subsidize the various State departments in regard to certain aspects of their work. The Commonwealth has already done something in this direction by subsidizing expenditure in the States on herd testing.

98. *To Mr. Francis.*—The Queensland Government has declined to take advantage of this offer by the Commonwealth Government. I presume that it suits Queensland for the time being to refuse Commonwealth assistance for herd testing; but the other States have accepted the offer. Victoria will get about £3,000 from the Commonwealth Government. This State spends upwards of £13,000 a year on herd testing, and the Commonwealth contribution to the whole of Australia is only £10,000. I admit that probably a certain amount of friction will take place between the Commonwealth and the States in this new effort in research. I am thinking more of the possibility of friction due to political considerations. Personally I welcome the establishment of the laboratories, and as head of the Victorian Department, I shall do all in my power to prevent friction. There always has been harmony between the various State departments engaged in research work. I do not quite agree with Dr. Rivett that technical information of immediate value to the farmer is now being disseminated more widely than prior to the establishment of the Council for Scientific and Industrial Research. We have to remember, however, that the Council has been established for only about two years, and we are looking to the future. It has not really got a proper start yet. We are hoping for good results when it is properly established.

99. *To the Chairman.*—The results of investigational work carried out by the Council at Canberra should be available immediately for the whole of Australia. The State Department of Agriculture publishes a journal monthly, giving information concerning work which officers of the department are doing. Articles published in it are written by officers of the department, and deal with current work. I am not sure that articles dealing with the work of the Council could be published in the *Journal*, unless some arrangement could be made for payment whereby its enlargement could be provided for. The *Journal* is read widely by farmers and pastoralists in this State, and it would be to the advantage of our farmers to publish any useful information concerning progress of our primary industries.

(Taken at Sydney.)

WEDNESDAY, 22ND MAY, 1929.

Present:

Mr. M. CAMERON, Chairman;

Senator Barnes	Mr. J. Francis
Senator Payne	Mr. Gregory
Senator Reid	Mr. Jackson
Mr. Coleman	Mr. McGrath.

Bertram Thomas Dickson, B.A., Ph.D., Botanist, Chief of the Division of Economic Botany of the Commonwealth Council for Scientific and Industrial Research, sworn and examined.

100. *To the Chairman.*—Work that has to do with plants comes under my control. At present this division is engaged in investigating "water blister" in pineapples in Queensland, "blue mould" in tobacco in Victoria, New South Wales and Queensland; "bitter pit" in apples in Western Australia (in co-operation with the Western Australian Department of Agriculture), the "cork" disease in apples, "spotted wilt" disease in tomatoes (in conjunction with the Waite Institute in Adelaide), and the Noogoora burr in Queensland and New South Wales. It is called the Noogoora burr because, so far as I can find out, it was first recognized in Australia on the Noogoora station, which was then just outside Brisbane. We are not sure that it is a native of Asia. This burr is found around the Mediterranean generally. It may be a native of Asia Minor or North Africa; but, at any rate, it is found in the Asian type of climate and land. It is found, also, in the United States and in South America, and is a pest wherever it is. In regard to this burr, we

are co-operating with the Prickly Pear Lands Commission, which is not a Commonwealth board. I am advising the Commonwealth Prickly Pear Board with regard to its work on the control of prickly pear by fungi. At the moment we are not doing anything in agrostological matters, nor in plant introduction or plant nutrition, because we have not yet the staff to cover it. We are, however, planning to do it. In the matter of agrostology —that is, grasses and fodder plants—we are proposing to scout for desirable introductions. We are also hoping to do work on the nutrition of crop plants, to see if we cannot improve yields by modifying fertilizer treatment or by whatever means may happen to develop. We work in co-operation with Commonwealth Quarantine Department in connexion with the prevention of the introduction of undesirable plants. Already, in consultation with Dr. Cumpston and his staff, I have drawn up a programme which is quite watertight as to just what we shall do and how we shall do it, in order to safeguard us absolutely from the introduction of undesirable plants or diseases. It is difficult at times to ascertain exactly the loss occasioned by any particular disease, and it is highly desirable from the Commonwealth point of view to have a survey, as full as possible, of the incidence and severity of the various plant diseases in Australia. To that end I have started in Victoria, through the kindness of Dr. Cameron, the Director of Agriculture there, a survey of Victorian records. I hope to continue this survey in the other States, and eventually to develop a scheme whereby all the States will collaborate with the Commonwealth in keeping in touch with all the diseases, reporting where they occur, and under what conditions, and how severe they are, so that we may really be able to ascertain the situation. Such schemes are in existence in Great Britain, Canada, the United States of America and South Africa; but are only partially in operation here. Hitherto there has been no organized body in Australia to do the work, and I thought that the Botanical Division of the Council for Scientific and Industrial Research could function along those lines. As an instance, I sent out a questionnaire to the dealers in pineapples—the men in Sydney and Melbourne who receive shipments from Queensland—asking them how long they had known the disease of water blister in pineapple, how severe they thought it was, and what loss they estimated was occasioned by it. At the same time I got in touch with the Committee of Direction of Marketing in Queensland, and asked it for returns. Of course, the returns we received were not 100 per cent.—they never are in such cases—but, generally, it appears that the disease has been known in Sydney and Melbourne for fifteen years, and the loss from this one disease is estimated as at least £7,500 each year. Queensland pineapple-growers are, therefore, losing £7,500 a year, let alone what they have to pay for transportation of the diseased fruit. I have not sent out any questionnaires in regard to blue mould in tobacco plants, but the growers with whom I have discussed the matter tell me that this disease is the limiting factor in their planting of tobacco. Were it not for the outbreaks of blue mould in the young plants the Australian tobacco-growers could probably grow enough tobacco to supply Australia's requirements, provided, of course, the aroma proved to be satisfactory. According to the present acreage and value of leaf we roughly estimate that the loss arising out of the presence of blue mould is about £15,000 in an ordinary year. Some of the growers tell me that they lose 50 per cent. of their crop in certain years; other growers have told me that they have actually ploughed in their crops without getting any return for their labour. The tomato-growers, particularly those in South Australia, have found the tomato wilt the limiting factor. Some of them have declared that it is useless to plant tomatoes, because, if they do, the plants will only go down with the wilt disease. The position is not quite so bad in Victoria and New South Wales, while in Tasmania it varies according to climatic conditions. There is less of it in a wet year and more of it in a dry year. I cannot give any figures as to the actual loss. Statistics have not yet been kept on these lines. That is why I hope that we can make a start in the preparation of such statistics. So far as I can find out the wilt is not bad in Queensland; but there are other diseases there which affect tomatoes. I have no idea of the loss they occasion. At present I am carrying on work in four rooms made available at the Sydney University. In those rooms we are carrying out laboratory work on blue mould in tobacco and water blister in pineapple. The investigation of wilt in tomato is being done at the Waite Institute, Adelaide. Professor Osborne and the Vice-Chancellor, Professor Wallace, of the Sydney University, have been very kind, indeed. They are actually also letting us have space in a small glass house. The accommodation is certainly limited, but it is the best we can get at the moment. We are hampered for lack of room and lack of equipment, and particularly because we have not sufficient glass house accommodation. When the laboratories are established at Canberra the number of persons likely to be engaged on botanical work will be about fifteen; but will vary. Sometimes a man will have to go out to one of the States to do a certain piece of work in the fields. The laboratories at Canberra will be our head-quarters. All the men engaged in the divisional work will, if necessary, concentrate there in order to carry on special laboratory studies which cannot be done in the fields. Many of our staff at times, and at varying times, will be out in the States studying the grasses and plants wherever they grow. As the work justifies it, it is highly likely that the number of the staff will be increased. There are very many problems to be tackled; but there are very few men available to do the work. We shall have to increase our staff, and the States will also have to increase theirs. The site chosen for the Botanical Laboratories at Canberra seems to be admirable. That is to say, it is an excellent building site; but it will not be so excellent from the point of experimental plots. I expect eventually we shall have to get 50 acres or 100 acres, or, perhaps, more, as the case may justify, at some distance from the laboratories; but nevertheless possibly still in the Territory. I think the proper class of soil should be found within a reasonable distance of Canberra. Of course, as we shall be introducing plants for the whole of the Commonwealth, it stands to reason that experiments on forage plants suitable for monsoonal rainfall regions cannot be undertaken at Canberra. We shall, therefore, have to deal with plant introduction testing in the north, where there is a heavy rainfall, as well as in the south—say in Tasmania or Victoria—where the rainfall is different. But all the work done in these testing areas will be correlated with the work done at Canberra. Climatically, Canberra differs from the better rainfall regions of Australia; but it is not possible to get an area anywhere in Australia which is suitable for the whole of the Commonwealth. Canberra is the logical centre for Australia, and, as a matter of fact, by means of glass houses and watering we can, in a measure, control our own climate. The only disadvantage of Canberra that I can think of is that there we shall not be in close contact with a large university, and its library and facilities. But time will remedy that disadvantage. That disadvantage would apply to any other spot remote from a State capital. We hope to cover the Commonwealth with very diversified work, and no one place could

possibly be chosen that would offer everything required. The officers who are to use the building at Canberra are satisfied with the plans. We have gone through them very carefully, and are quite satisfied with them. The period for which the accommodation now to be provided will prove sufficient to meet our requirements will depend a great deal on the way things develop. We may find in ten years that the building is too small. But if we progress more slowly, but nevertheless steadily, it may prove sufficient for a longer period. In the light of my present information, I think it will give us sufficient accommodation for at least ten years. Our work will develop, I hope, but inasmuch as men will be out in the fields a great deal at varying times and for varying periods, although the staff may grow extensively the officers may not all be housed in this building at the same time. Adjustments will therefore be possible. We are co-operating with Western Australia in the work which is being done in regard to bitter pit in apples. We are also co-operating with South Australia, Victoria and New South Wales in regard to the work on tomato wilt. The Australian Tobacco Investigation have appointed their director, Mr. Slagg, and myself to look after the tobacco research problems, and in this direction we are doing work in Victoria, New South Wales and Queensland. We are in actual co-operation with the Victorian Department of Agriculture in regard to certain phases of this work, and are planning similar co-operative work in New South Wales. Any information obtained by us will be made available to the States, and we hope that any information the States get will be available to us. In every respect we wish not only to co-operate, but also co-ordinate with the States. We are already working harmoniously with them in the instances I have quoted. I have occupied my position since the 1st October, 1927. Prior to that I was Professor of Botany, and, later, Professor of Plant Pathology at McGill University in Canada.

101. *To Senator Reid.*—Mr. Simmonds, Plant Pathologist of the Queensland Department of Agriculture, has been and is co-operating with us in the study of water blister in pineapples. He is using our statistics and working in the fields in Queensland, and we are working at the marketing end in Sydney. As a result of that co-operative effort we ascertained the cause of the trouble and carried out a series of control tests on experimental shipments. These were sent to us by Mr. Simmonds, and we checked up the results. We have every promise that another season's work will enable us to suggest a suitable means of controlling the disease. The blister is serious only in January, February and March and the period is rather too short to enable us to get a lot of work done. We have had to halt until next January, so far as actual control work is concerned. But in the meantime we can study the disease. With regard to Noogoora burr, Dr. White Haney, of my staff, has gone to Queensland, where she has met the representatives of the State Department of Agriculture and the Prickly Pear Lands Commission officials. As a result of these consultations she has outlined a programme for the study of the burr in the field, in order to find out as much as possible about it; and at the same time she is looking into matters relating to the control of it. None of the State officials is working under me in that instance; but Dr. White Haney is always in touch with Mr. Power, of the Prickly Pear Lands Commission. Dr. Angell, of my staff, will go to Myrtleford, in Victoria, and work on some farm alongside Mr. Adams, the Pathologist of the Victorian Department of Agriculture, in the study of blue mould in tobacco. There will be no suspicion of any rivalry between the Commonwealth and State departments. If I should happen to find a control for Noogoora burr, I should report it to the Council for Scientific and Industrial Research, which would at once get into touch with the Queensland Government and the Prickly Pear Lands Commission. The State authorities would in all probability do the rest of the work; but our officer would possibly maintain contact with the problem. The Commonwealth Staff is a research staff whose function it is to find out all it can with regard to any problem for the good of Australia. It is not its function to go into any State to carry out the actual control or eradication of a disease. That is work which has to be taken in hand by the State. If I should find by investigation or through correspondence with colleagues at Kew or Washington, Victoria or India that a certain grass was very desirable from many points of view and was well worth trying in Australia, I should bring that grass into the Commonwealth under quarantine and test it in an introduction garden. Then, having determined its value, we could say to the States, "We recommend this grass as having this or that quality, and we turn it over to you to commercialize it." The Commonwealth could not go into the commercializing of the grass. As I say, we have nothing to do with the regulation or inspection of anything. It is possible that 10 per cent. of Australia's production is lost through disease or low yields brought about by pests. Of course, epidemics occur at times which modify any percentage. We have not yet applied to any State department to carry out experiments for us and report to us, but the officers of the Commonwealth may discuss with the officers of the States any problem in all its aspects and arrive at a working basis, so that one authority may tackle a certain phase of the problem and the other another phase of it; each subsequently reporting to the other the result of any tests carried out. We cannot tackle a problem on a sound basis unless we have all the information gained as the result of past investigation by State officers. It will be possible to convey to Canberra in special containers the soil of different districts and test it there; but, of course, we shall have to duplicate the rainfall and temperature conditions, also. This can be done in glass houses. But the probability is that we shall have to go to the districts themselves in order to carry out our experiments. We have only just arrived at the stage when it has been decided that the Council for Scientific and Industrial Research shall initiate the introduction of new grasses. I am now engaged in preparing plans for the purpose. The first part of the work will relate to the Quarantine Division of the Department of Health. The department has not yet done anything in regard to the nutrition of native grasses, but is planning to do that class of work, also. Parallel with the introduction of grasses will be the study of native grasses, which in many cases are of the first importance.

102. *To Mr. Gregory.*—In regard to other phases of economic botany, we hope to be able to introduce plants which eventually will be of benefit to Australia. Our researches may include fruits. Many of our crop plants were introduced into Australia a long time ago. The agrostological section of our work will cover the study of native grasses and native forage plants from the point of view of nutrition, yield, and reaction to fertilizers. In time we shall carry on crossing experiments in order to see if we cannot develop better lines or strains of native grasses for propagating purposes. It is possible that we shall do the same in regard to native forage plants. Our nutrition work will deal more specifically with the nutrition of crop plants, particularly in regard to fertilizers and especially what one calls "minimals." In recent years it has been discovered that, although there are ten principal

elements which are supposed to be absolutely necessary for plants, minute traces of copper, zinc and boron can also be found in them; but they are in such small quantities that they are hardly visible. They are like vitamines. They are not actually vitamines, but are needed for plant development, and we are hoping to be in a position to study that phase of plant nutrition in order, perhaps, to improve fertilizers by the addition of minute traces of those things in which plants may be found to be deficient. Our nutrition work will concentrate at first on grasses and forage plants. I agree with Dr. Cameron that the fundamental work of research should be the task of the Commonwealth, and regional work the task of the States. That is what I meant when I said that it was the function of the Commonwealth to study the problems and ascertain all the fundamental facts, and then turn over the information to State officers. The Commonwealth might co-operate with the States in using the information thus obtained, but it is the function of the State department to apply it. At times it may be a little difficult to have that arrangement cut-and-dried, inasmuch as it is our intention to co-operate very closely, practically on terms of equality, with State officers in many of these problems. The State officers will have all the information that we have, but they may also ask us to help them in applying it. There must be the utmost collaboration between the States and the Commonwealth. Canada has a Federal Department of Agriculture. There is also a Federal Department of Agriculture in the United States of America, but the position in either of those countries, when departments of agriculture were established, is not paralleled in Australia. In Canada, the Department of Agriculture was functioning before many of the provinces became provinces, and when the latter came into existence there was already a long-established Federal service which was merely extended into the new provinces. The same circumstances applied in the United States of America. In Australia, on the other hand, the States were long established before federation, and I should say that it would not now be an easy matter to set up a Federal Department of Agriculture. We shall do valuable work in making known our discoveries to the people. The Council for Scientific and Industrial Research has decided to publish in bulletins or in journals the result of our investigations. For instance, quite recently we published a bulletin on bitter pit in apples, which contained a great deal of valuable information obtained as a result of the co-operative work between ourselves and the Western Australian Department of Agriculture. A bulletin has also been published relative to the "walk about" disease prevalent in horses in the Kimberley district. These bulletins are distributed to any person who applies for a copy. Arrangements are also made for the press to receive carefully prepared summaries containing the gist of the findings and the recommendations made resulting from the findings. By writing to the Federal Department of Agriculture any taxpayer of the United States of America can obtain a copy of any farmers' bulletin published by the department. I would recommend the adoption of the same practice here, but I should not like to commit the Council for Scientific and Industrial Research to that extent. I am planning to have a grass garden at Canberra. The cotton grass discovered at Port Hedland has not yet been brought under my attention. I should think there are areas in Australia suitable for the growing of flax. Flax is grown for fibre and for linseed. The fibre flax requires a good rainfall and good soil—about a 30-in. rainfall or better. The seed flax requires a somewhat drier climate, with bright clear skies and good sunshine. I should think both kinds of flax could be grown in Australia.

103. *To Mr. Jackson.*—At present Canada is ahead of Australia in research work. The dominion Department of Agriculture has established experimental farms in every province where its research work is carried on in regard to different phases of agriculture. There is also a huge central experimental station at Ottawa, the dominion capital. The Canadian department is in very close touch with the Research Council of Canada. Field stations have been established in all the Canadian provinces dealing with Federal problems, plant diseases, insect pests and so forth. Recently a Rust Research Laboratory has been established at Winnipeg, where eight officers do nothing but study rust in wheat. Of course, Canada has a larger population than Australia, and, being so close to the United States of America interchange facilities are very easy, whereas Australia is a long way from those centres with which this interchange of information may be made. Each province in Canada has its university—there is more than one in some cases—its department of agriculture and its agricultural college. In some cases the college is attached to the university. The dominion Prime Minister has recently announced that £600,000 is to be spent on building more laboratories for the Canadian Council for Scientific and Industrial Research. This programme is to be completed within three years.

104. *To Senator Payne.*—From the marketing point of view bitter pit in apples is one of the most serious things affecting the apple crop, particularly in the case of Western Australia and Tasmania, whose orchardists depend upon the British market for the disposal of the major part of their output. Our investigations have led to the conclusion that bitter pit results from immaturity of the apple at picking time. An apple picked on the immature side develops bitter pit. There is no bitter pit if the apple is picked at the right stage of maturity. We have not ascertained why that is so; but are quite satisfied on the point that, if the apple is picked on the immature side, it develops bitter pit. We are now trying to ascertain why some varieties of apples are more subject to the disease than others. Of course, all apples do not ripen in the same way. Some ripen evenly throughout the whole of the tissue. Others ripen more irregularly. Just why this is the case we do not know yet. In all probability it is partly due to the constitution of the apple; but it is certain there would be no bitter pit if apples were not picked when immature. The matter seems so simple that we were not believed when we first made the announcement. The information was published in a bulletin, and at the same time a method was suggested by which the grower could, in a fairly satisfactory way, determine for himself whether his apple crop was at the right stage of maturity for picking. If an apple is cut through its middle equatorially and dipped into a saucer of iodine solution it can be at once seen whether it is at its proper stage of maturity for picking. The immature apple contains a lot of starch, which in the mature apple is turned into sugar. When starch is touched with iodine it turns blue. If the apple, when left in the iodine for a couple of minutes, shows on the cut surface only one or two marks of blue, it is over matured. If, however, it shows an absolute blue mass looking at you in the face, it means that the whole of the

apple is full of starch and is thus immature. If the purple or blue is evenly scattered in spots throughout the tissue it means that the apple is just ripening nicely, and you can safely pick it. If an apple is picked when there is very little purple it is too ripe, and will arrive in London with internal breakdown due to over-maturity. When we speak of maturity we do not mean absolute ripeness. We mean a stage of maturity which will enable the apple to be stored at once and taken to England, coming out of cold storage just when it is fully ripe. It would be a good idea, in connexion with bulletins, to have a sufficient number sent to the State departments for distribution among those particularly interested. Our department would help to prepare lantern slides to illustrate lectures. We are now taking steps to demonstrate in Tasmania what has been done in Western Australia. Mr. Carne, one of our senior pathologists who did the work in Western Australia, will come east early in June in order to go to Tasmania to check up on results. We asked the State Department of Agriculture to pick apples just as we wanted them, and they did so and put them in cold storage. Mr. Carne will open these apples, dissect them, and show just what has happened to them. As an illustration of the work that has been done by Mr. Carne, I quote the following article from the *West Australian*:—

IMMATURE APPLES.

INSPECTOR VINDICATED.

It would be fresh in the minds of apple-growers and agents, said the Minister for Agriculture (Mr. H. Millington) on Saturday, that considerable adverse criticism occurred in the early part of the current apple shipping season, in connexion with the action taken by the fruit inspector at Fremantle in preventing the shipment of a large proportion of the fruit offered for despatch by the *Euripides*, which sailed on 20th February, on the ground that it was too immature, and in consequence would open up in a badly bitter-pitted condition upon arrival in Great Britain. Considerable diversity of opinion was apparent, and while there were some growers and agents who admitted that varieties such as Cleopatras, Jonathans, and Dunn's might be too immature for export at that date, all were practically unanimous that a very bad and palpable mistake had been made in refusing to allow Cox's Orange Pippins to go forward, the last-named being a variety which usually matures early in the export season.

As a matter of fact, said Mr. Millington, had nothing else been available for the inspector to judge by excepting the general colour of the fruit, which in the past had been the principal guide, there was little doubt that it would have been passed for shipment, but fortunately, the Superintendent of Horticulture (Mr. G. Wickins) had formed the opinion that apples were maturing later this year than usual, and he asked Mr W. M. Carne (formerly of the Department of Agriculture, but now of the Council for Scientific and Industrial Research), who had studied the maturity question in connexion with the bitter-pit investigation, to be present at the inspection Mr Carne consented, and the results he obtained with the iodine test for starch reaction caused Cox's Orange Pippins to be rejected. Some growers were so convinced that the decision was wrong that they placed a number of the rejected cases in cold store and arranged that the Superintendent of Horticulture should see them opened at the time when the *Euripides* arrived in London. This was done, the fruit being taken out of cold store and examined on 10th April, in the presence of the Superintendent of Horticulture and the agents concerned. The result showed the need for the rejection as the fruit opened up in very bad order.

It was very pleasing to note the sporting spirit displayed by the owners of the fruit, the Minister added, for although the apples had been placed in cold storage for the purpose of demonstrating that the inspection was at fault, when the actual result was known they immediately complied with a request made by Mr Wickens that sufficient of the fruit should be handed over to Mr. Carne to enable him to take photographs of it, make a detailed examination to find out what percentage of pit had occurred in the various sizes, and disseminate the information so that all growers would gain knowledge from the test. Several cases were taken and the examination was carefully made with the following results.—2½-in. fruit, 97 per cent. pitted; 2¾-in., 87 per cent.; 2¼-in., 67 per cent.; 2-in., 72 per cent. Those figures included only the fruit visibly affected, without cutting. When cut, the final figures might show a larger proportion of pitted fruit.

Climate affects apples. It modifies the time of maturity. Apples maturing this year on 28th February may be immature next year on the same date. We are hoping that the test for bitter pit will be made in every fruit-growing centre every year by the orchardist himself. Mr. Carne has already shown a number of growers how it can be done; but it takes a long time to spread the information. It will gradually get around. I have not yet made investigations into potato diseases, but I have laid it down in my programme to look into two potato troubles—one a virus disease and the other powdery or corky scab. There are others.

105. *To Mr. Francis.*—In certain cases the problems we are investigating are not peculiar to Australia. We have a reciprocal arrangement with the United Kingdom and the United States of America for the interchange of information. We also get it by personal contacts. By the last mail I received from the United States of America Department of Agriculture a full statement as to how they set to work to arrange their plant disease survey. I had written and told them that I was hoping to organize such a survey here, and they sent me full information as to what they are doing, to see if it might be of any value to me. We receive information in regard to botanical research work from Washington, Ottawa, South Africa, and India. As a matter of fact, if I write for information I can usually get it by return mail. We are planning, particularly in co-operation with Dr. Richardson at the Waite Institute, to make a complete survey of the natural grasses of Australia to ascertain their uses. It is an urgent problem, but it brings to light one of our great difficulties. There are not available in Australia at the present time men to do the work required. At times I have urged our universities to encourage young fellows to go into this field of work. There are very few at present who seem to be inclined to do it. We are thus handicapped by a lack of trained men. I have determined what is the cause of water blister in pineapples. It is a fungus which inhabits the soil in sub-tropical countries. Its technical name is *Thielaviopsis paradoxa*. This fungus can enter the pineapple at any wound or bruise. If the pineapple is splashed by rain, or if any soil adheres to it when it is dropped, this fungus, which is microscopic, will grow right into the pineapple at an extremely rapid rate. It usually works up the core and outwards to the outside of the fruit, causing the whole of the interior tissue to break down. It means that all the cells of the pineapple, which are so full of juice, break down, and the juice runs out of the cells and drips from the pineapple until the latter collapses and becomes a rotten mass. At the same time the fungus begins to fruit, and in the fruiting stage it turns to quite a dark olive-green, which in mass looks black. You see this rotten black mass which was once a pineapple; that will take place in four days. Pineapples shipped from Brisbane apparently sound are dripping by the time they reach Sydney. There is no actual cure for this at the present time, but care in handling will prevent it. I had Mr. Simmonds send shipments from districts supposed to be very bad with this disease. He exercised care in handling them and packed them himself, and they arrived without any sign of water blister, whereas a parallel shipment from a grower was full of water blister. We were in rather a quandary about this, and formed the idea that a formalin treatment would control the disease. We dipped the pineapples for a certain time in a certain quantity of formalin and allowed them to dry. By that method we certainly controlled the disease, but we spoilt the pineapple. The formalin seemed to turn the skin of the pineapple into dull bronze, although otherwise it was perfectly sound. We next got promising results by dipping the butts into boracic acid and letting them dry off, but unfortunately the end of the season arrived at that stage of our work, and we had to wait until the next season arrived. We have achieved no results so far in regard to Noogoora burr. Dr. White Haney has only been in Queensland for a month. We have not had more than time to make a beginning of the survey, but already we have been in correspondence with Egypt, Algeria, Palestine, and the United States of America on the subject. In Egypt the burr grows on the canal banks, and we have been told that it causes no worry there, because the goats eat it off. We have not yet had replies from Algeria or Palestine. The United States of America suggests the annual control by mowing the plant before it comes into blossom. The building proposed to be erected at Canberra will undoubtedly give us greater facilities for carrying out our work. Until we have a building somewhere we are greatly handicapped, and must neglect about two-thirds of our problems. The few rooms we have now are the absolute minimum for what we are doing at present. Our research will not extend to a testing of the suitabilities of different classes of fertilizers—that is a matter which could well be left to the States; but where it comes to the influence of the fertilizer on some plant or other we might function. That necessity might arise out of our investigation into the nutrition of natural grasses. The Council for Scientific and Industrial Research is very much impressed with the importance of getting information to the practical farmer.

106. *To Mr. McIrath.*—It may be that hundreds of thousands of pounds have been spent on research work in Australia during the last 25 years, and yet no practical means have been discovered of curing blight in cabbages and tomatoes or potato diseases. But, as a matter of fact, each Department of Agriculture has been obliged to spend a considerable portion of its funds in inspection and education work. One of the difficulties of the State has been that the amount of money and the time available for actual research work have been limited. The aphis, which affects cabbages, is an entomological problem with which I have not been asked to deal. It is true that those who are engaged in research go slow in certain respects, but we hesitate to make pronouncements which are not correct. We prefer to be sure. Research work takes a long time. There is a serious disease of tobacco called tobacco mosaic. For 43 years this disease has been investigated, yet no one has succeeded in finding out the cause of it. I myself spent eight years trying to find out what caused it. We know what causes blue mould in tobacco, and we are now working on the best means of controlling it. I am satisfied that the Commonwealth is getting an adequate return for the expenditure on my staff. The Wimmera rye grass which has been introduced has done a tremendous lot for the dairying industry in Australia. We are all the time controlling diseases. For example, 40 years ago orchards were abandoned because black spot in apples ruined the crops, but research has demonstrated that by spraying with a Bordeaux mixture or lime sulphur that disease can be controlled, and by these means it is now controlled throughout Victoria. Otherwise there would be no apple crop there. In countries that export fruit very careful spraying programmes are observed, and only the best of fruit is exported. But it does not necessarily follow that because we see a perfect-skinned grape or lemon imported from America all the grapes and lemons in America are the same.

107. *To the Chairman.*—Temporary sub-stations will be established by us. For instance, it may be found necessary for a cubicle or two to be erected in the Myrtleford district on one of the tobacco-grower's fields. In those cubicles our investigator may conduct his work.

(Taken at Sydney.)

THURSDAY, 23RD MAY, 1929.

Present:

Mr. M. CAMERON, Chairman;

Senator Barnes	Mr. J. Francis
Senator Payne	Mr. Gregory
Senator Reid	Mr. Jackson
Mr. Coleman	Mr. McGrath.

Gustavus Athol Waterhouse, D.Sc., B.E., Curator and Executive Officer of the Division of Economic Entomology under the Council for Scientific and Industrial Research, sworn and examined.

108. *To the Chairman.*—There must be collaboration between botany and entomology on plant diseases that are carried by insects. There is also need for collaboration in regard to insects which attack economic plants. For instance, white ants attack timbers. There are numerous problems which may turn up at any time. The entomological scientist assists the botanical scientist, and vice versa. We shall not be actually associated with the botanical division in the matter of pests which attack fruit. For instance, in regard to woolly aphis our line of attack is the introduction of a parasite to attack the aphis. It is the insect pests that are attacked by us. But information in regard to the plants affected would have to be obtained by us from the botanical division. For instance, the scientific names of certain noxious weeds having lately come into question, we have applied to Dr. Dickson for the necessary information and for the information as to the relation of certain weeds one to another. We are not competent botanists ourselves, but as there are botanists working for the Council for Scientific and Industrial Research who can supply us with the necessary information we apply to them. For that reason it is undoubtedly necessary to have the entomological and botanical divisions in close contact with each other at Canberra. The entomological work of our department is now being carried on at No. 12 Melbourne Buildings, Canberra, with the exception of the men in the field. Naturally, a great deal of our work has to be done in the field. For instance, the senior entomologist in charge of buffalo-fly investigations is in Java with an assistant. Another assistant is working in North Australia. When the laboratories are established at Canberra, the whole of our staff will be housed there with the exception that when we want to make a concentrated attack we must have small field stations in various localities. For instance, Dr. Brailsford Robertson, chief of the division of animal nutrition, has field stations in Queensland, although he is established in South Australia at the Adelaide University. It is wise to have the botanical laboratories at Canberra adjacent to the entomological laboratories. There will be bacteriological problems to be undertaken in connexion with our work. It has been suggested that we should have a bacteriologist on our staff, but his time would not be occupied fully, and as Dr. Dickson will probably have two or more bacteriologists on his staff we will be able to have our work done by one of them. Dr. Cumpston, Director-General of Public Health, sees to it that the utmost care is taken that pests with which we are dealing have no opportunity to escape. We have to submit our insectaries for his approval. It is almost definite that Dr. Dickson's gardeners will take care of our plants for us; also the cultivated plants we have to test against. For instance, if we bring in an insect to attack a possible weed we have to test it under quarantine conditions against possible economic plants it might attack. That work will all be done in our insectaries, but the seedlings will be raised for us by Dr. Dickson's gardeners. The actual tests must be under our control in our own insectaries.

I understand that it is proposed to build an administrative block between the botanical and entomological laboratories for the joint use of both divisions. I am perfectly satisfied it will be an advantage to both divisions to have a joint museum and a joint library. It will lead to a saving of officers. I think the site chosen at Canberra is an excellent one. It is difficult to say if Canberra is the best site for these laboratories For some phases of work Canberra is ideal; but it will be impossible to do other phases of work there. Sub-stations will be necessary. From an administrative point of view, however, Canberra is, I think, the best site. As a matter of fact, if the central building were anywhere in Australia it would still be necessary to have sub-stations. For instance, in Canada the central entomological work is done at Ottawa, and in the United States of America at Washington, and it has been found to be a distinct advantage to have this work done at the Seat of Government. I had a great deal to do with the planning of the proposed administrative block at Canberra. Ample accommodation is provided for the two branches that come under my department, the museum and library. The latter will hold approximately 11,000 volumes, and that should be ample for many years to come. When I saw the plans first I thought that the provision for the museum was too little, but the altered plans have considerably increased the accommodation, and I think it should meet requirements for quite a long time. The States are doing entomological work, but not on exactly similar lines to ours. For instance, Western Australia and New South Wales have been doing work on the blow-fly. The policy of the Council for Scientific and Industrial Research is to establish a research station to ascertain the best methods of attack and then to hand over to the State any information thus obtained. It will be then for the States, through their organization and inspectorial staffs, to set the thing going. The proposal at Canberra is entirely for research. We shall not have fruit or stock inspectors. We shall do scientific work there for the whole of Australia. If we solve a problem we hand our results over to the States to carry on the work of destruction. Of course, we shall attend to any of that work that is necessary in the Federal Capital Territory. If we find a parasite that destroys the blow-fly we shall pass on the information to the States for their inspectors. In short, we shall do the fundamental work and got the States to carry out the control work. If we undertook the work of destruction of pests there would be definite duplication of work done by the States. We could deal with any pest in existence provided we were prepared to stand the cost. For instance, we could handpick all codlin moths, but it would not pay to do so. The experiments we are carrying out in an endeavour to find a parasite to attack the codlin moth are very promising The egg of the codlin moth is not more than 1/32nd of an inch long, but there is a little wasp that lays its own egg in the egg of the codlin moth. Its only food is what it can obtain in the egg of the codlin moth. We are developing along those lines at the present time. One of our junior officers is at the Farnham Royal Institute in England, studying the *Trichogramma* which is the name of the parasite. Within the last fortnight Mr. Hill has published a bulletin on the subject of the grass-grub. He has been in Tasmania investigating it for about two years. The evidence he has obtained so far is mostly negative. It will never pay to use sprays. But we have not lost sight of the problem. A related moth in Europe is attacked by a parasite, and shortly a scout or officer of our department is to be appointed to seek out this parasite in England and send it to us. It is a wasp parasite Mr. Hill has not been able to obtain a single parasite from many thousands of caterpillars of grass grubs in Tasmania. The first object is to see whether we have a local parasite. We have not yet obtained one, but we may yet do so, although so far the evidence, as I have already said, is negative.

109. *To Mr. Gregory.*—The question of eradicating prickly pear is undertaken by a prickly pear board, consisting of representatives from the Commonwealth and the New South Wales and Queensland Governments. It is really a separate organization from the Council for Scientific and Industrial Research. I have been interested in the work done and I have read the reports of the board. The work done has been a real eye-opener, showing what can be done by means of biological control over noxious weeds. We are aiming at something similar in our work. Every possible phase of an insect pest has to be investigated to find out the best means of attack. The early caterpillar stage or the late caterpillar stage may be the best, or, perhaps, it may be best to attack at the pupal stage. It may be as well to wait until the insect emerges. Some insects have only one generation in the year, which makes it necessary to spend three or four years in getting the whole life history of an insect. It is, therefore, a slow process. One of the fruit flies attacking fruit is a native of Australia. Other fruit-flies have been introduced. It is very difficult to deal with any pest that attacks any of the native plants growing in the scrub or bush.

110. *To Mr. Coleman.*—The prickly-pear problem was attacked about twelve years ago. It is probably the biggest individual problem we have. The Board has competent officers, and the Council for Scientific and Industrial Research feels that it should not interfere with them. Mr. Dodd, the chief of the Board's staff in Queensland, has discussed his difficulties with me. We always exchange views. We are working on perfectly friendly terms. I asked him certain questions, and he told me how he was getting on and the difficulties he had to overcome. There will always be perfect co-operation between us and the Prickly Pear Board. It would not be wise to interfere with an organization that has all its ramifications functioning. So far as our relations with the States are concerned, we know one another, we mutually agree that we will tell one another all that happens, and that we will help one another. I have known all the State entomologists for many years; I have recently visited all of them except those in Western Australia, and our relations are always extremely cordial.

111. *To Senator Payne.*—It would be foolish to establish entomological laboratories at Canberra and botanical laboratories elsewhere. In Sydney the entomologists are on the same floor as the botanical people. In Queensland the two branches are housed in the same building. The two divisions are constantly consulting each other. The laboratories will be regarded as headquarters, and the bulk of the work will be done there, but there are problems that will have to be tackled elsewhere. The blow-fly problem could be tackled in Canberra, but not the Buffalo-fly problem. There are quite a number of grubs that attack grass. For instance, the grass grub of Tasmania attacks the stem of the plant. There is also the cutworm, which attacks the grass below the ground. There are caterpillars or larvae of beetles that attack grasses. A bulletin has been published on the Tasmanian underground grub. I cannot say that it has not been as prevalent in recent years as in previous years. In regard to codlin moth, bandaging and spraying are a great help if the work is done properly. Orchards that have become diseased and neglected are great breeding places for diseases. Around Sydney there used to be a lot of orchards, but when settlement came they were abandoned. They are great breeding places for pests. The codlin moth

trouble could be kept down if the orchardists exercised necessary vigilance. At one time in New South Wales the orchardist had to bandage every tree and spray two or three times a year. I think those regulations have since been relaxed.

112. *To Mr. Francis.*—I cannot say that the buildings at Canberra will meet our full requirements. If we make one or two successes every member of Parliament will be wanting us to tackle every problem, and one man cannot tackle more than one major and perhaps one minor problem at a time. The Commonwealth is investigating the most difficult problems. Of course, we should like to be in a position to tackle every problem, but it is a question of men and money. Entomology under present conditions has only really been recognized within the last ten or fifteen years. There have been entomologists who were dealing more with repellant sprays, but now there is a fairly close study of the pests. America made the first start, and in some instances there is excellent control of pests in America. However, I think the buildings now proposed for Canberra will meet our requirements for some time.

113. *To Senator Reid.*—If we discover a parasite we can liberate it, provided the Commonwealth authorities allow us to do so; but we have first to prove to Dr. Cumpston that it will not injure anything else but the particular pest it is supposed to kill. The Commonwealth has no control over the matter of spraying; that is purely a State function. But, of course, the State would take serious note of any recommendation of ours. Our department has not been in existence for more than a year, and the staff has not been functioning for more than six months. So far the bulk of the work done has been in organizing. The museum at Canberra will contain insects and plants. Every insect in existence may be a friend or a foe to man. We must have, in addition to our known economic insects, specimens of every other insect in Australia, because we never know when a question may arise. Some one may write in "This insect is attacking so-and-so," and we will have information in our museum about that insect. Dr. Dickson will need a collection of plants. The matter of accommodation required is difficult to estimate. In the museum there will be room for 3,000 or 4,000 cabinet drawers. Sometimes you get 200 or 300 insects into a cabinet drawer. On the other hand, one cabinet drawer may contain only eight or ten. I may say that not half the insects of Australia are known. In 1923 the known insects of the world were 470,000, of which there were only 37,000 in Australia. Since that time I suppose another 3,000 have been identified in Australia. Our population here is not dense, and therefore the insects are not so well known, but every scientific publication issued records the naming of some new insect. An officer in the Northern Territory sent down his first collection as the result of ten days' collecting, and we have been able to recognize some totally new insects already. There is a great effect of climate on insects. At Mt. Kosciusko I estimated that there were about half a million little butterflies, but only 25 varieties. At Brisbane you could find 80 different kinds of butterfly, but of the whole lot there would not be more than 10,000. Already we have a big collection bought or collected.

The witness withdrew.

George David Ross, Under-Secretary, Department of Agriculture, New South Wales, sworn and examined.

114. *To the Chairman.*—I am a member of the Standing Committee on Agriculture, and also a member of the advisory committee of the Council for Scientific and Industrial Research. Through the Standing Committee close co-operation is maintained between the Commonwealth and the State in respect of the investigation of problems affecting the agricultural industry. So far, it has functioned quite satisfactorily to all concerned. At present work is being done conjointly by State officers and officers of the Council for Scientific and Industrial Research. The relations between the two are such that from time to time we can so arrange matters that there will be no unnecessary overlapping. A hard-and-fast line of demarcation cannot be laid down. The avoidance of overlapping is a matter of amicable arrangement. By the establishment of Commonwealth laboratories work can be undertaken which the States cannot do. I am not a bit afraid of our not being able to work amicably together. We have been allowed to express our views forcibly and clearly, and have always been able to arrive at an amicable understanding with the Commonwealth authorities. There is a long list of troubles affecting agricultural production in New South Wales that are awaiting scientific investigation. We have definitely established methods of control of bunchy-top in bananas, but I am afraid that beetle borer will be a greater menace to bananas. We must find methods of controlling that pest. So far, as a State we have not been able to do so, and we may ask the Commonwealth to investigate the problem. We have arrived at a solution for many of our problems, but we may arrive at far superior methods of treatment than those already employed if we can enable officers to devote additional time and a more intensive study to those problems. My department can furnish full information to apple growers in regard to the means by which they may prevent any appreciable loss from codlin moth, but we have also an officer who is now in his second year carrying out research work in connexion with the control of the moth. We recognize that the existing methods are expensive. If we can devise some means by which this pest may be controlled at far less expense the growers will benefit considerably. At present we ask them to bandage and spray. They are asked to inspect the bandaging at regular intervals and spray with arsenate of lead at regular intervals. It is an expensive process, particularly the bandaging. Better means of controlling the moth may be achieved by the discovery of a parasite. We are ranging over the whole field with the object of finding some better and cheaper means of combating the pest. State officers are carrying out research work as far as time will permit, and will continue to do so; but there is room for an organization which will have at its disposal officers who can be detailed to a given problem and put in such a position that they may conduct what I may describe as a long-time research in connexion with the problem from every angle, in the hope not only that they may solve that particular problem, but also that they may add to our fundamental store of knowledge which will enable other officers engaged in research work to make use of the knowledge developed in that field in the development of their researches in other fields. For instance, resulting from the great work done by Pasteur, Lister was able to develop septic surgery. Pasteur himself, out of his original work, was able to combat a disease which threatened the silk-worm industry in France, and by that means was able to prevent the loss of hundreds of thousands of pounds. Pasteurization, as we know it to-day in the butter factory, is due to Pasteur's work upon control by organisms that were injuring the wine and beer industries in France. Arising out of his work, pasteurization for cream has developed, also the method of dealing with anthrax by vaccine, and also, I believe, treatment of hydrophobia. Unnecessary overlapping between the Commonwealth and the States should be cut out, but I do not think there is likely to be much

overlapping. In any case, I do not think we should confine ourselves to the narrow view that if one man is put on a problem that is the end of things. He may not meet with success, whereas another man tackling the problem on other lines may achieve success. Very often mistakes of one man induce another to re-cast his line of action or thought. State organizations are limited in their scope, mainly through lack of funds and also through lack of men. We are building up a staff in New South Wales, but the work the staff is doing does not enable it to devote more than half of its time to research. There is always the danger that a man joining our department may become involved in what I might describe as routine scientific work, and his opportunities for research work will thus be limited. There should be an organization in existence the staff of which can devote the whole of its time to research work. My officers are engaged in combined duties. The work of the biological branch can be classed under three headings: first, identification of diseases in connexion with specimens forwarded by farmers, fruit-growers, and others, and the giving of advice for the treatment of those diseases; secondly, the study of local outbreaks; and thirdly, research into diseases of somewhat obscure origin and the study of methods which, in our opinion, are not quite adequate, with a view to their improvement. We have a veterinary research station, but have nothing on the botanical side. I would not be prepared to recommend expenditure on the establishment of a botanical experimental research farm. At present our officers go to the locality where a disease has broken out. If we have an experimental station we should have to introduce the disease there in order to deal with it. It is far better, we think, for the staff to be in a position to move all over the State, attacking each disease where it occurs. In connexion with bunchy-top in bananas, one of our officers was stationed on the North Coast for the whole of the time. In connexion with codlin moth one officer was stationed at the Bathurst Experimental Farm for twelve months, and he was subsequently sent to America to continue research work there. In regard to cereals we have an excellent plant-breeding branch, which covers the whole field of agriculture, including horticulture. We have also 6,000 acres of experiments on private holdings, and that is altogether apart from pasture improvement work. I see no reason why Canberra should not be suitable as a head-quarters for botanical research, and also from an administrative point of view. We receive publications from all over the world giving us direct guidance of research work on agriculture. Officers in each section of our work keep in touch with what is done abroad in connexion with their particular sections. Scientists abroad are quite prepared to give us the benefits of the results obtained by them in their research work. Of course, most men are not willing to disclose the nature of any work that is in the embryo stage, but the moment their work is brought to a stage where it is ready for disclosure they will give all the information you care to ask for. I think it is possible for Australian scientists to pursue investigations with as good a chance of arriving at a successful solution of difficulties as scientists have in other parts of the world. We encourage our officers to maintain private correspondence with those who are engaged in similar work overseas. Most of our troubles are world wide, and most have been imported. I think it is very desirable that the Commonwealth botanical laboratories should be established, and every one connected with the State Agricultural Department should work in the closest co-operation with the Commonwealth officers.

115. *To Senator Barnes.*—The shortage of men for industrial research is most probably due to the low salaries paid years ago. Agricultural research has not been given much prominence until recent years. It was only fourteen or fifteen years ago that it was recognized as a definite policy by our department that our own men should be trained. But then the war intervened, and our system broke down for the time being. We are now training our own officers, and, as time goes on, our difficulty in this respect will be largely overcome. We have now twenty men at the university in the course of being trained for our work. As far as I am aware, no departmental graduate who has gone through the course of agriculture at the Sydney University has been employed by a private firm. We select our own lads. When they leave school we pay them for the time they spend in going through their course at the university. It is true that, in any case, the field of opportunity for these lads is not very wide.

116. *To Senator Payne.*—Ever since its inception the Department of Agriculture in New South Wales has been engaged in an endeavour to solve problems; but the solution of those problems has not proved easy. It takes time and the services of a number of men. Our efforts, however, have been extended as men became available. From the inception of the department it has been in a position to advise, and is continually aiming at giving further advice as the result of further work. Diseases which were practically unknown a few years ago have recently appeared and the economic position is such that the more intensive campaign in connexion with the work we undertake has been rendered necessary. It is very difficult to give accurately the cost to New South Wales of the research work done by State officers; but approximately we spend between £20,000 and £30,000 a year upon it. We have eight trained biologists and ten trained men in the entomological branch. We have also seven trained veterinary pathologists at Glenfield. The inauguration of a Federal department of this character should be of advantage to the whole of the Commonwealth. It should have a stimulating effect on the class of work that is being carried out by our own department. It should make up for the deficiency that may occur if some States have not sufficient funds to carry on their own campaigns.

117. *To Mr. Francis.*—The Poisonous Plants Committee, on which the Council for Scientific and Industrial Research is represented is operating as a joint body. We are engaged in tabulating all the poisonous plants in Australia. We are also trying to arrive at means of combatting the flying-fox pest. In that connexion we are co-operating with the Federal authorities. We pay into a joint fund to which Queensland also contributes. An officer is appointed by the Council for Scientific and Industrial Research, and we are all interested in the work. We make the services of our own officers available to assist them. The flying-fox problem is a serious one. Shooting is the only means of getting rid of the foxes that we can recommend at present, but that is costly. It is about eighteen years since New South Wales first commenced experiments in the top dressing of pasture. For many years the work we were doing was about the only work that was being done in this State in this direction. Very little attention was paid to our experiments. In recent years, however, experiments in this direction have become prominent. We are extending our plots over additional areas. We secure areas in inland districts—possibly 80 acres or more, even as much as 140 acres in some cases—and we top-dress them and compare them with similar areas not so treated. In the coastal belt, where land is more valuable, the experiments are carried on on smaller areas, say, 10 acres or 20 acres. By this means we try to demonstrate to the agricultural community the value of top dressing. As a result, we find that men are now getting ahead of us and putting in thousands of acres

of top dressing. Basic slag has been used, but not lately. Basic slag is a by-product of steel manufacture. It is the waste when iron is converted into steel and is ground up. It is mostly imported, and is not very popular here, although New Zealand uses large quantities of it. Our agrostologist has been in touch with the officers in New Zealand. The means that we employ of making available to the practical farmers all the information we get are the best that could possibly be adopted. We encourage the formation of branches of the Agricultural Bureau, and we secure the attendance of farmers periodically at the experimental plots, where our instructors discuss the work that has been done and afford to the farmers any other information they may seek. We print leaflets and bulletins freely, but the individual must ask for them. We do not send them out to a central organization. Formerly we sent supplies to secretaries of organizations for distribution to the members of those bodies; but years afterwards we would find them in the secretaries' offices still unopened. Now each individual has to write to us. Members of our staff visit districts and give lectures. We have organized a "better farming train," following the example of Victoria. We have stationed some of our agricultural officers in country districts. We keep our sheep and wool and veterinary officers in various centres, so that they may keep in contact with the people they will have to serve. A public meeting was held in Parkes recently, and it asked us to establish a young department of agriculture there. The list of officers set out by that meeting was such that it would mean that we would need to have an additional 400 or 500 men to serve all the State in the same way. The agricultural bureau movement has developed. We have possibly about 12,000 members in it, and probably 400 branches. Occasionally a branch will die and be resurrected at a later stage, when the right kind of secretary can be obtained. New branches are formed from time to time. It is a live organization. The annual conference last year was attended by 270 delegates. There are district conferences. Very largely the farmers are working with us in regard to the control of bunchy top. But our greatest trouble is that many men hopped into the banana-growing industry in the early stages, or just before the final crash, and they simply walked off the land when the crash came. Lantana took possession of the holdings, and now we have odd banana plants coming up through it largely affected with bunchy top. But it is only a matter of a little time when we can safely say we shall have bunchy top under full control.

118. *To Senator Reid.*—In regard to the control of bunchy top New South Wales and Queensland are co-operating with the Federal authorities. A board was formed, with Professor Goddard, of Queensland, as supervising officer. It had also the services of the Queensland fruit expert, Mr. Pollard. New South Wales supplied the services of a biologist, Mr. McGee. The same sort of control is exercised in regard to prickly pear. Co-operative effort in dealing with bunchy top has proved of benefit to both States. It has proved to be the correct method of tackling the problem of bunchy top and prickly pear. The Prickly Pear Board has sent officers to America to secure insects that cause damage to the pear. The insects are tested in America, and, if found satisfactory, are subsequently tested here. They are taken first of all to stations under the control of the Commonwealth board, and bred for distribution purposes. At that stage the board ceases to function and the State department and the Queensland Prickly Pear Board complete the work of distribution. If the tests prove that the insects are satisfactory, the State does the distribution work. The whole thing works in perfect harmony. The States and the Commonwealth work in close co-ordination. As a matter of fact, I am head of the Department of Agriculture in the State, and also a member of the Prickly Pear Board. In March last we distributed 80,000,000 cactoblastis eggs in the pear areas from the Queensland border down. The results have not been as pronounced in some districts as in others. In the Scone district, and at Camden, the pear is not as succulent as in other districts, and the cactoblastis have not yet made headway; but I think that the introduction of other insects will serve to weaken the pear and enable the cactoblastis to get to work with success. It is not so simple as it seems. The cactoblastis may convey a bacteriological or fungus disease with it, and it may be that the presence of that disease causes a quicker breakdown than is the case if the cactoblastis works alone. The whole of the problem is being investigated from every angle. The cochineal has done excellent work in many districts. In some cases we find that the pear has apparently developed a resistance to the cochineal, and we are quite satisfied that the best results can only be obtained from a complex where the cochineal, the red spider, the chelinidea and the cactoblastis are all working together. The red spider is not that which attacks fruit. It confines its attention to prickly pear. It was liberated first at Chinchilla in 1924 or 1925. It does wonderful work up to a point. It weakens the pear considerably. The chelinidea destroys the fruit, and prevents the pear from maturing. The Department of Agriculture was working on the codlin moth problem before I joined it 33 years ago. Our present object is to improve our methods of control. We can control the moth; but we realize that conditions for the producer are becoming more strenuous every year, and that we should try to evolve some means by which we can control the moth without a very heavy expenditure involved in dealing with it on the conditions now laid down. In 1926, in one district I visited, I found that the position was disastrous. A very progressive orchardist lost 50 per cent. of his fruit, due solely to the carelessness of other people in the district. One man was carefully picking up the fallen fruit heavily infested with codlin moth and sending it to a piggery. The man in charge of the piggery was supposed to boil it before giving it to the pigs, but he did not do so. The result was that the grubs came out and developed, and simply supplied the whole district with a plentiful supply of moths. On our own orchard in the same district we lost nearly 80 per cent., although we were spraying all the time. The carelessness of the individual has been the great cause of the devastation by codlin moth. Parliament has given the department power to enforce preventative measures. In that particular district one man received a surprise when he heard the amount of the penalty imposed on him. As the result of our efforts, the position in that district has now come back to normal; but for every man we save there is always another who is careless or ignorant. If the law was enforced against such men codlin moth would be kept under control and the losses from that source would be very small; but the means of control are very costly. It would mean the employment of additional labour to examine the bandages so many times a year. The orchardist will try to avoid doing it. He may not have the necessary money. I am not in the position to say that the saving would compensate the orchardist for the expenditure involved in an enforcement of the preventative measures. It depends upon the price obtained for the fruit, and upon the quantity on the trees during the particular season. It is essential, however, that the fruit-growers should take steps to keep the codlin moth under control. At the same time it is equally essential for the Department of Agriculture, or some other authority, to

endeavour to find some cheaper means of combating the pest. I am certain that it will be an immense advantage to every one concerned if we have a proper co-ordination of the Commonwealth and State activities in the matter of botanical and entomological research. The Commonwealth officers cannot carry out effective work unless they have proper laboratory accommodation and glass houses, and all the necessary paraphernalia connected with research, and before they could assist us they would have to do effective work. I think there is a field the Commonwealth is quite justified in entering. In the interests of Australia as a whole that work must be done by someone. Already the States have their hands full. The greatest benefit we will derive will be the increased knowledge that will be provided by the Commonwealth officers, a fundamental knowledge built up as the result of their work. All workers will be able to apply that knowledge in their particular researches. For instance, a young man who had a scholarship at the Sydney University was investigating the colouring matter of autumn leaves. It seems a waste of time, yet the technique he adopted was found very useful by other workers in carrying out investigations in economic problems, and they got very fine results. My department has not done very much work in the sugar section. In recent years we have done something in connexion with the control of gumming, and only quite recently we have endeavoured to produce varieties of sugar cane which are more resistant to disease and give a higher sugar content. That work is only in its infancy. It is being done in conjunction with the Colonial Sugar Refining Company. Our expenditure in this direction will be very small. The main thing is to have a glass house. That has already been arranged for. We have a very fine staff worked up by sending pupils through the university. We have always had an opportunity to select these students. Many have been disappointed at not being chosen, but our selections have always been justified. Many we had to turn down because we did not have sufficient vacancies. I have often expressed my regret that such capable young men as they appeared to be could not be selected. I am quite satisfied that our schools are turning out young Australians capable of fulfilling these positions.

119. *To Mr. Gregory.*—I think that agriculture is sufficiently important to justify the establishment of its own department. Officers need the whole of their time to consider problems associated with agriculture alone. The Department of Agriculture in the United States of America confines its attention entirely to agriculture. Our primary industries are sufficiently great to justify one body being appointed to look after that one phase of our life. If men had to consider a problem associated with secondary industry as well as those associated with agriculture I think the latter would suffer. I quite agree that, in order to prevent waste, it is wise to maintain an investigation into secondary industry. It has been our opinion for many years past that it is wise to devote attention to the need for more intensive cultivation rather than sending people out far back. Our policy at present is to devote the full application of our present knowledge to lands accessible to railways. New South Wales has been comparatively late in starting to use superphosphate as a top dressing for pastures; but the method is progressing at a tremendous rate, and I do not think it will be many years before we pass Victoria in the consumption of superphosphates. We are carrying on experiments on the North Coast and on the South Coast in regard to the use of nitrates. I do not think any investigation has been made in the direction of making use of hydro-electric power for the extraction of nitrates. Representatives of an English firm were here recently making inquiries. We use every method of propaganda at country shows. The lecturer we send always has a mass of our literature, so that he may be in the position to advise any one who comes along. Of course, application of the knowledge which we gain is the main thing. It is useless for our officers to have the information in their hands unless they can convey it to the individual. I do not anticipate any trouble between the States and the Commonwealth in regard to the establishment of this institute at Canberra.

The witness withdrew.

Sydney Frank Marsh, managing director of Whitehurst's Uralla Granite Company Limited, sworn and examined.

120. *To the Chairman.*—In any building of a permanent character likely to be built in Canberra some portion, either the base or the facing, should be built of granite or trachyte that will stand the ravages of time. A facing of granite on the botanical laboratories at Canberra would cost approximately £1 2s. 6d. a foot, taking into consideration all openings, returns and ornamentations. That would be the cost of the material fixed in the building. If the buildings were intended to last for longer than 100 years, I should say that there would be a call for the use of granite; but if the intention is to replace the building in 50 years other material will do. There is no material but granite or trachyte that will last 100 years without showing the ravages of time. I am speaking, of course, of the building material available in New South Wales. I have an intimate knowledge of the better classes of granite available in this State; I have worked them and competed in the market with them, and I have seen what happens to them under working conditions. Consequently I know which are good and which are not good. I have had this experience for the last seven years in my capacity as manager; but I have had previous practical experience in a lower capacity. There are quite a number of good granites in this State, and they are the best class of material to use in any building of a permanent character. But there is a great deal of variation in granites, as much as there is between sand and sandstone, or as there is between various sandstones. There are fine-grained and coarse-grained granites. The latter are known to the trade as bastard granites, being neither one thing nor the other. Granite is a stone of volcanic origin in which the mingling of the quartz and feldspar can be so widely varied that in some cases the coarser stones are absolutely useless for anything but ballast. They could not be used for building purposes, and no one attempts to use them for those purposes. There are other granites in the process of disintegration, as demonstrated by the country in which they are found. A perfectly good stone for building purposes would have within 3 feet of it another stone which is rotten. If you attempt to work the first you will quickly find out by its slowness in coming to a finish that it is not suitable for building purposes. It is not lasting; it is at its last stage of usefulness, as disintegration has set in, although it may not be actually visible to the naked eye. In the *Sydney Morning Herald* yesterday appeared the following advertisement:—

FEDERAL CAPITAL COMMISSION.

Tenders, rendered on the proper form, will be received until Noon on Monday, the 27th May, 1929, for—

(a) Supply and building in of sandstone facing to the Australian Institute of Anatomy; and
(b) Supply and delivery f.o.r. Canberra of pink granite from Tarana, New South Wales, for the Australian Institute of Anatomy.

Plans, specifications, bills of quantities, and conditions of contract may be inspected and tender forms obtained at the Offices of the Federal Capital Commission, Canberra, and 40 Young-street, Sydney.

The prescribed deposit must be lodged with every tender. Each tender is to be forwarded in an envelope, clearly marked, "Tender for Sandstone" or "Tender for Granite," as applicable, to the Secretary, Federal Capital Commission, Canberra.

No tender necessarily accepted.

When I applied for a copy of the specifications at the address given, I ascertained that, although the advertisement calling for tenders appeared on Wednesday, it was the original intention to fix Thursday as the closing day for the receipt of tenders, and that the time had only been extended because there were not more than three copies of the specifications available, and there were seven applicants for them. I happen to own the only available deposit of pink granite from Tarana. The Tarana quarry was established some years ago in the hope that an order would be received for the supply of the red granite required in the Rural Bank building, Sydney. The architects for that building were Messrs. Rose and Rowe, and Mr. Ross has stated on many occasions to representatives of the Chamber of Manufactures and various other public bodies that, although he had declared that 98 per cent. of the material used in the building would be Australian, he did not use Tarana pink granite in place of the red granite he imported from Sweden because of the unsuitability and poor quality of the Tarana granite. He made that statement as far back as three years ago, and it has been repeated from time to time. It was repeated in an article in the *Sydney Morning Herald* on the 27th November, 1928, inspired by Mr. Ross. In January of this year Messrs. Anselm Odling & Sons, members of the Hardstone Association, received a letter from Mr. Hayward Morris, an architect at Canberra, asking if there was available a supply of this particular Tarana pink granite. On the 9th January he was advised by letter that the quarry had been closed down and the plant dismantled and removed, and, further, that no supplies of the granite were available except a few stones on the ground to which anything might happen unless he purchased them at once. According to the advertisement in the *Sydney Morning Herald* which I have quoted, a material which we claim to be the most inferior granite of the working granites in New South Wales has been definitely specified for the first permanent building to be erected at Canberra. Beyond the stock which I hold, and which, because of its unsuitability, I would refuse to supply for building purposes at Canberra, there is a stock of from 700 to 800 cubic feet of this particular stone held in one of the Sydney yards. To my knowledge it has been in that yard unsaleable for the last seven or eight years, and a fortnight ago could have been bought for a song. I think you would find it very hard to buy at a low price to-day; at any rate, it is the only supply available to my knowledge. The conditions of the contract provide that a supply must be available to carry on this particular building for the next 50 years. It seems to me that whoever has specified the use of this particular granite has made no inquiry either as to its suitability or as to the permanency of supplies. I have always been led to understand, in regard to Commonwealth buildings, that the main factors were continuity of supply and quality. It is hard for me to believe that this pink Tarana granite will be allowed to go into the building for the Institute of Anatomy. It is not suitable material to put in a permanent building. The stone is too porous, and its quality is poor. There is no red granite in Australia of a good quality except that which is found in places beyond reach. It is to be found in Victoria of good quality; but so far out that it is not a commercial proposition to work in competition with imported granite. When the Tarana Company looked like failing I was appointed manager, and I spent several hundred pounds in opening up the quarry to see whether we could get a good quality of stone in fair quantity. But, after six months operations, I advised the directors that it was useless to continue, that the material was no good, and that there was no possibility of reaching a suitable material in the deposit we were working. The area we were working covered 800 or 900 acres. The only reason for our opening the quarry in the first place was the fact that, during the war, Swedish red, known as Balmoral stone, was unprocurable, and there was a demand for pink granite from people who, for monumental work, required it regardless of its quality. At the time pink Tarana was the only material available to the trade for that particular purpose. If the term "granite" had been used in the specifications for the Institute of Anatomy at Canberra, instead of specifying one particular granite, tenderers could have submitted several granites for approval by a body of experts to decide the best to use. There is a big variation in Australian granites, and there is also a big variation in the price of them. Some deposits are handy to railways; others are far out.

121. *To Mr. McGrath.*—When the Tarana quarries were working the price charged for the granite was as high as £1 10s. a foot. It was last used as a facing stone about three years ago. Since then its use has been entirely discontinued. The quarry was closed because the architects would not buy the material once they had studied it. If the specifications for the supply of material for the Institute of Anatomy are not altered there will be only one man tendering for supplies of pink Tarana, unless a tenderer chooses to open up a quarry to procure the material. But no one would open up a quarry to get 500 feet of granite. It would cost £500 before a stone could be removed. After the installation of the machinery it would be necessary to incur considerable expenditure in removing the overburden and in providing access to the quarry. I would not say that Tarana granite is not better than the sandstone to be found around Sydney; it is harder than sandstone, but it is not a good granite for the purpose for which it is sought to be used at Canberra. The big fault is that it is porous. Where it has been used in Sydney and is exposed to the wet weather you can see the stains going right through the blocks from end to end.

122. *To Senator Payne.*—Tarana granite has been used in Rickard House, Pitt-street; Ira L. and A. C. Borks premises in William-street; the Atlas Insurance Building in Bridge-street, and for the steps of the Union Bank at the corner of Pitt and Hunter streets. All these jobs have been completed within the last five years, and the Tarana granite shows signs of having absorbed water, with the consequential staining which must lead to decomposition. That has taken place in every instance. The Tarana granite which I have mentioned as being available in a Sydney yard for the last eight years could have been had until a few weeks ago for the carting away. It has been unsaleable for eight years.

123. *To Mr. Francis.*—Knowing that Mr. Hayward Morris was informed that the stone was not available, it is hard to understand why it has been specified for use in the Australian Institute of Anatomy. I am certain that the architects in Canberra knew that the quarry had been closed, and that there was no supply of granite available except a few culls left over from previous jobs. My belief is either that the architects are providing for the use of a poor granite in order to discourage its use as building material, or that their idea is to make use of some other material altogether on the ground that the granite they require is not available. I do not know if any of the architects on the Civic Design Committee at Canberra have used Tarana granite or given any public expression of disapproval of it as a building material. All I know is that Mr. Ross justified his expenditure of £30,000 on Swedish red granite on the ground that the Australian red granite available was too poor in quality.

124. *To Senator Reid.*—While I was manager of the quarry at Tarana it was my business to interview practically all the leading architects in Sydney with a view to trying to get the quarry going; but the general opinion among the architects was that they would not use our stone because it was unsuitable. They condemned it because of its quality—because of its colour, its texture, and its general condition. No one can condemn a granite on account of want of durability until it is tested. An architect will usually condemn material on its looks. It is his business to know a good thing from a medium or poor-looking thing. Sydney architects would not have the Tarana stone because of the look of it. In one or two isolated cases it was used as an emergency, but for general building purposes the architects would not have it because of its poor quality. It is porous, showing that it is disintegrating. Polished Swedish stone is impervious to water for the reason that it holds what is known in the stone trade as its full sap. When granite loses this sap it loses its suitability as a building stone. Without exception, Tarana pink contains no sap. It is hard to say how long the process would take, but its absorption of water ultimately leads to disintegration and fretting, just as happens with free stone. I would not use it for coping or steps. It wears very much more quickly than a dry granite with a full measure of sap and life. It is wearing away all the time. If you leave it rock-faced you have indentations which hold water. A smooth face throws off the water, and the only thing that would run into the granite would be that which comes from natural absorption. Hammer-faced granite would probably stand longer than rock-faced, but deterioration would set in at the point where it is in contact with the earth. Fine axed and gritted Tarana is almost white. Therefore, if the Federal Capital Commission is looking for a pink granite it would not get one by using Tarana red and fine-axing it. It may be that the stone in the yard in Sydney has been offered at an absurdly low price.

125. *To Mr. Gregory.*—I have been engaged in the granite industry for nine years, and I regard myself as an expert in my knowledge of granite and trachyte because of the opportunity I have had to become conversant with material that I have been handling every day. Failures teach you more than any study of the article you have handled. The Tarana quarry I have mentioned is the only one available in the district. It was purchased to get the plant. It cost £5,000, and was purchased for £250, shifted elsewhere, and the quarry abandoned. I produce a sample taken from the Sydney yard of the best stone that has been delivered from that quarry to date. It can easily be broken and even crumbled by tapping it. I can show five granites of New South Wales which could not be broken with an iron bar. If the Tarana red is to be fine-axed and thus turned into white, why cannot the Federal Capital Commission use a pure white granite? There are adjacent to the Tarana quarries two or three miles of country with exactly similar stone, but no one would attempt to open up a quarry to supply this order for 500 cubic feet. I do not think the architect at Canberra would care to pay more than 15s. a foot for the granite. That would mean an order for £375 worth of granite with nothing to follow it up. It would cost £500 to get the necessary plant to quarry the stone. You would need a rock-drilling plant and a compressing outfit, and you would need to cut through the bush to provide access to the quarry. You could not get a crane there under £250. It would be possible for any person to say that ample stone of this quality would be available at Tarana for 100 years, but the stone is unsuitable. I have the Tarana stone to sell to the Federal Capital Commission, but I am not selling it to them. In response to this advertisement five tenders will be submitted, but I know that four of the tenderers will state that they are supplying grey granite, for the reason that no Tarana red is available. If only one tender is received offering red Tarana it ought to be investigated. I am confident that the Commission will only get one legitimate tender from the stock I have already mentioned as being available in a Sydney yard. The other people cannot tender for Tarana red because there is no stock of it available for them. The tenderers usually have a fortnight in which to submit tenders for work at the Federal Capital. Tenders are called simultaneously in both Melbourne and Sydney, and plans and specifications are available in both cities. The period of fourteen days allowed is ample, particularly when bills of quantities are supplied.

126. *To Mr. Coleman.*—The only pink Australian granite accessible and readily worked is the Tarana granite, and whatever red granite is now used for building construction is imported. Other pink granites are available in Australia. There is the Gabo Island deposit. The columns used in the Lands Department, Sydney, are Gabo red, and two more beautiful examples could not be seen anywhere. Gabo granite is not used because of the cost of getting it and the lack of demand for it. The Commission may be actuated with the desire to use Australian materials in the Institute of Anatomy at Canberra, but there is no supply of pink Tarana available other than that which I have mentioned, and the tenders could easily have read "Tarana or any other suitable granite." My company has the biggest sale of grey granites in Australia. The biggest job in progress in Australia to-day in which granite is used is the new Bank of New South Wales, and my company is supplying over 20,000 cubic feet of granite for it. The granite we supply lends itself to polishing and all sorts of treatment. It is a satisfactory granite in every respect. It will stand up to the weather. The Tarana granite in use in Sydney buildings is polished, but it shows weather stains, which fact has prevented the stone from coming into more general use. The stone to be seen in William-street is a disgrace, and architects will not put it into other buildings once they have seen what has occurred to the stone in Sydney. As an Australian, I think that Australian granite should be used in an Australian national building, but as a company we are quite prepared to compete in the open market with any granite of repute and take our chance.

127. *To Mr. Gregory.*—The quarry at Tarana was started and worked intermittently for about two and a half years; since then it has been entirely closed. The quarry is situated near Bathurst, between Sodwalls and Oberon. It is about a mile from the station.

(Taken at Sydney.)

FRIDAY, 24TH MAY, 1929.

Present:

Mr. M. CAMERON, Chairman;

Senator Barnes	Mr. J. Francis
Senator Payne	Mr. Gregory
Senator Reid	Mr. Jackson
Mr. Coleman	Mr. McGrath.

Bertrand James Waterhouse, Architect, Deputy Chairman of the Civic Design Committee, Canberra, sworn and examined.

128. *To the Chairman.*—The Civic Design Committee has asked me to express its views to the Public Works Committee. The committee has received the drawings of the proposed Botanical Laboratories, Canberra. We always ask that an outline of the specifications should be submitted to us for approval, and during the course of deliberations the general structure of the building is considered in detail for the guidance of the designing architect in preparing the finished specification. The complete specifications for these buildings have not been submitted to us. What we have considered is an outline giving the general idea of the proposed construction of them. In the initial stages the point we stressed was that it should be so designed as to lend itself very readily to extension at a later date so that the whole design would be a comprehensive one. That idea was adopted by the designing architect at Canberra, and plans were prepared for the whole scheme before we approved of the entomological portion which is now being built. The botanical portion is a logical extension of the original plan and is based on the requirements of the committee dealing with the scientific part of it. The proposed building will lend itself to economic extension when necessary. Hollow concrete blocks for walls and floors are quite suitable for building construction, but I prefer to consider the merits of all classes of concrete before deciding upon one. As the hollow concrete block method is a lighter form of construction it enables us to carry out larger spans. It also offers a little more facility for conduits for electric lighting and so forth. The lightness of construction appeals to most architects. The extra cost of using hollow blocks as against concrete slabs would depend largely on the extent of the area to be dealt with. It would not be very much on a very large contract. It would be higher with small areas. I should say that it would not be more than 10 per cent. at the most. Against that you would secure economy in the fewer supporting members that would be required. At Canberra, where there is all the material necessary for making solid concrete, I think I would prefer it; in fact, I can see no reason why the special form of flooring need be adopted there. I would not recommend the extra cost of hollow blocks, where solid reinforced concrete flooring would answer all specific purposes. I should use a flooring that gives the greatest durability, and meets all practical requirements and at the same time keeps down the cost, a matter which has to be borne in mind. Hollow blocks would not give extra durability. I think that it would be better to use malthoid in preference to bituminous felt for floor covering. I think it would want a layer of one ply and also a layer of two ply malthoid laid down, with bituminous material to make a good solid lasting floor. The so-called felts are not durable. I think that, for this class of building, a facing with cement is quite sufficient. It is to be an industrial building for practical purposes. The form of the building in its proportions and mass is pleasing, and I do not think there is any reason to expend money in making a facade treatment. Cement is perfectly durable. It is only a matter of requiring an occasional colouring. I see no reason to depart from that class of construction in this building in the position it occupies. It will certainly be adjacent to the University, but I still think the design proposed will be quite suitable. The method adopted has been decided upon on grounds of economy, because of the suitability of the style. It will lend itself to the style of architecture in the complete buildings. The old Gothic style of architecture has many disadvantages, particularly on the score of cost. The stonework is very heavy, involving a great deal of carving and tracery. The cost of this is prohibitive, and on that account the Gothic style has been largely abandoned. Furthermore, we must consider efficient lighting in these buildings as the most important factor. The Gothic style of architecture does not lend itself very readily to laboratory work. The Civic Design Committee has approved the plans of this building and considers that it meets the scientific requirements of the authorities remarkably well, and that, from an

aesthetic point of view, it will fit in entirely satisfactorily as a member of a group. The cost submitted to us, apart from some fittings such as book shelves, was estimated at £52,000. We consider the price reasonable. It worked out at about 2s. per cubic foot, which is quite a good price for the number of fittings allowed for and the equipment necessary in such a building. At the Sydney University we expect that class of work to cost 1s. 10d. per cubic foot. The physical laboratory at that university cost about 1s. 8d. per cubic foot. That building was very similar in character and construction to the Canberra laboratories. The system adopted by the Federal Capital Commission, that of selling material to contractors, has not come under the survey of the Civic Design Committee. As a business undertaking it may be of advantage to the Commission, but I always plead for absolute freedom for the builder to purchase wherever he likes and in the best market. That encourages better competition. A tenderer may be able to buy better than the Federal Capital Commissioners in certain directions, and nothing is to be gained by penalizing the Commonwealth with that extra expense which is involved in enforcing him to buy from the Commission. Architects always allow in the specification a reasonable amount for certain items of furniture; it may be a door or a window which is selected by the architect from any firm he chooses. Generally we find that the client suggests the firm he would like to deal with. That is always covered by the specification, and is distinctly in accord with the agreement between master builders and the Architects Institute. The architect selects fittings in company with his client or by himself, and the invoices are forwarded to the builder, and on the completion of the contract they are sent along to the architect for checking. It is provided that all discounts allowed by the merchant to the builder must be credited to the client. If they are not allowed by the merchants there is an allowance of 10 per cent. off these costs to the builder. That is in accordance with the conditions of contract agreed upon between the Master Builders and the Institute of Architects. I cannot say that the system adopted by the Federal Capital Commission would tend to make the cost of building higher. It would be governed largely by the cost at which the Commission could supply the material, but I think you are restricting the purchasing opportunites of the builder. If he is free to purchase wherever he likes he can naturally make his tender as low as posible. On the other hand, the Commission may have bought wisely and well, and may hold large stocks which it can sell at a less price than that at which the builder can buy. But, altogether, I am more for the freedom of the builder in his tendering. In a building of this character it would be inadvisable to have wood sashes. Steel gives a great variety of shapes, which gives better facilities for ventilation. Steel framed windows cost less in maintenance. They give less trouble than wood sashes. I suppose that 12s. 6d. might cover the special kind of steel window required for ventilation. We can get down to 9s. 6d. and 10s. for ordinary standardized windows, but they have not all the necessary interlocking systems. If you have to keep out the wind and weather, and have to use the open window, it is false economy to stick at a shilling or two. A good window in the first instance is least cost in the long run. I think a month would be a reasonable time to allow for the calling of tenders for this building. I think malthoid would be the best flooring for the laboratories. There are other portions of the building where a hardwood flooring would be satisfactory. There will be a good many solid floors in this building, which could be rendered with cement and covered with linoleum. Tallowwood is very suitable for flooring. It is denser than jarrah, which is also an excellent flooring timber

The difficulty is to secure quantities of tallowwood properly seasoned. There is a good deal of seasoned jarrah available. We have less trouble from shrinkage in jarrah than we have in other timbers. It may be that a good deal of jarrah has been prepared for parquetting. I would not permit a central mixing concrete plant for any job in which I was associated. In very dry and hot weather initial set would rather tend to impair the material in course of transport to the job if it were a couple of miles distant. I have never heard of mixing concrete at a central depot and carrying it over a distance to a job. I hope that method will not be adopted in Canberra. Material of that nature should be mixed as near to the site of emplacement as possible. Concrete should be got into position as quickly as possible after mixing it. Transport over even a short distance leads to deterioration. There is also a chance of dust having an injurious effect. Besides, you might have a breakdown for a quarter of an hour in transport, and in that way get initial set. I have not used Tarana red granite. The samples now before the committee are similar to samples we have had submitted to us. I suggest that it would be advisable to have a report from University tests on any material, such as granite. These tests should be as to the crushing strength, durability and so forth.

129. *To Mr. McGrath.*—The Civic Designs Committee did not recommend any particular material for use in connexion with the Institute of Anatomy at Canberra. The specifications may call for the use of Tarana red granite, but those details will not be submitted to us for decision. We advised on the design, and on the suitability of the building, the aesthetic side and the suitability of the plan for the work to be done, and as to how it conformed in its location with other buildings. We discussed whether the construction should be of brick or reinforced concrete. We dispassed the colour and so forth, but when it came down to the matter of specifying the use of any particular material that was a matter which was in the hands of the *designing architect. If it was submitted to us that a* pink granite might be suitable, we might have said yes. But there are so many other things associated with granite. For instance, there is the question of its durability upon exposure, also the finish it would take, and the geological qualities of the material. But those are matters that are decided by the architects' branch; and not by our committee, which is purely advisory on the other matters. I am fairly certain that the committee did not recommend that tenders should be called for Tarana red granite only.

130. *To Senator Payne.*—I have had no experience in the use of Tarana red granite, nor have I had an opportunity to observe its lasting qualities. The advantage of the central mixing concrete plant would be *mitigated by the difficulties in transit, particularly if* delays occur. If you have the aggregate, the cement and sand, and proper mixing on the spot, it is the best method to be adopted. I have had a long experience in *using red myrtle for domestic dwellings, and have found* it eminently suitable. It is a hard and durable timber, looks well, and takes a very fine polish. At times we have had a little difficulty in getting supplies just at the moment they were required, and once or twice we have felt very doubtful as to whether it was properly seasoned; but as I understand that all these difficulties have been overcome, and that there are ample supplies of seasoned myrtle available, I should say that opportunities should be given to make use of it. I have used properly seasoned Tasmanian oak on three occasions with eminent satisfaction. Mr. A. C. Ingham used Tasmanian oak to panel his lounge. The utmost liberty should be allowed to the builder in the purchase of his material. It facilitates tendering when the owner *is not supplying the material.* Of *course, economy* would impel a government which had facilities to acquire large stocks of material to take steps to see that those stocks were used up. I see nothing wrong in the Federal Capital Commission stipulating that the material of which it has large stocks should be used in the erection of this building, but as a general principle the builder should be permitted to buy in the best market.

131. *To Mr. Francis.*—There should be no difficulty in ensuring that the cement required for this building is properly mixed according to the specification. If it is subsequently discovered that the mixture is not in accordance with the specification, it will be entirely the fault of the supervising officer. It is very important that tests should be taken at frequent intervals and deposited with the Commission or the architect acting on his behalf. Mixing on the spot would thus be adopted, and it would be conducive to greater accuracy.

132. *To Senator Reid.—The principle of the Innes* Bell hollow concrete block is that it is in itself interlocking, securing the necessary rigidity and adhesion between block and block, and enabling larger spans to be established, thus eliminating certain beams and posts which are otherwise required. Under test, this system has proved entirely satisfactory. It gives more room. An important factor in a laboratory is the avoidance of beams on which dust may deposit. I prefer the solid concrete flooring in the building at Canberra, but in special circumstances I would recommend the use of Innes Bell blocks. Where lightness of construction and not excessive tensile strength is required, hollow blocks answer the purpose admirably, because there is very little loading on the floor. That is not the case in warehouse buildings and factories. Steel windows are a prevention against the spread of fire. Wooden frames will ignite long before glass cracks. It is very difficult to gauge water absorption in cement absolutely. You may get a mixture of varying consistency. A thin mixture by the time it has reached its destination, some distance from the central mixing plant, will have all the heavier aggregate at the bottom. By the time it gets into position it will not be the proper mix that it should be. That is a very serious risk to run. There is also the risk of the tendency to initial set. The fewer the handlings there are from the time the concrete is mixed until it is put into position the better for the material. The vibration during transport may occasion different layers of different consistency in material. It is most important to have a cohesive mixture of the right consistency and get it into position as quickly as possible. If you introduce anything else it will prejudice the strength of the material. Furthermore, the work may be partly finished and if the additional material comes along a little too late there is a tendency to form a cleavage. It is true that Canberra has had a great advantage through the seasoned timber it has been the policy of the *Commission to accumulate*, but generally I would prefer that pressure should be brought to bear on the suppliers of timber to meet the requirements of the market by providing well seasoned *timber. I am against the Government dabbling in such* things. From the point of view of economy, the Commission is doing the wisest thing to attempt to dispose of the material it has in hand in the way it is *doing.*

133. *To Mr. Gregory.*—The building will be uniform with the other buildings on the University site. I think it would be unwise to build industrial structures of the materials that would be used for the University itself, which will naturally be of stonework. At Oxford and Cambridge, quite close to the older buildings are scientific and industrial buildings of much cheaper construction than that which would be required to make them of the same character as the early Gothic work. And they are not at all out of harmony with the old buildings. Of course, they are not absolutely next to one another, nor will the buildings erected for

laboratories at Canberra be next to the university building. Cement is about £23 a ton in Sydney and tallowwood is 84s. Transport has to be added to get the price at Canberra. Steel windows will be employed in the laboratories partly for fire protection purposes and partly to prevent deterioration. There is a gradual return to wooden frame windows amongst the architects, but not for industrial buildings. It would not be economy to have wooden framed windows at Canberra. They involve constant maintenance. They are larger than steel frames, and the area required to be painted is larger. Kauri pine will be used for benches, which need to be made of a fairly dense timber that will stand a varying temperature. It will be Maryborough pine. The export of New Zealand kauri is prohibited.

134. *To Mr. Jackson.*—The most simple steel framed window would cost twice as much as wooden framed windows, but I think the extra expense is justified on account of the economy in using something which is more durable, is eminently suitable, and eliminates painting and maintenance. In metal framed windows the glass has to be very carefully puttied, and back puttied with a special putty or mastic, because ordinary putty will not harden on a metal frame.

135. *To Senator Reid.*—I have taken ordinary redwood sashes out of old houses 40 years old and found them in comparatively good order, except at the joints. There is quite a long life in wooden-framed windows if they are looked after. Another point that may be considered very seriously is that steel frames can be sprayed with paint before they are fixed. The vulnerable point in a window is the point that cannot be seen. The extra cost of spraying the frames before fixing them is money exceedingly well spent. There are some inferior frames on the market, but it is only a matter of getting a reliable firm. Tests should be made of the steel that is used in the frames if they are being made locally.

136. *To Mr. Gregory.*—Steel reinforcement in concrete work costs £6 per cubic yard. The standard rate for steel reinforced concrete is £22 10s. in Sydney.

(Taken at Mount Gambier.)

TUESDAY, 4TH JUNE, 1929.

Present:

Mr. M. CAMERON, Chairman;

Senator Barnes	Mr. J. Francis
Senator Payne	Mr. Jackson
Senator Reid	Mr. McGrath.
Mr. Coleman	

Albert Ephraim Knight, Quarry Proprietor, Mount *Gambier, sworn and examined.*

137. *To the Chairman.*—I have been engaged in the business of supplying stone to the public for about five years, and I think that Mount Gambier stone could be used in Canberra to great advantage. I am a building man. It has been my bread and butter for the last 35 years. I have not an intimate knowledge of Sydney freestone, but a very sound knowledge of freestone generally and other rocks, and I consider that the facilities offered by coralline rock would be an economical proposition even as far off as Canberra. *I think we can convince the Commonwealth architects* that this material is highly suitable for building purposes. I have prepared the following statement for the committee:—

MOUNT GAMBIER CORALLINE LIMESTONE.

The limestone so extensively used in and around Mount Gambier, and which is becoming increasingly *popular in many outlying districts*, is a marine deposit of Miocene age. It outcrops about 8 miles to the west of the township, but as it constitutes a distinct stratum in an otherwise thick and extensive *polyzoal limestone series, and is composed chiefly of* bryozoa (moss coral) having, perhaps, from 90 to 95 per cent. of such fauna in the aggregate, the name "Coralline" is here given in place of its original geological name "Polyzoal." Its geological age is completed at from 10,000,000 to 15,000,000 years, but whatever the time period since its deposition may be, it has produced a high state of petrefaction, and consequent tenacity To observe the strength and durability of coralline limestone in a practical way, one can only look to the buildings in which it has been used. The township of Mount Gambier has many fine examples of architecture. The hospital, the various churches, and many public buildings, all testify at least to the utility of the stone None of these buildings, however, is of a greater age than 65 years, and while their present condition is agreeably expressive of stability and long life, the effects of oxidation or erosion cannot be said to have been tested. It is *scientifically accepted that organic limestones* constitute by far the most important group of fossiliferous rocks. Rocks of this class are composed either wholly of carbonate of lime, or contain other mineral matter also in varying proportion. Many kinds of limestone owe their origin directly to the agency of animals or plants, which extract the calcareous matter from the water in which they live, in order to build their hard external cases. The accumulated remains of these organisms are generally compacted by a crystalline cement to form a coherent rock. Coralline limestone is a product of such laws, having a calcium content of 98.25 per cent. For a comparatively young rock nature, perhaps, has never been more careful in its work, for we find in this homogeneous mass a remarkable state of cohesion. The rock, however, has not yet reached the crystalline, and it is on account of this very fact that the stone has become valuable for building and other purposes. To the layman the *stone gives the impression of being soft and friable;* actually it is neither, for it possesses a toughness unique in rock formation, and seems to have reached a stage in its life where chemical processes have united their forces with abnormal results. Coralline is used chiefly as a building material, and with a colour variation from white to cream, very pleasing effects are obtained. In actual practice the stone is cut with a peg tooth saw, excepting in such work as moulding, carving, &c., when wood-carving chisels may be applied. The ease and speed with which it can be worked fully compensates for transportation over very long distances, and in cases where architectural order demands enrichment, such as moulding and carving, saving in labour cost is more pronounced. Its maximum crushing resistance of 50 tons to 1 foot area provides ample strength for very high structures, and being multiplied by its dead weight of 27 cubic feet to 1 ton, a crushing height of 1,350 feet is pro*duced. A further transverse test conducted by R. W.* Chapman, professor of engineering, Adelaide University, revealed the following carrying capacity of the stone:—Supports were 20 inches apart, load applied in centre, depth of beam 9 inches, breadth 4.25 inches, maximum load carried, 3,890 lb. In external treatment the most pleasing and solid effect is obtained by the adoption of rock-faced finish, for in this way the natural beauty of the texture of the stone is shown to the best advantage. Being of a porous nature, it is a non-conductor of heat, cold, and sound, and in practical building construction local experience has demonstrated that external cavity walls are advisable. Other uses are—tennis courts, building lime, and agricultural lime—and supplies are practically inexhaustible. During the past few years many fine buildings have been erected with this stone, chief among them being,

Castle Delgany, Portsea—architect, Mr. Desbrowe Annear, the Agricultural College, Ouyen, Victoria; High School, Warracknabeal; High School, now in progress at Horsham, for Mr. Evan Smith Architect-in-Chief, Victoria; Post Office, Prahran, for Architect General (Mr. Murdoch); Capitol Theatre, Mount Gambier—architects, Caberry and Chard, Sydney; Heywood Hotel—architects, Laird and Buchan, Geelong; Jens Hotel, Mount Gambier—architects, Joy and McIntyre, Melbourne; Woollen Mills, Mount Gambier; additions to Robe, Kingston, and Penola Hotels; Hospital, Naracoorte; Hospital, Hamilton—architect, Mr. A. P. Daniel, Mount Gambier. The quarry is situated on the Beachport railway line 8¾ miles from Mount Gambier, where all materials are loaded directly into trucks on the company's private siding for despatch, either via Mount Gambier, or to Beachport, where good shipping facilities are available.

Costs of Coralline Limestone at Canberra.

	Per ton.
	s. d.
Block stone f.o.r. at siding, 2 tons each ..	10 0
Freight to Albury	35 1
Freight, Albury to Canberra	32 2
Transtrucking at Albury	1 2
Counting charge	0 7
Carting from railway station to building ..	6 0
Delivery cost, at building	85 0

One ton of Coralline limestone produces 27 cubic feet.

In fine finish work, one man will easily cut 2 tons per day. At a wage of, say, 30s. per day of eight hours, the cutting cost will, *obviously, be 15s. per ton.* Therefore, the stone will cost 100s. per ton cut ready for building. For face work only of, say, a three-storied building, the stone will not need to exceed 9 inches in thickness. Thus 1 ton will produce 36 superficial feet of walling, at a cost of approximately 2s. 9d. per foot. The only place where the stone will oxidize or *where erosion would take place is on the eastern and* northern sides of a building. A peculiarity of stone is that rain will preserve it, while the sun will destroy it. With all stones erosion occurs where the morning sun strikes it and where it is protected from the weather. We now have materials that are transparent, and can be applied to any porous stone to protect it *from erosion. Casein* is one of the best of these materials. I think it would only have to be applied once in 30 years. It costs *only about 3s. 6d. per* gallon.

138. *To Mr. Jackson.*—When we fell a block of our stone it is saturated with water. We immediately cross-cut it, and when the saturation diminishes it is *easier to handle. If it is kept for a considerable time* it can still be cut easily. I recommend cutting and facing the stone on the job.

139. *To Mr. Coleman.*—If the costs permit, I should recommend the use of this stone at Canberra. I should think the Sydney costs would not come within 50 per cent. of the figures I have quoted.

140. *To Mr. Jackson.*—From my knowledge of Sydney freestone, I should say that 15 cubic feet of *it would weigh a ton,* whereas it takes 27 cubic feet of coralline in a wet condition to weigh a ton. There would probably be a *gain of 100 per cent. in handling* coralline. I am doubtful whether you could get freestone from Sydney under 4s. or 5s. per foot with a fine dressed finish similar to that of the Mount Gambier stone. I have quoted for rail freight. I have not considered sea freight from Beachport, which is our nearest shipping place.

141. *To Mr. Francis.—In the cutting of* 9-in. facings our stone would probably go quite as far as Sydney freestone. At Canberra a more up-to-date method of cutting the stone than we adopt could be used. A machine costing £150 would repay the cost *in about a week. We have the patent rights* of this machine. We have never had a complaint from a customer regarding the quality of our stone. I should say that the life of freestone would be shorter than that of coralline. Murray Bridge freestone is of very good quality, but I have seen it fret in fifteen years. I would not suggest that you attempt to use this stone *throughout a building,* but only for facing. I have not gone into the matter of the cost of the stone fixed into a building. *Apart from the test made* by Professor Chapman, a test as to the strength and durability of the stone was made in Melbourne and a similarly satisfactory result was obtained. I have discussed the question with Melbourne engineers, and they think that I am right when I say that there is a ratio multiple in the compression test which has *never been proved. A cubic inch* of stone would carry, say, 50 lb., and a piece 2-in. cube, which is four times the size, should be crushed at 200 lb., but I am prepared to say that 800 lb. would not crush it. As the size increases, so the multiple will increase. Our stone is most reliable, and so far as erosion is concerned I claim that it is superior to any freestone in Australia. The earlier buildings in Mount Gambier were not constructed of coralline. The spire of the Presbyterian Church *is standing up satisfactorily,* although it is getting on for 55 years old, and the Roman Catholic Church is about 42 years old. I have heard good opinions in regard to the post office at Prahran. Let me draw the attention of the committee to the following paragraph published in the Australian *Home Beautiful* of 1st March, 1927:—

> The entrance of "Castle Delgany," designed by Mr. Desbrowe Annear for the late Mr. Harold Armytage, *is approached by a flight* of eight broad steps. This photograph shows best the beautiful quality of *the Mount Gambier lime*stone of which it was constructed. Though soft enough to be cut with a cross-cut saw, the stone will harden and mellow with the years.

142. *To Senator Reid.*—After the stone is put into the building, it is given a rubbed face. It can be dressed with hammer, chisel, or axe. Sometimes it is *rock-faced. It* lends itself to carving or it can be turned like wood. There is nothing *in the stone to indicate that erosion would take* place. It is free from salt. There is practically nothing in it but calcium, which comprises 98.25 per cent. There is 1.10 per cent. of residual matter, and after that there is practically nothing. The weather only improves the stone. If our stone were protected against oxidization on the eastern side with casein or *similar material I think it would last* hundreds, if not thousands of years. The limestones are the longest living stones. I shall *ascertain the cost of shipping* our stone to Sydney, and advise the committee of it.

143. *To Senator Barnes.*—I recommend hollow wall construction with the Mount Gambier stone because it is porous. It could be painted, but the cost of that would not be warranted. The stone lends itself to painting, which makes it watertight.

144. *To Mr. McGrath.*—I do not claim that this stone is as lasting as granite, but limestones are the *longest livers among* freestones. We are sending our stone 700 miles up the West Coast, and also into Gippsland. There is *no quarry combine in* Mount Gambier. We have open competition among three quarries.

145. *To Senator Payne.*—Labour conditions are not as good elsewhere as they are at Mount Gambier, but I have allowed for that in the figures I have submitted. If suitable expert labour were available, I

should think it would be possible for the cutting price I have quoted for Canberra to be reduced considerably. Mr. Murdoch has visited Mount Gambier in connexion with the work at Prahran and about twelve months have elapsed since its completion. I discussed the position with him in Melbourne. We went through the tests, and he was quite satisfied.

146. *To Senator Reid.*—In facing the building with 6-in. blocks of coralline it would be desirable to have *a cavity wall. The blocks* should be tied to the bricks or concrete by means of wires. Blocks 6 inches thick would *carry a ten-story building. In steel and con*crete construction blocks of coralline could be put right on the face.

147. *To the Chairman.*—You ask me if I have ever heard architects say they would not care to use our stone. We meet architects who are satisfied with what they are using. Some will never change their methods. Some say they do not like white stone, but they will put up a house and paint it white.

(Taken at Adelaide.)

SATURDAY, 8TH JUNE, 1929.

Present:

Mr. M. CAMERON, Chairman;

Senator Barnes	Mr. J. Francis
Senator Payne	Mr. Jackson
Senator Reid	Mr. McGrath.
Mr. Coleman	

Dr. Arnold ~~Edward~~ Victor Richardson, Waite Professor of Agriculture, University of Adelaide, and Director of the Waite Agricultural Research Institute, sworn and examined.

148. *To the Chairman.*—I am aware of the proposal to establish botanical research laboratories at Canberra. I certainly consider that there is a sufficient field of research to warrant the Commonwealth embarking on the proposed expenditure. The matter *of the distribution of research work between the* States and the Commonwealth in the field of agriculture was settled at a meeting some two years ago when the Council for Scientific and Industrial Research met the Directors of Agriculture of the States, that is, the Standing Committee on Agriculture, and asked it whether it considered that there *was a field for the Commonwealth in agricultural* research, and if it thought there was, what were the relative spheres of the Commonwealth and the States. The unanimous verdict of the Standing Committee was that there was a definite place for the Commonwealth in that sphere and that the broad division in respect of policy should be along the lines that the States should confine their attention to the problems that were of particular interest to the States, and that *the Commonwealth should tackle those problems* which transcended State boundaries and dealt with broad, national, fundamental questions. As the result, the Commonwealth is entering the sphere of agricultural research and is working on those problems of more or less national interest, leaving the States to carry out research on the more specific local *problems. I have paid many visits to Canberra in* connexion with the proposed establishment there of botanical laboratories. There are disabilities at the present time, as, indeed, there are likely to be in regard to any new centre which is set up as the political and administrative head-quarters of a nation, but in the course of time they will, I think, disappear with the increase of population and the facilities that are available. One drawback at present at Canberra *is the absence of a university, and the fact that* the capital has not an agricultural environment. In regard to research, you first of all require a central home where the laboratory work is done, and you also need field centres or subsidiary centres where the actual problems are tackled, so it does not really matter where the central organization is located. It *is essential, however, that the subsidiary* organizations should be in close touch with the botanical problems being investigated. For *instance, if you wished to do* intensive work in connexion with prickly pear, it would be only possible to do it in a district where that plant grew. Similarly, research on "take-all" must be done in the wheat areas, and if you were working on fruit pests it would be necessary to go into the fruit centres. Australia is a *large country with diversified climate, soil, and* agricultural interests, and the research must be scattered over a wide area. Just as wheat problems must be tackled in the wheat belt, so veterinary problems such as *Caseous lymphadenitis* must be investigated where that disease is most rampant. Of course, we also require a central organization where the scientific work *is actually done. You ask me whether a national* botanical laboratory should be located at Canberra. I do not know that that is quite a *fair question.* There is no one centre in the Commonwealth at present which is outstanding in regard to botanical research and where the organization could be located with advantage. With all the possibilities of Canberra, it *is probably as good a place as any other,* unless you are going to commit yourself to the policy of establishing centres *in the existing capital cities. Remember*ing that Canberra is the political and administrative home of the nation, it would appear clear that unless there are other reasons to the contrary, as much as possible of the work should be done at that administrative centre, just as the Department of Agriculture of South Africa is quartered at Pretoria. Washington *with its 15,000 officers is doing national* work for the United States of America, and Ottawa is the home of the Canadian organization. *There are areas in the* Federal Capital Territory which would be suitable for experimental work, but, of course, the soil in the immediate vicinity of the proposed laboratory is not as suitable as might be obtained elsewhere. There *would be the same objection if you established it in* Melbourne or Sydney. The soil around Sydney is *exceedingly poor, and so also is that immediately* around Melbourne and Perth. So far as I know, Adelaide alone has the advantage of a wonderful agricultural environment right up to the city. We have our laboratories at the Waite Institute, and immediately alongside them we have soil that is characteristic of the major part of the wheat belt of Australia. But the disadvantage to which I have referred could be got over by having a number of sub*sidiary stations where the field work could be done.* This will always be necessary in a national organization where it is impossible to fix upon any one site as being thoroughly representative. There should be no friction arising between State and Commonwealth activities. The whole policy of the Council for Scientific and Industrial Research has been directed towards the prevention of overlapping in order to make the best use of the efforts of the limited number *of research workers available in Australia.* It is recognized generally that any judicious expenditure in destroying pests or increasing the productivity of agriculture is justified. In every agricultural country large sums are spent annually in the endeavour by scientific research to reduce the heavy toll that is taken by insect and fungus pests. The secretary of the *Department of Agriculture* in the United States of America has pointed out that these pests have been

responsible for the loss of 15 per cent. of the total agricultural production of the country. This means that the damage thus done has nullified the work every year of a million men, or, in other words, the produce of 1,000,000 agriculturists is wiped out every year by the depredations of insect and fungus pests. In Australia the blow-fly is probably responsible for damage to the extent of from £3,000,000 to £4,000,000 annually. It would be difficult to say how much loss is due to take-all in wheat. I should say possibly 10 per cent. of the crop is claimed each year, and that means damage to the extent of £3,000,000. The solution of this problem would be a handsome dividend on any expenditure contemplated in regard to botanical research. Taking the whole of the work done in Australia at the present time, I should say we are decidely behind the United States of America in proportion to population, and also behind South Africa. In the United States of America the Federal Department of Agriculture is the great organization which conducts agricultural research extension and instruction, whereas in Australia that work is carried on by the State. In proportion to population, I should say that the amount of research work done here falls far short of what is done in other countries. The land values in the wheat belt have increased very considerably in South Australia during the last twenty years, partly as the result of the increased productivity of those areas, due to improved methods of agriculture. The most outstanding fact, I suppose, is the introduction of superphosphate, which has probably added at least 3 to 4 bushels to the acre. That discovery was made by Liebig and Sir John Lawes, of Rothamsted. The introduction of improved varieties of wheat, too, has been of great assistance. The most improved varieties in this State have been bred at the Roseworthy Agricultural College, and those are the varieties actually under cultivation at the present time Furthermore, the introduction and general use of more thorough methods of fallowing have been responsible for increased yields. The average yield in South Australia has increased from 6.1 bushels to 12.4 bushels in the last 40 years, although the acreage has increased at the same time by 50 per cent. and poorer lands have been brought under cultivation. So we might say that as the result of the scientific work of the Department of Agriculture here, lands that were hitherto regarded as more or less valueless have been brought under cultivation. The standard of cultivation has been raised and the value of land in the settled districts has increased probably three-fold in the last twenty years. I understand that the committee has visited the Kybybolite Experimental Farm, and it must have been impressed by the developments that have taken place there as the result of top-dressing of the pastures. This estate was purchased by the Government for £2 17s. 6d. an acre. At that time I suppose it would have been very difficult to grow sheep of reasonable frame and health and high wool productivity on that land. The productivity has now been increased three-fold or four-fold by the application of superphosphate and the planting of subterranean clover. But it is in regard to the future that we must seek to measure the possible value of scientific work. All our competitors, such as the United States of America, Canada, Argentina, and the whole of Europe, are increasing and developing their scientific activities for the purpose of increasing their production. For the permanent success of industries such as the wheat industry, we must continually apply scientific methods. Increased expenditure on scientific research is the price we must pay for advanced agriculture and a prosperous farming community. Since Australia is dependent to such a large extent on its flocks, it is necessary that as much research as possible should be given to the improvement of its pastures. Research along these lines will be part of the work of the proposed laboratories. Very little work, indeed, has been done in Australia on our natural pastures, which are responsible for practically 90 per cent. of the pastoral production. The greater proportion of the cattle of Australia depend on these pastures, and to a large extent the dairying industry is dependent on them. It is surprising that very little work has been done in the past on that important source of national wealth, and one of the objectives of the division of botany will be to introduce new crop and pasture plants to Australia, and to endeavour to increase the production of pastures by a scientific study of them. You ask me for particulars of the results achieved at the Waite Institute, where we have been working for only a short period. Take the matter of soils research. You heard from Professor Prescott yesterday afternoon of the very valuable work he has done in that connexion, first of all endeavouring to arrive at a sound basis for classifying the soils of Australia on uniform lines. Further, he has made a soil survey of several important irrigation areas along the Murray, and he has definitely shown that there are many types of soil on those irrigation blocks. Some of them are definitely worthless although water has been applied to them, and they have been settled. Had we been able to make a soil survey beforehand, much money would have been saved and a great deal of disappointment on the part of returned soldiers would have been avoided. Then, again, it has been been shown that there are certain diseases in oat plants in various parts of the State. It is what we call the manganese deficiency disease. The Waite Institute has shown that it is due to a deficiency of manganese. An application of 75 lb. per acre of manganese sulphate will enable profitable crops to be raised, and without that sulphate the crop is practically a failure. It is very difficult to assess what we have done so far in regard to agricultural problems, but we have been able to show definitely that the yields of wheat could be increased considerably if certain fundamental practices were observed. We have also demonstrated that under certain conditions in high rainfall country the practice of fallowing might be dispensed with. The evidence for that is not yet complete, but there is every reason to believe that there will be a considerable increase in productivity from high rainfall country by dispensing with fallowing. This is made possible by the application of nitrogenous manures. We have shown definitely that as regards rain, which exercises a dominating influence on wheat yields, the quantity of rain that falls in South Australia is sufficient to increase the yields by at least 50 per cent. As the result of our transpiration tests we have shown that 1 inch of rainfall is capable of producing 3½ bushels of wheat In regard to plant diseases, Mr. Samuel has proved definitely the cause of tomato wilt. He has shown that it is a virus disease transmitted from plant to plant by means of an insect called *Frankliniella insularis* We have a number of pastoral investigations in progress, but as this is entirely a new field of work, we are endeavouring to determine methods of technique so they can be used by workers throughout Australia in studying natural pastures. Our wheat-breeding experiments have not been in progress for a sufficient time to enable us to show tangible results, but we have a large number of crossbred wheats which promise to give highly increased yields.

149. *To Senator Payne.*—I have spent twelve months in studying the organization of research in Canada and the United States of America. The organization of the American Agricultural Colleges in the United States was brought into existence by that famous democrat, Abraham Lincoln, who, at the most critical period in the history of American development, namely, the Civil War, signed the bill for the establishment of agricultural colleges. I refer to the Land Grant Act, whereby 11,000,000 acres of the most fertile land in the country was set apart for agricultural research and education. As the result of that measure, the State and Federal activities began contemporaneously. There was a Federal Department at Washington, and the act provided that there was to be a college of university standing in each State of the Union. The State colleges of agriculture have what is called the tripartite form of education. Each college has three branches of work—research, instruction, and extension. Apart from the president there is a director of research, a director of instruction, and a director of extension. The work of this national institution is done right under the nose of Congress. This is a fine strategical position, because it has the ears of parliamentarians from all over America, and it has achieved results which justify an annual appropriation of £147,000,000. Let me read one paragraph from my report published by the Victorian Department of Agriculture on the subject of agricultural education and development in America:—

> Wisconsin has now achieved leadership in the production of dairy produce, cheese, and butter, among the American States. Despite many disadvantages, she now occupies first place among the States for the output of dairy products. During the last twenty years Wisconsin's dairy production has quadrupled, the total value rising from £4,000,000 to £16,000,000 per annum. Much of this is admittedly due to the leadership and work of the dairy school of the experimental stations. In addition to the output of dairy products, Wisconsin's cereal yield is considerable. Though only two-thirds the size of Victoria, and though the northern half of the State is mostly poor land in need of drainage, Wisconsin, besides producing £10,000,000 worth of dairy produce, raises 100,000,000 bushels of oats, 70,000,000 bushels of maize, and 25,000,000 bushels of barley.

Compare this with Victoria's 8,000,000 bushels of oats and 1,000,000 bushels of maize. This dairy school established the Babcock test and with Henry and Morison conducted research which set a standard for feeding dairy stock throughout the world. If a soil survey had been carried out before certain land near Renmark had been utilized, hundreds of thousands of pounds would have been saved. If a soil survey had been made of the Murrumbidgee irrigation areas before that land was settled, a good deal of the trouble that arose when it was found that lucerne would not grow there would have been avoided. I would not say that before any further expenditure is incurred for the purposes of closer settlement a soil survey should be made, but I contend that it is very desirable to take that precaution before embarking upon huge expenditures on irrigated lands. There are two kinds of soil surveys. There is the intense survey and also the reconnaissance survey, which can be done in one-tenth of the time. Australia is such a huge continent that I would not hold up settlement generally on account of the need for soil surveys. Personally, I consider that the scope for research in the Commonwealth with respect to dairying is almost illimitable. Reference has already been made to the need for the prevention of overlapping. Some twelve months ago we submitted this question to the State Standing Committee on Agriculture. We asked them if there was a place for the Commonwealth in dairy research, and, if so, what work could the Commonwealth undertake. I submitted a scheme to them which you will find in the Journal of the Council for Scientific and Industrial Research. Their conclusions were that perhaps we might start by having not more than one dairy chemist and one dairy bacteriologist. My personal view is that while the field is illimitable, the progress along national lines is conditioned by the rate at which we can convince the State departments that we can come in without overlapping. Professor Wadham has made an excellent report on dairy research, and has shown that there is an enormous field for it.

150. *To Senator Reid.*—We have been rather chary about publishing any reports from the Waite Institute until we have been established four or five years. We hope to have our first report available at the end of this year. We have published seven papers in journals in different parts of the world, but we have not yet published any formal report. From time to time we give lectures such as that which was excellently reported this week in the Adelaide *Advertiser*. The other States are spending quite a large sum of money in agricultural research. Victoria and New South Wales are spending much larger sums than South Australia. The Waite Institute is unique in that it was privately endowed. In other States much scientific work is done by Departments of Agriculture. Each State has a Journal of Agriculture, in which accounts of the work of the officers of the department are published, and thus made available to all who are interested. The Waite Institute is definitely attempting to breed varieties of wheat suitable for climates such as that of Eyre Peninsula, one of the driest portions of South Australia, and no doubt the varieties found suitable for that district will be suitable for other dry parts of Australia. Fine work in this respect is being done by other States, particularly in New South Wales. Thanks to Farrer, we have a large number of varieties which have caused a great increase in production. Farrer's work has probably added £1,000,000 a year to the value of Australian wheat production during the past twenty years, and possibly he has done more to build up Australia than any other person. It is interesting to note that all that work was done in the Federal Capital Territory. The discovery of a good wheat for dry areas would mean a considerable extension of the wheat belt. I doubt whether the cultivation of the additional areas would affect a State meteorologically, but I belive that in Victoria the Meteorological Department has published some evidence that the sowing of wheat in the northern Mallee has slightly affected the rainfall. It is difficult to prove this owing to the long period over which the figures would have to be taken to arrive at a reliable result. You ask me what is the minimum price at which it would pay Australia to grow wheat. We do not deal with the economic aspect at the Waite Institute at the present time. We have no branch of agricultural economics. If I said it was 3s., 4s., or 5s. per bushel you would find tremendous variation in the cost of production on different farms. We could tell you how much it costs to grow an acre of wheat, but the yield depends on the rainfall. In seasons of high productivity the cost might be as low as 2s., but in a drought year it might be £1 or more per bushel. There are two aspects of wheat cultivation which must be kept clearly in mind. First of all, there are the improvements that are possible by the application of scientific and technical knowledge. This will increase the productivity per acre and lower the cost of production to some extent. Secondly, there are those improvements that lower the cost of production by virtue of more efficient farm management by the increased use of motor traction and large implements on the farm. The former are engaging the attention of the scientific workers, and the latter must be taken up by economic research workers and implement makers. The two phases are quite different. We are attempting to build well the foundations for successful agriculture. I was trying yesterday, in an address to the Rotarians, to show that the introduction of motor traction in wheat-farming in the United States of America had enabled large areas of country to produce 1 acre of wheat in 2 man-hours, as compared with 8 man-hours where horse power was used. That is to say, by the use of tractors there is a fourfold increase in wheat productivity per man. Henry Ford uses 65 tractors on his "Dearborn" farm, and he does all his seeding and

harvesting in fifteen days by employing factory operatives. It means the application of the principles of the industrial revolution to agriculture. Agriculture, of all the great industries of the world, is the most dependent on power. It is the last affected by the introduction of mechanical power, and its future will be much dependent on the use of increased motive power. Wheat-growers in the past have paid too much attention to the price of their product and not enough attention to the cost of production. So long as we have a surplus of production beyond domestic needs we must always depend on overseas parity. Any artificial scheme attempting to influence prices of primary products by tariffs, bounties, bonuses, pools, &c., will break down sooner or later. Once having determined the characteristics of the soils in one part of Australia, when you find those same soils in other parts you can apply the same methods with an absolute certainty of obtaining similar results. That is the great advantage of a soil survey. The United States of America Department of Agriculture has spent many years and much money on the classification of soil and in making a soil survey of the whole country.

151. *To Senator Barnes.*—Many institutions in different parts of the world have achieved eminence along certain lines of work. For instance, in veterinary research I suppose that the Onderstepoort Veterinary Research Station established by Sir Arnold Theiler is regarded as the leading institution in the Empire, if not in the world. Similarly in Great Britain we have Cambridge for plant breeding and animal nutrition, and the Rowett Station, Aberdeen, which is noted for its work on animal nutrition. In the United States of America the Pennsylvania State College is famed for its research work on animal nutrition, and Wisconsin is noted for dairying research. The overlapping that occurs in the Commonwealth also applies internationally. We are endeavouring through the Empire Marketing Board to distribute important problems within the Empire. Take the biological control of insect pests. Australia has been selected as the one place within the Empire at which biological control of insects is to be tested on a grand scale. The Empire Marketing Board has contributed some £60,000 towards that work, and other countries will await with interest in the next five years the result of this experiment. Similarly the Waite Institute is doing work for that board on the mineral content of pastures for our localities. Gradually there will come about an international desire to prevent overlapping, just as we are trying to do in Australia. The medium for that will probably be the Imperial Agricultural Research Conference, the first meeting of which was held last year. The next meeting will be held in August in 1932, when representatives from every part of the Empire will foregather in Australia mainly to find out how we use our individual resources for the benefit of the Empire without overlapping.

152. *To Mr. McGrath.*—Even if the report published in the press a few days ago that with the change of Ministry in Great Britain the Empire Marketing Board is likely to be abolished were correct, it would have no effect on our investigations. I should think that no British Government would abrogate any arrangement made by a previous Government with Australia for a given period; at any rate, not until that period had elapsed. It would be a sad blow to imperial co-operation if the board were abolished, but I think that wiser counsels will prevail. Although you point out that there is not likely to be a university at Canberra for many years, taking a long view and having regard to the future of Australia, I am inclined to say that the proposed botanical laboratory should be established there.

153. *To the Chairman.*—It seems to me that State officers work under great disadvantages. From the point of view of the prosecution of research it is very desirable that the person conducting research should be able to keep on with his job without interruption. In a State department there are many calls on an officer's time, and his work is likely to be interrupted at critical periods. On the whole, research work is better conducted where the worker can apply himself continuously to his job. We find an increasing desire on the part of farmers and graziers to take advantage of the advance made in scientific investigation. Looking back over my experience in the last fifteen years in Victoria and South Australia, I should say that the farmer has completely changed his attitude towards scientific workers. Fifteen years ago the agricultural scientist had to tread very warily. He was more or less discredited, but, fortunately, by the conduct of the experiments in different parts of the State, we were able to convince the farmer that we had a message to convey to him, and once he was convinced of the soundness of our views, his attitude entirely changed. I think that has been the experience throughout Australia. The States are probably doing as much as they can afford at the present time in proportion to their resources to encourage scientific research. The report on agricultural development in America, from which I have quoted, shows that the United States of America has a very efficient organization. There are 3,000 counties in each of which there is a county agent, and there are trained agricultural scientists who get into touch with the farmers. That is the kind of organization likely to give the best results in Australia. We have adopted this in principle in South Australia, but the principle needs to be extended. In this State we have only six or seven men as instructors in agriculture, and we have 20,000 farmers and pastoralists, so it would take about ten or fifteen years for each instructor to make one visit to each farm. This shows the need for a great increase in the number of instructors.

(Taken at Perth.)

WEDNESDAY, 19TH JUNE, 1929.

Present:

Mr. M. CAMERON, Chairman;

Senator Barnes	Mr. J. Francis
Senator Payne	Mr. Gregory
Senator Reid	Mr. McGrath.
Mr. Coleman	

Percy George Hampshire, Superintendent of Dairying, Department of Agriculture, Western Australia, sworn and examined.

154. *To the Chairman.*—I have been informed of the proposal before the committee. In the absence of the Director of Agriculture, who is at present in Melbourne, the Minister of Agriculture in this State has asked me to represent the department. I desire to present to the committee the following prepared statement, which sets out the view-point of the department:—

> The Western Australian Government considers that the Commonwealth Government should assist the States in research matters, particularly those that are of interest to the whole of Australia, but that the work should be carried out in co-operation with the Departments of Agriculture and in the States affected. This has been the case as far as this State is concerned in connexion with the buffalo-fly investigation, the Kimberley horse

disease investigation, and the bitter pit investigation, and the Government appreciates the valuable assistance rendered to the State by the Council for Scientific and Industrial Research on these problems; also in connexion with the Braxy-like disease. This disease is, as far as we are aware, only prevalent in this State, but as heavy losses were being experienced here and the disease was becoming more widespread, the Council for Scientific and Industrial Research, on being appealed to, decided to assist by arranging for our veterinary pathologist, Mr. Bennetts, to be seconded to them in order that he might devote the whole of his time to this investigation. This arrangement is for a period of two years, during which time the whole of Mr. Bennetts' salary will be paid by the Council, but it might also be mentioned that as further assistance was required, another officer, Mr. Harley, M.R.C.V.S., has been sent over to assist Mr. Bennetts. This procedure shows that the Council for Scientific and Industrial Research realizes the necessity of conducting the research work on the spot.

There are other problems, such as the lucerne-flea, the red-legged earth-mite, the fruit-fly, and the blow-fly. The first two named constitute the outstanding pasture problems, and are so widespread that their control by artificial means is difficult and costly. These attack the leguminous crops and other crops such as potatoes, cabbages, lettuce, in fact, most vegetables. Oats have also been attacked. The department has carried out numerous experiments with dusts and sprays, some of which have proved fairly effective, but these means are impossible when dealing with pastures or large crops. Endeavours have been made to obtain a natural enemy, but although many countries have been communicated with, up to date we have not been successful. The means adopted to control fruit-fly are fairly effective if properly applied, but it would be far cheaper if some biological means could be discovered for eradicating this serious pest.

These problems are of Commonwealth importance, and should also be investigated by that body, but as previously pointed out, we are strongly of opinion that the work should be carried out in the States affected and with the co-operation of the officers of the Agricultural Department. It is also believed that the States will be benefited to a far greater extent by this means than by the appointment of an officer as suggested by the Dairy Council.

The establishment of laboratories at Canberra is viewed with dismay, as this would not be in the best interests of the States. If this occurred, State officers would not obtain the experience and knowledge that would be possible if their problems were investigated in the States with the co-operation of the Departments of Agriculture. It is realized that this course may mean some slight overlapping, but it is contended that the research worker at Canberra could not have the necessary local knowledge or the interest in the subject as would be the case with a State officer. It is, therefore, believed that the Commonwealth can render the greatest service to the States by allowing the Council for Scientific and Industrial Research to co-operate in research problems and by granting the necessary financial assistance to the States.

The committee may be interested to know of the steps that have been taken by the Government to assist in the development of the agricultural industry in this State, as, for instance, the establishment under the control of the Department of Agriculture of seven experimental farms and one stud farm. At each of the experimental farms wheat breeding is carried out continuously with the object of obtaining wheats that will prove most suitable for our conditions, and a notable achievement in this connexion was the breeding of the "Nabawa" variety, which is now planted on more than half of the area devoted to wheat-growing in this State. On these farms are also grown other cereals and fodders with the object of ascertaining those likely to prove of most value in the particular districts in which the farms are situated.

Two of the most recently established farms, namely, at Ghooli, near Southern Cross, and Dampawah, near Perenjori, are on the fringe of what is now known as the safe area for wheat-growing, and will prove definitely whether our wheat-growing districts can be further extended. On each of the farms many experiments are conducted every year, such as rate of seeding, time of planting, rate of fertilizer, fungicide experiment, bunt resistance experiment, &c. An agricultural college has also been established in this State, at which students have an opportunity of obtaining a good grounding in every phase of agriculture, and enable them to commence their agricultural careers under the best auspices and with the latest information regarding the successful practice of agriculture.

In order to assist farmers, the department has a staff of technical officers dealing with horticulture, dairying, pastures, potatoes, entomology, plant pathology, soil problems, stock health, and vermin (rabbits, foxes, and dingoes). These officers are continually travelling throughout the State advising settlers on their farms and by lectures and demonstrations. Many of these officers have their head-quarters in country districts, and are thus enabled to keep in close touch with the several problems affecting the man on the land. In order to assist the dairying industry it has been decided to subsidize on a £1 for £1 basis the purchase of approved bulls. This assistance also applies to the horse-breeding industry, and already several settlers have taken advantage of the subsidy to import approved stallions. As further evidence that the Government is willing and anxious to assist in the development of the agricultural industry, it might be mentioned that superphosphate is carried to the settlers at a very low rate, far less than the actual cost. As a matter of fact, during the past twelve months 217,141 tons were carried over the railways, the actual loss on this service being approximately £170,000. The rate charged is .52d. per ton mile, the average rate for all traffic being 1.76d.

The officers of the Department of Agriculture in this State have for some years past been giving particular attention to pastures with a view to improving the carrying capacity of the land and increasing the yield of the dairy stock. The committee will doubtless be interested to know that this department realizes the necessity and importance of research work, and, as a matter of fact, at the present time no less than 47 research projects are being conducted. These include diversified subjects such as the cause of mortality in young cattle, manurial injury to seed potatoes at planting, poison plant investigation, life history and control of wax scale, sheep feeding, soil classification, variotal disease resistance, control of disease of oats known as white wilt, &c.

The statement contains a reference to the increase in the areas of pastures in the last ten years. In 1919 there was nearly 14,625 acres of laid-down pastures

and to-day it is estimated that the area has increased to 220,000 acres. To show the value of top-dressing, I may mention that in the last five years the average returns from 65 plots in different parts of the State show an increase of 260 per cent. where an application of 1 cwt. of superphosphate per acre has been given, and an increase of 320 per cent. where 2 cwt. has been applied. That result has been achieved with one application per annum. In addition the pastures were improved by the growth of leguminous plants to the following extent:—1 cwt., 252 per cent.; 2 cwt., 330 per cent. In other words the pastures have increased in value thirty-fold. You ask me why the establishment of laboratories at Canberra is viewed by us with dismay. Of course it is to a certain extent a matter of policy. From the departmental point of view we feel that the authorities at Canberra might regard some of our troubles as of minor importance as compared with problems in, say, Queensland, and there might, and probably would be, a tendency to put our problems on one side. We think that greater enthusiasm would be engendered on the part of the officers carrying out the work if it were done in the State or in the part of Australia where the disease was most prevalent. You inform me that the proposal is rather to assist the States in every way, the necessary field work to be done in the local centres. The department has no data showing what is proposed. I realize that there must be head-quarters, and I would not oppose their establishment at Canberra so long as the actual field work were carried out in the localities where the troubles were experienced. I agree that there is great advantage in having the problems studied by men who can devote the whole of their time to the work. Officers employed by State departments might have their investigations interrupted from time to time. I am chary about giving a definite opinion as to the extent to which the establishment of the proposed laboratory at Canberra would involve duplication of the work now being done by the States. I agree that the more sane minds there are concentrating on a given problem the better chance there is of success. In Western Australia, generally speaking, we are not troubled with pests and we are jealous of keeping them out. Apart from the remarkable increase in our pastures due to the application of superphosphate and the planting of subterranean clover, the department has spent £13,000 in the purchase of good bulls. We have had a Bull Registration Act in operation for five years, and we have killed 1,000 scrub bulls. We have adopted the zone system of herd improvement. We have stamped out rinderpest with the financial assistance of the Commonwealth, and there has never been a recurrence of it. We are troubled with take-all in wheat in Western Australia and the disease is being investigated constantly.

155. *To Mr. McGrath.*—I was not aware that under the proposal before the committee the investigations, apart from the purely laboratory work, would be carried out in the States. I shall place that aspect of the matter before the Minister and probably the statement which I have submitted will be modified. Since the Federal department has been established we have worked harmoniously with it, but there is a general tendency in this State to expect that if given an inch the Federal authorities will take a yard.

156. *To Senator Payne.*—The Commonwealth department has been very helpful to the State department, and if an up-to-date laboratory were established at Canberra, the State should receive even greater assistance in the future than in the past. I recognize that certain investigations have a national aspect and could best be carried out by the Federal authorities. The State authorities in Western Australia are satisfied with the recent efforts to discover the cause of bitter pit in apples and we anticipate good results through the co-operation of the Federal authorities.

157. *To Mr. J. Francis.*—We are in favour of the Commonwealth co-operating with the States in research problems, but we object to those problems being investigated in the laboratories only. I am afraid that in the minds of the State Governments there lurks the fear that practically all the State organizations will eventually be superseded. I believe that the objects sought to be attained could best be achieved by the Commonwealth co-ordinating all the activities of the States. I should welcome any assistance from the Commonwealth in the investigation of such troubles as the Braxy-like disease in sheep, if the work were carried out in the States concerned, and a big Federal department was not built up at the expense of the States. The States have had some bitter experiences. For instance, before federation each State Department of Agriculture had a dairying division. Some years after federation a Federal dairy expert was appointed. He was taken away from New South Wales where he had been doing excellent work, but he found himself in the position of a king without a country. He desired to get a staff around him, and he began to encroach upon the work of the States. His duty was solely the checking of exports, but now the Federal department wishes to send officers into the different States to tell the State departments how to run their domestic affairs; such as the types of farms to establish and how to make butter. The Australian Dairying Council is another Federal creation. Mr. Rodgers was responsible for that innovation, and it was not made at the request of the farmers. A council has been created which interferes with the domestic affairs of the States and causes overlapping.

158. *To Mr. Gregory.*—Our dismay was occasioned more or less by the thought that the Commonwealth would endeavour to take the control of the Department of Agriculture from the State. It was not thought that all control would be taken by the Federal authorities, but it was feared that the State would lose its officers and the department would be weakened generally. I admit that the Federal authorities are working in collaboration with the States and that the desire seems to be that the Commonwealth should deal with fundamental matters, leaving the local work to the States. We publish bulletins in the *Journal of Agriculture* to encourage top-dressing and other modern practices, and we give lectures which are reported in the press. Six years ago top-dressing was not resorted to, but to-day an annual top-dressing is given on probably 95 per cent. of the farms in this State. I do not know that the Council for Scientific and Industrial Research could get any more information from other parts of the world than any State department could obtain. I agree that an up-to-date library would be essential for the proposed laboratory. There is a tendency on the part of the States to eliminate a number of publications on the score of expense. I believe that in the United States of America scientific investigations in connexion with agricultural matters emanated from the Federal authorities. Federation has been in operation in Australia for just on 30 years, and there has been no proposal until now to establish what is in the nature of a Federal Agricultural Department. It is rather late in the day to do that, but I welcome the establishment of the Council for Scientific and Industrial Research. The investigation of take-all in wheat could perhaps be carried out better by the Commonwealth than by the States separately. Up to the present time it has been recognized that a minimum of 7 inches of rainfall during the growing period is required for the successful production of wheat, but provided good farming methods are adopted and the best variety is selected there is a tendency to consider that 5 inches is sufficient.

159. *To Senator Reid.*—The State department would not require somebody at Canberra to supply it with information as to the success obtained in Queensland in dealing with a particular pest. I do not see that the States would be benefited from a publicity point of view by the proposal before the committee, but if the best men available concentrated their efforts upon the solution of problems confronting the Australian producers, I believe the work being carried out in the States could be the better directed.

160. *To Mr. J. Francis.*—I am prepared to modify to a certain extent the opinion expressed in the statement I have read, but I still point out that the department fears that the present proposal will not be adhered to in its entirity. It is thought that a huge department will be created at the expense of the States. You ask me whether I would adhere to that opinion if the heads of the State departments in New South Wales, Victoria, and South Australia enthusiastically supported the proposal. I should be only too pleased to put that aspect of the matter to the Minister I am satisfied that a proposal to which those three States were agreeable would be favorably considered by the Western Australian Government.

161. *To Senator Barnes.*—We have a good deal of difficulty in securing suitable men for our staff, and we are training them through the university. Half a dozen take a course in agriculture every year, and in two instances we have sent men to America, one to study soil survey and another plant nutrition and feeding. Buffalo-fly, which affects cattle and is prevalent in the islands north of Australia, is being propagated in Perth, and the cause of the disease is being investigated, but we are not in a position yet to make a definite pronouncement.

By Authority: H. J. Green, Government Printer, Canberra.