1917-18.

THE PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA.

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

REPORT

TOGETHER WITH

MINUTES OF EVIDENCE

RELATING TO THE PROPOSED

ERECTION OF WORKSHOPS, ETC., AT FLINDERS NAVAL BASE.

Presented by Command; ordered to be printed, 10*th April*, 1918.

(*Cost of Paper.*—Preparation, not given; 855 copies; approximate cost of printing and publishing, £115.)

Printed and Published for the GOVERNMENT of the COMMONWEALTH of AUSTRALIA by ALBERT J. MULLETT, Government Printer for the State of Victoria.

No. 56.—F.13391.—PRICE 2S. 9D.

MEMBERS OF THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

(Second Committee.)

THE HONORABLE HENRY GREGORY, M.P., Chairman.

Senate.	*House of Representatives.*
Senator George Henderson	William George Mahony, Esquire, M.P.
Senator Edward Needham	James Mathews, Esquire, M.P.
Senator John Newland, Vice-Chairman.	Sydney Sampson, Esquire, M.P.
	Hugh Sinclair, Esquire, M.P.
	The Honorable William Henry Laird Smith, M.P.

FLINDERS NAVAL BASE.

ERECTION OF POWER-HOUSE, ETC.

LIST OF WITNESSES EXAMINED BY THE FIRST COMMITTEE.

ERECTION OF WORKSHOPS, ETC.

LIST OF WITNESSES EXAMINED BY THE SECOND COMMITTEE.

EXTRACT FROM THE VOTES AND PROCEEDINGS OF THE HOUSE OF REPRESENTATIVES.

No. 35 OF 26TH SEPTEMBER, 1917.

19. PUBLIC WORKS COMMITTEE—REFERENCE OF WORKS—FLINDERS NAVAL BASE.—The Order of the Day having been read for the resumption of the debate upon the following motion of Mr. Watt :—

That in accordance with the provisions of the *Commonwealth Public Works Committee Act* 1913–1914, the following works be referred to the Parliamentary Standing Committee on Public Works for their report thereon, namely :—FLINDERS NAVAL BASE.—Erection of Workshops, Hospital, Detention Barracks, Quarters for Married Officers and Warrant Officers ; Water, Sewerage, and Storm-water Reticulations ; Electric Distribution System ; and accessory works for that establishment.

Debate resumed.

Question—put and passed.

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

FLINDERS NAVAL BASE—ERECTION OF WORKSHOPS, HOSPITAL, ETC.

REPORT.

The Parliamentary Standing Committee on Public Works, to which the House of Representatives referred for investigation and report the question of the carrying out of the following works at Flinders Naval Base, namely :—Erection of Workshops, Hospital, Detention Barracks, Quarters for Married Officers and Warrant Officers; Water, Sewerage, and Storm-water Reticulations; Electric Distribution System; and Accessory Works for that Establishment, has the honour to report as follows :—

INTRODUCTORY.

In pursuance of the policy already decided upon to establish in the vicinity of Western Port a sub-base for torpedo boat destroyers and submarines to be known as the "Flinders Naval Base," certain works have been carried out at that place and certain others are in progress.

2. To allow of the early removal from Williamstown of the Naval *personnel* accommodated there, and to permit of the early commencement of training and the carrying out of those works for which the Base is designed, it is now desired to proceed with the erection of certain workshops, quarters, and a hospital, and to provide for water and sewerage reticulations, &c., without which, it is represented, it would be inadvisable to commence operations at the Base.

DESCRIPTION OF THE PROPOSED WORK.

3. The items comprised in the reference now under consideration are—

(*a*) Workshops.
(*b*) Hospital.
(*c*) Detention Barracks.
(*d*) Armourer's Workshop.
(*e*) Quarters for Married Officers.
(*f*) Quarters for Married Warrant Officers.
(*g*) Water Reticulation and Fire Service.
(*h*) Sewerage Reticulation.
(*i*) Storm-water Reticulation.
(*j*) Electric Distribution System.
(*k*) Accessory Works.

(*a*) *Workshops.*—These are to consist of a machine and fitting shop, 176 ft. 6 in. long by 65 feet wide, and a boiler shop 119 ft. 6 in. long by 55 ft. 6 in. wide. Each of these buildings is proposed to be a steel-framed structure, clothed with brickwork, and protected by a steel-framed roof with tile covering. The height of the walls in each instance will be 46 feet from the floor level to the eaves of the roof. The estimated cost is £26,350

(*b*) *Hospital.*—This building, designed to serve until ultimate requirements can be foreseen, is to be in the nature of a temporary hospital. The plans provide for a construction partly permanent and partly temporary. The intention is to build the administrative block or depôt surgery of brick and the wards or hospital proper in wood, and so constructed that the latter can be subsequently removed and made use of as infectious blocks. Provision is made for about 40 beds, and the estimated cost is .. 8,842

(*c*) *Detention Barracks.*—This proposal is for a building 104 ft. 4 in. long by 31 ft. 8 in. wide, consisting of brick, with 22 concrete cells and a brick stockade wall enclosing a tar-paved exercise yard 114 ft. 10 in. long by 40 feet wide. Timber buildings for the accommodation of seven warders are also provided. Estimated cost £5,715

(*d*) *Armourer's Workshop.*—This is to be a wood and iron building, 92 ft. 6 in. long by 41 feet wide and 16 feet high from the floor level to the eaves. Estimated cost 1,707

(*e*) *Quarters for Married Officers.*—These are intended to comprise one Senior Officer's house, a two-storied brick building of eight rooms, kitchen, &c., estimated to cost 2,425
and one Junior Officer's house, a two-storied brick building of six rooms, kitchen, &c., estimated to cost 1,984

(*f*) *Quarters for Married Warrant Officers.*—These will be single-storied brick dwellings of five rooms, kitchen, &c. Two separate designs are proposed. It is intended to construct five of the first design at an estimated cost of £1,465 each 7,325
and five of the second design, at £1,415 each 7,075

(*g*) *Water Reticulation and Fire Service.*—This covers the provision of a 12-in. main to convey the water required for the Base from the service reservoir to be situated about 2½ miles from the main buildings, the carrying of this water by smaller pipes to the various portions of the Base, the erection of fire hydrants, &c. It is intended that the pipes shall be all of cast iron, and of such a size as to ensure not only adequate water supply for the Base, but also sufficient pressure and volume for fire extinguishing purposes. Estimated cost 25,000

(*h*) *Sewerage Reticulation* covers the laying of sewerage pipes from the various buildings to the septic tank. It is stated that 90 per cent. of the sewerage will gravitate, while the remaining 10 per cent. will require to be pumped. This will necessitate the installation of two small pumps of the centrifugal type driven by electric motors automatic in action working by a float. The pipe will be of sizes varying from 4 inches diameter to 18 inches diameter at different points, and is to be of tested vitrified stoneware throughout, with the exception of a length of about 1,602 feet across a creek near the septic tank. As this length has to be carried on trestles, it is suggested that it should be of cast iron instead of stoneware. Estimated cost 12,750

(*i*) *Storm-water Reticulation.*—This is designed to provide for roof waters and discharges around the buildings into a number of stoneware or open drains, which will convey the water into Hann's Inlet. The piping will vary from 18 inches to 4 inches in diameter, and will be of good stoneware, but untested, in accordance with general practice. Estimated cost 7,300

(*j*) *Electric Distribution System* will provide for the transmission of power and light to the various buildings within the Base. It covers only the mains starting from the switchboard in the power-house and finishing at the distributing point of each building. The system of supply asked for is direct current, at 460 or 230 volts. All cables will be hard-drawn bare copper cable, carried overhead on round wooden poles. Provision is made for 63 street lights, consisting of brackets attached to poles carrying the overhead wires. Estimated cost 16,200

(*k*) *Accessory Works*—

Gymnasium	840
Stoker's School	428
Signal Tower	285

It is intended to utilize the existing buildings of this description now at Williamstown, and the amounts mentioned are the estimated costs of removing and re-erecting the buildings at Flinders.

Roadways and Footpaths.—This comprises the making and forming of roads within the Base proper. It is proposed that they shall be constructed of 3 inches of ashes, 6 inches of spalls, and 3 inches of metal, or, in the event of ashes not being obtainable, with 9 inches of spalls and 3 inches of metal.

The footpaths projected give complete access to the buildings already erected and those to be erected in the immediate future. The main road is to be 24 feet wide, and the less important roads somewhat narrower. Estimated cost 11,000

Steam Reticulation and Boiler House.—This involves the construction of a boiler house and the installation of two boilers, with space for three. The steam generated in these boilers will be used for heating water, which will heat the buildings, be used for cooking purposes, and provide hot water for laundry purposes and for use in the baths and lavatory basins. Estimated cost £16,720

Recreation Grounds.—This covers the provision of recreation grounds around the married quarters and comprises three tennis courts (including one for the Captain), a bowling green, and a croquet lawn. Estimated cost 1,500

Permanent Fixtures and Fittings comprise everything in the way of school outfit, desks, blackboards, &c., office furniture, and furniture and fittings for quarters and barracks. Estimated cost 5,000

Local Telephone Service.—The equipment is designed as an automatic independent service not connected with any Government lines, and will be able to take up to 100 instruments. It is intended that the telephone wires shall be run overhead, and can be carried on the electric light poles. Estimated cost 2,700

Fencing.—This covers the provision of cyclone fencing and gates for the Captain's house, Senior, Junior, and Warrant Officers' residences, and the recreation ground at the married quarters—a total length of 183 chains of fencing, 24 double gates, and 27 single gates. Estimated cost 700

Laying out Grounds and Cleaning up generally.—This is designed to cover the levelling of ground between the various buildings, various fillings where necessary, and general tidying up. Estimated cost 1,700

Electric Clocks covers the provision of one turret clock, with one 5-ft. dial and 2-cwt. bell and mechanism for striking ship's time ; also eighteen electric clocks in other buildings. It is assumed that the wiring can be run on the overhead electric light poles. Estimated cost 725

Fire Alarm Installation provides for twelve fire alarm pillars similar in type to those installed in the streets of Melbourne. They are to be divided into two closed electrical circuits brought to a fire exchange. The exchange equipment will consist of necessary line testing equipment, relays, gong, and registering punching mechanism. Estimated cost 700

General Excavations is a lump sum assumed as being necessary to cover minor excavations, &c., outside such buildings as junior married officers' quarters, warrant officers' quarters, barracks, &c. Estimated cost 3,345

Contingencies 529

Total £168,845

COMMITTEE'S INVESTIGATIONS.

4. The Committee spent two days at the Base familiarizing itself with the lay-out, and inspecting the sites proposed for the various buildings. A careful study was made of the plans submitted for the various works, and, in addition to examining witnesses from the Navy Department and the Department of Works and Railways, evidence was also obtained where it was considered warranted from experts outside the Commonwealth service.

A Sectional Committee visited Williamstown Naval Depôt to inspect the workshops there and ascertain if any of the material of which such buildings were constructed could be economically utilized at Flinders.

In addition to the evidence taken by it, the Committee had at its disposal the evidence taken in regard to some of these matters by the First Committee before it lapsed.

COMMITTEE'S RECOMMENDATIONS.

5. After carefully weighing the evidence taken, the Committee arrived at the following conclusions, viz. :—

(i) *Workshops.*—If the establishment of the Base as a training centre and repair depôt is to give the maximum amount of usefulness, it is essential that the machine and fitting shop be provided at an early date, and the Committee is satisfied that the design suggested for the building in question is satisfactory. While agreeing with the immediate construction of the machine and

fitting shop, the Committee, however, is not impressed with the fact that any special urgency exists for the construction of the proposed boiler shop at the present juncture, as indications are that it will be some time before any considerable use would be made of such a building. In view, therefore, of the size of the structure to be provided for a machine and fitting shop, it is thought that one end of such shop might very well be used for what boiler work will be necessary, at any rate for some years. Attention was given to the height proposed and the material of which the buildings should be constructed. Claims were advanced that a steel-framed structure clothed with galvanized iron would lend itself more readily to alterations and extension when necessary, but the high cost of galvanized iron at present, combined with the fact that greater comfort for the workmen would result from a brick structure, which could also, if occasion demanded, be readily extended, influenced the Committee in favour of this latter material. It was represented to the Committee that it would not be economical to construct brick or concrete piers for a building of the height proposed, especially where provision had to be made to carry 30 and 35-ton travelling cranes ; it is, therefore, recommended that steel stanchions be used to support the roof and carry the travelling cranes. Some diversity of opinion exists as to the possibility of effecting some economy in construction by substituting hardwood for steel roof principals, as well as a saving of approximately 4 feet of wall construction, while giving the same clearance for the travelling cranes, and it is suggested that this matter be carefully gone into by the Departments concerned.

The resolutions passed by the Committee in connexion with this building are shown by the following extracts from its Minutes of Proceedings :—

(*a*) Senator Needham moved : That the workshop buildings proposed for Flinders Naval Base be erected of brick and to a height of 46 feet from floor to eaves.

Seconded by Senator Newland. Carried unanimously.

(*b*) Mr. Mahony moved : That steel stanchions be used to support the roof and carry the travelling cranes instead of brick or concrete piers.

Seconded by Senator Henderson. Carried unanimously.

(*c*) Senator Needham moved : That the erection of the machine and fitting shop and of the boiler shop as proposed by the Departmental plan be approved.

Seconded by Mr. Mahony.

Senator Newland moved as an amendment : That the Committee recommends the erection of the machine and fitting shop in accordance with the Departmental plan but does not consider it advisable to proceed with the erection of the boiler shop at present.

Seconded by Senator Henderson.

The Committee divided on the amendment :—

Ayes (7).	Noes (2).
Mr. Gregory,	Mr. Mahony
Senator Henderson,	Senator Needham.
Senator Newland,	
Mr. Mathews,	
Mr. Sampson,	
Mr. Sinclair,	
Mr. Laird Smith.	

And so it was resolved in the affirmative.

The amendment becoming then the motion, was put and carried.

(ii) *Temporary Hospital.*—The proposal to construct a temporary hospital to meet all needs until further experience will show the ultimate requirements of a permanent hospital commended itself to the Committee, which is quite in accord with the proposal as submitted.

The decision arrived at is shown in the following extract from the Minutes of Proceedings :—

Senator Needham moved : That the construction of the temporary hospital be approved as recommended.

Seconded by Mr. Mathews. Carried unanimously.

(iii) *Detention Barracks.*—While agreeing with the design and proposed construction of the detention barracks, the Committee is under the impression that the accommodation sought to be provided is much more than is likely to be required for some considerable time. As no adequate evidence was adduced to show the necessity for a building of this size, it is recommended that the proposal be reduced by approximately one-half.

The decision arrived at is shown in the following extract from the Minutes of Proceedings :—

Mr. Mathews moved : That the accommodation to be provided for in the Detention Barracks be reduced by one-half.

Seconded by Mr. Sampson. Carried unanimously.

(iv) *Armourer's Workshop.*—The construction of this building was referred to and passed by the First Committee in 1915, the estimated cost of construction on that occasion being given as £375. Consequently it was with some surprise that the Committee received this request for the construction of the building at an estimated cost of £1,707. The explanation received from the Navy Department was that the original request was for practically a replica of the armourer's workshop at Williamstown Naval Depôt, which in practice had been found to be cramped; also that with the change and advance in armaments the armourer now has to deal with a far greater number of items, and many of a much more complicated nature. In view of this explanation, the Committee agrees to the greater expenditure, but is of opinion that more foresight should have been shown when submitting the item in the first instance.

The decision arrived at is shown in the following extract from the Minutes of Proceedings :—

Senator Needham moved: That the construction of the Armourer's Workshop as proposed be approved.
Seconded by Senator Henderson. Carried unanimously.

(v) *Quarters for Married Officers.*—Although the designs of these buildings are stated to be satisfactory and to show no leanings towards extravagance, the Committee is not prepared to agree to the provision of quarters for the officers concerned at the prices estimated. While the Senior Officer's house passed by the First Committee in 1915 was estimated to cost £1,750, the building now proposed is estimated to cost £2,425. Similarly the Junior Officer's house, estimated in 1915 to cost £1,240, is now estimated to cost £1,984, and the Warrant Officers' houses, which were originally to be built of timber and iron at an estimated cost of £680, are now proposed to be built in brick at a cost of £1,415 in one design and £1,465 in another. When it is borne in mind that these amounts are for the houses alone, and that nothing is included for cost of land, lay-out of grounds, fencing, &c., the Committee is satisfied that, even allowing for the rise in the price of materials and labour since 1915, the cost is too great. It recommends, therefore, that the amounts to be spent for these houses be restricted to Senior Officer's house, £1,900; Junior Officer's house, £1,450; and Warrant Officers' houses, £1,200 in each case.

The decisions arrived at are shown in the following extracts from the Minutes of Proceedings :—

(*a*) Senator Needham moved: That the amount to be allotted for the Senior Officer's house be reduced from £2,425 to £1,900.

Seconded by Senator Henderson. Carried unanimously.

(*b*) Senator Needham moved: That the amount to be allotted for the Junior Officer's house be reduced from £1,984 to £1,450.

Seconded by Senator Henderson. Carried unanimously.

(*c*) Senator Newland moved: That the amount to be allotted for the Warrant Officers' houses be reduced from £1,465 and £1,415 to £1,200 in each case.

Seconded by Senator Needham.

Mr. Gregory moved as an amendment: That the amounts be reduced to £1,000.

Seconded by Senator Henderson.

The Committee divided on the amendment :—

Ayes (4).	Noes (5).
Mr. Gregory,	Mr. Mahony,
Senator Henderson,	Mr. Mathews,
Mr. Sinclair,	Senator Needham,
Mr. Laird Smith.	Senator Newland,
	Mr. Sampson.

And so it passed in the negative.

The Committee then divided on the original motion :—

Ayes (5).	Noes (4).
Mr. Mahony,	Mr. Gregory,
Mr. Mathews,	Senator Henderson,
Senator Needham,	Mr. Sinclair,
Senator Newland,	Mr. Laird Smith.
Mr. Sampson.	

And so it was resolved in the affirmative.

Day Labour versus Contract.—Considerable evidence was taken as to the relative advantages of carrying out Commonwealth works by day labour or by contract. For some years the Commonwealth policy has been to carry out most of its works by day labour, and the evidence of the opponents of that system tended to show that the result has been a slackening of effort on the part of the men and increased cost to the Commonwealth. On the other hand, the advocates of the day-labour system contend that the cost to the Commonwealth is no greater than

when a work is carried out by contract, but that the Commonwealth and the employees under the day-labour system reap the advantage of the profit usually made by the contractor. Further, it is contended that under a system of day labour the men work under more reasonable conditions, are not unduly harassed, and the result is that the work is carried out in a better manner. The Committee, however, felt that it could not ignore the fact that certain buildings already erected at Flinders have cost, in material and labour, over 60 per cent. more than was estimated. Furthermore, representatives of the Master Builders' Association of Melbourne stated in evidence that they would be prepared to erect the Warrant Officers' houses at a price at least 10 per cent. lower than that now estimated. After discussion, the Committee decided to recommend that for the erection of the Senior, Junior, and Warrant Officers' houses tenders be called. At the same time it is recommended that the Department of Works and Railways submit its tender for carrying out the work by day labour, and that the best offer be accepted.

The decision arrived at is shown in the following extract from the Minutes of Proceedings :—

Senator Needham moved : That the Senior, Junior, and Warrant Officers' houses be erected by day labour.
Seconded by Mr. Mathews.
Mr. Sinclair moved as an amendment : That tenders be called for the Senior, Junior, and Warrant Officers' houses, and that the Department be instructed to submit its tender for building the said houses under the day-labour principle.
Seconded by Mr. Sampson.
The Committee divided on the amendment :—

Ayes (6).	Noes (3).
Mr. Gregory,	Mr. Mahony,
Senator Henderson,	Mr. Mathews,
Senator Newland,	Senator Needham
Mr. Sampson,	
Mr. Sinclair,	
Mr. Laird Smith.	

The amendment then became the motion. The Committee divided on the motion in the same manner.
And so it was resolved in the affirmative.

(vi) *Water Reticulation and Fire Service.*—The proposed system of water reticulation and provision made to cope with possible outbreaks of fire generally commended themselves to the Committee. Evidence was taken in regard to the manufacture and cost of cast-iron piping and also as to the suitability of reinforced concrete pipes for water service. It was ascertained that the State Rivers and Water Supply Commission is using practically all cement pipes in connexion with the supplying of water to the Base, and is putting down reticulation pipes at Warracknabeal and connecting them with the mains in the usual way. It was stated that at present prices concrete pipes are probably not half as dear as cast-iron pipes, and there is every reason to believe they will be quite effective. In view of these facts, and of the high cost of cast-iron pipes at the present time, together with the difficulty of obtaining supplies and the possibility of delay, the Committee recommends that the reticulation be carried out wherever practicable in reinforced concrete pipes.

The decision arrived at is shown in the following extract from the Minutes of Proceedings :—

Senator Newland moved : That the water reticulation be carried out wherever practicable in reinforced concrete pipes.
Seconded by Senator Henderson.
Mr. Mathews moved as an amendment : That the pipe from the reservoir to the Base be of cast iron.
Seconded by Senator Needham.
The Committee divided on the amendment :—

Ayes (3).	Noes (6).
Mr. Mahony,	Mr. Gregory,
Mr. Mathews,	Senator Henderson,
Senator Needham.	Senator Newland,
	Mr. Sampson,
	Mr. Sinclair,
	Mr. Laird Smith.

And so it passed in the negative.

The Committee then divided on the original motion :—

Ayes (6).	Noes (3).
Mr. Gregory,	Mr. Mahony,
Senator Henderson,	Mr. Mathews,
Senator Newland,	Senator Needham.
Mr. Sampson,	
Mr. Sinclair,	
Mr. Laird Smith.	

And so it was resolved in the affirmative.

(vii) *Sewerage Reticulation.*—The only debatable point raised in connexion with the departmental scheme for sewerage reticulation was the question of crossing the creek near the septic tank, where the sewerage pipe will have to be carried over a distance of about 1,602 feet on trestles. Here the Department proposed to use cast-iron pipes, but, in view of the evidence obtained by the Committee in regard to the use of reinforced concrete pipes by the State Rivers and Water Supply Commission, it is satisfied that such pipes might with economy be substituted for cast-iron pipes at this point.

The decision arrived at is shown in the following extract from the Minutes of Proceedings :—

Senator Henderson moved : That reinforced concrete piping be used where the sewerage is carried over low-lying ground on trestles.
Seconded by Mr. Sampson.
Mr. Mathews moved as an amendment : That cast-iron piping be used in that place.
Seconded by Senator Needham.
The Committee divided on the amendment :—

Ayes (3).	Noes (6).
Mr. Mahony,	Mr. Gregory,
Mr. Mathews,	Senator Henderson,
Senator Needham.	Senator Newland,
	Mr. Sampson,
	Mr. Sinclair,
	Mr. Laird Smith.

And so it passed in the negative.

The Committee then divided on the original motion :—

Ayes (6).	Noes (3),
Mr. Gregory,	Mr. Mahony,
Senator Henderson,	Mr. Mathews,
Senator Newland,	Senator Needham.
Mr. Sampson,	
Mr. Sinclair,	
Mr. Laird Smith.	

And so it was resolved in the affirmative.

(viii) *Storm-water Reticulation.*—The proposal submitted by the Department was considered satisfactory, and agreed to.

The decision arrived at is shown in the following extract from the Minutes of Proceedings :—

Senator Needham moved : That the storm-water reticulation be approved.
Seconded by Mr. Mathews. Carried unanimously.

(ix) *Electric Distribution System.*—The Committee was much impressed with the evidence obtained from some of the leading electrical engineers in Melbourne and Sydney as to the advantage of an alternating current installation for a general electrical system, and also with the fact that the adoption of such system would effect a saving of approximately £6,000 in cable wiring alone ; still, in view of the emphatic declaration of the Navy Department that a direct current installation is essential for Naval requirements, the Committee felt impelled to agree to such system being installed. The Committee was also satisfied that an overhead system would be more economical and equally effective for the purposes of the Naval Base, but, in view of the evidence received from members of the Naval Board to the effect that it is intended to establish an aviation school at the Base, it recommends that the electrical wires be placed underground in hardwood troughs and bitumen in those positions where overhead wires would be considered dangerous for aviation.

The decisions arrived at are shown in the following extracts from the Minutes of Proceedings :—

(*a*) Senator Henderson moved : That a system of providing power and light by direct current be adopted.
Seconded by Senator Needham. Carried unanimously.

(*b*) Senator Needham moved : That the electrical wires be placed underground, in hardwood troughs and bitumen, in those positions where overhead wires would be considered dangerous to aviation.
Seconded by Mr. Sampson. Carried unanimously.

(x) *Accessory Works—Gymnasium, Stokers' School, Signal Tower.*—After careful consideration the Committee is satisfied that no good purpose would be served by leaving these buildings at Williamstown Naval Depôt, and as a saving would be effected by removing them rather than erecting new buildings at the Base, have agreed to such removal being carried out.

The decision arrived at is shown in the following extract from the Minutes of Proceedings :—

Mr. Mathews moved : That the Gymnasium, Stokers' School, and Signal Tower, at Williamstown Naval Depôt be removed to Flinders Naval Base.
Seconded by Mr. Mahony.

The Committee divided on the motion:—

Ayes (8).	No (1).
Mr. Gregory,	Mr. Sinclair.
Senator Henderson,	
Mr. Mahony,	
Mr. Mathews,	
Senator Needham,	
Senator Newland,	
Mr. Sampson,	
Mr. Laird Smith.	

And so it was resolved in the affirmative.

Roadways and Footpaths.—The Committee recognises the necessity of forming good roads to permit of ready access to the various activities of the Base, especially in wet weather, and, in view of the decision to eliminate tramways as originally proposed, excepting the tramway from the magazine to the jetty, and rely on motor traction for the Base, considers that such roads should be made suitable for motor service. It is recommended that, before the work be put in hand, investigations should be made to ascertain whether any material suitable for the making of the roads might not be available on the Base area or in its vicinity.

The decision arrived at is shown in the following extract from the Minutes of Proceedings :—

Mr. Mahony moved : That a system of roads, and motor transport in lieu of tramways, be approved, and, for this purpose, a sum of £11,000 be recommended for construction of roads, footpaths, sidings to wharf, and tramways from magazine to jetty.

Seconded by Senator Henderson. Carried unanimously.

Steam Reticulation and Boiler House.—After carefully considering the question of the class of boiler to be installed and the advantages of a high pressure as against a low pressure system, the Committee is satisfied that the system proposed by the Department is suitable for requirements, and recommends that it be adopted. It considers, however, that provision should be made to include the temporary hospital, which had not been decided upon when the scheme was first prepared.

The decision arrived at is shown in the following extract from the Minutes of Proceedings:—

Senator Needham moved : That the steam-reticulation and boiler house proposed by the Department be adopted, subject to its extension to include the temporary hospital.

Seconded by Mr. Mathews. Carried unanimously.

Recreation Grounds.—Although members of the Committee are unanimous in their views that ample facilities for recreation for officers and men and their families should be provided at the Base, considerable divergence of opinion exists as to the advisability of putting in hand the formation of tennis courts or bowling greens at the present time. Further, no complete scheme of recreation areas for the Base appears to be in existence, and in the absence of a general scheme, the Committee cannot agree to the expenditure of the amount proposed.

The decision arrived at is shown in the following extract from the Minutes of Proceedings :—

Mr. Mahony moved : That the amount of £1,500 suggested for recreation grounds be approved.

Seconded by Senator Needham.

Mr. Mathews moved as an amendment : That the item of £1,500 for recreation grounds, for which no definite plans and estimates were submitted, be eliminated.

Seconded by Mr. Sampson.

The Committee divided on the amendment :—

Ayes (6).	Noes (3).
Mr. Gregory,	Mr. Mahony,
Senator Henderson,	Senator Needham,
Mr. Mathews,	Senator Newland.
Mr. Sampson,	
Mr. Sinclair,	
Mr. Laird Smith.	

The amendment then became the motion, and Senator Newland moved as an amendment : That this Committee agrees to the expenditure of £1,500 for recreation grounds on the understanding that the amount is not to be expended until quarters are completed and occupied.

Seconded by Senator Needham.

The Committee divided on the amendment :—

Ayes (3).	Noes (6).
Mr. Mahony,	Mr. Gregory,
Senator Needham,	Senator Henderson,
Senator Newland.	Mr. Mathews,
	Mr. Sampson,
	Mr. Sinclair,
	Mr. Laird Smith.

And so it passed in the negative.

Mr. Sinclair, having previously given notice of a further amendment, then moved: That after the word "eliminated," in the motion of Mr. Mathews, be added the words "until a general scheme of recreation grounds be formulated by the Department."

The Committee divided on the amendment:—

Ayes (6).	Noes (3).
Senator Henderson,	Mr. Gregory,
Mr. Mathews,	Mr. Mahony.
Senator Newland,	Senator Needham.
Mr. Sampson,	
Mr. Sinclair,	
Mr. Laird Smith.	

The words proposed having been added, the Committee then divided on the motion reading: "That the item of £1,500 for recreation grounds, for which no definite plans and estimates were submitted, be eliminated until a general scheme of recreation grounds be formulated by the Department."

Ayes (7).	Noes (2).
Mr. Gregory,	Mr. Mahony,
Senator Henderson,	Senator Needham.
Mr. Mathews.	
Senator Newland,	
Mr. Sampson,	
Mr. Sinclair,	
Mr. Laird Smith.	

And so it was resolved in the affirmative.

Permanent Fixtures and Fittings.—Although complete details were not available for submission to the Committee, it is quite understood that a considerable amount will be required for fixtures and fittings in quarters, &c., before the buildings erected can be considered suitable for occupation. The Committee, therefore, approved of the expenditure of the amount proposed.

The decision arrived at is shown in the following extract from the Minutes of Proceedings:—

Senator Newland moved: That the amount of £5,000, proposed by the Department, be agreed to.
Seconded by Senator Henderson. Carried unanimously.

Fencing.—The details of the whole of the fencing which will be required at the Base are not yet available, and the amount of £700 asked for may be taken as covering only what might be called a first instalment. This amount the Committee agreed to.

The decision arrived at is shown in the following extract from the Minutes of Proceedings:—

Mr. Laird Smith moved: That the amount of £700 proposed for fencing be agreed to.
Seconded by Senator Needham. Carried unanimously.

Laying-out Grounds and Cleaning Up generally.—The work intended to be covered by this item is necessarily somewhat vague, but includes the making of approaches, levelling up between buildings, grassing, and sloping around buildings, &c. This work will, in the opinion of the Committee, be necessary, and is concurred with.

The decision arrived at is shown in the following extract from the Minutes of Proceedings:—

Senator Needham moved: That the amount of £1,700 proposed for laying out grounds and cleaning up generally be agreed to.
Seconded by Mr. Laird Smith. Carried unanimously.

Local Telephone Service.—The proposal submitted by the Department and concurred with by the Acting Chief Electrical Engineer of the Postmaster-General's Department commended itself to the Committee, and is agreed to subject to the wires being placed underground, as recommended for the electric distribution system.

The decision arrived at is shown in the following extract from the Minutes of Proceedings:—

Mr. Mahony moved: That the automatic telephone installation proposed be approved, but that the wires be undergrounded, as with the electric distribution system.
Seconded by Senator Needham. Carried unanimously.

Electric Clock Installation.—The proposal submitted by the Department was considered satisfactory, and agreed to subject to the wires being placed underground, as recommended for the electric distribution system.

The decision arrived at is shown in the following extract from the Minutes of Proceedings:—

Mr. Mahony moved: That the electric clocks be installed as proposed, but that the wires be undergrounded, as with the electric distribution system.
Seconded by Senator Needham. Carried unanimously.

Fire Alarm Installation.—The proposal submitted by the Department was arrived at after discussion of details with the Chief Officer of the Metropolitan Fire Brigades, Melbourne, and is agreed to subject to the wires being placed underground, as recommended for the electric distribution system.

The decision arrived at is shown in the following extract from the Minutes of Proceedings :—

Mr. Mahony moved : That the fire alarms be installed as proposed, but that the wires be undergrounded, as with the electric distribution system.
Seconded by Senator Needham. Carried unanimously.

General Excavations.—The particulars given in evidence as to the work this was intended to cover were altogether too vague to satisfy the Committee, and, in view of the approval of the expenditure of £1,700 for laying-out grounds and cleaning up generally, and the existence of an item of £529 to meet contingencies, the Committee decided that this item of £3,345 be not agreed to.

The decision arrived at is shown in the following extract from the Minutes of Proceedings :—

Senator Needham moved : That the amount of £3,345, sought to be provided for this purpose, be not agreed to.
Seconded by Mr. Sampson.

The Committee divided on the motion :—

Ayes (7).	Noes (2).
Mr. Gregory,	Mr. Mahony,
Senator Henderson,	Mr. Sinclair.
Mr. Mathews,	
Senator Needham,	
Senator Newland,	
Mr. Sampson,	
Mr. Laird Smith.	

And so it was resolved in the affirmative.

WANT OF CO-ORDINATION.

6. During the course of its inquiry, the Committee was struck by the lack of co-ordination between the Department of Works and Railways and the Navy Department, which has resulted in waste of effort and loss of time, and consequent loss of money to the Commonwealth.

A striking instance is furnished by the proposed electric installation. The Electrical Engineer of the Department of Works and Railways stated in his evidence that, when preparing the design for the electrical installation, a communication was addressed to the Navy Department on 8th January, 1917, asking for their estimate of the amount of power required for the various buildings, but no reply was received. Secondly, no intimation was given of the possibility of erecting civilian quarters to the west of the officers' quarters, which will necessitate the provision of additional cables or an additional circuit. Thirdly, estimates were prepared for an overhead installation, an underground installation on the solid system, and an underground installation on the " draw in " system, and submitted to the Navy Department in March, 1917, to indicate which system was preferred. No reply having been received by October, 1917, estimates were submitted to the Committee on the overhead system, and it was not until the Third Naval Member was under examination before this Committee that information was obtained that overhead wires in certain positions were considered dangerous to aviation, and the Navy Department wanted them placed underground.

Further instances might be quoted, but sufficient has been said to indicate that the Commonwealth is not reaping the full benefit of the talent available amongst its officers, and greater efficiency and economy could be effected by a freer interchange of thought between those officers who stipulate for the requirements of their Department and those who are charged with the duty of giving effect to the requests.

SUMMARY OF RECOMMENDATIONS.

7. Briefly summarized, the Committee's recommendations are—

(*a*) That the machine and fitting shop be put in hand at once ;
(*b*) That the boiler shop be not erected at present ;
(*c*) That the temporary hospital be erected at once ;
(*d*) That the accommodation to be provided in the detention barracks be reduced by one-half ;

(*e*) That the armourer's workshop be proceeded with in accordance with the amended design ;

(*f*) That the amount to be allotted for the erection of married officers' quarters be restricted to—

(i) Senior officer's house, £1,900,
(ii) Junior officer's house, £1,450,
(iii) Warrant officers' houses, at £1,200 each ;

(*g*) That tenders be called for the erection of the married officers' quarters, the Department submitting a tender to carry out the work by day labour ;

(*h*) That the water reticulation be carried out wherever practicable in reinforced concrete pipes ;

(*i*) That reinforced concrete piping be used for sewerage reticulation where the pipes are to cross low-lying ground on trestles ;

(*j*) That the storm-water reticulation be proceeded with ;

(*k*) That a system of providing electrical power and light by direct current be adopted ;

(*l*) That electrical wires be placed underground in hardwood troughs and bitumen in those positions where overhead wires would be considered dangerous to aviation ;

(*m*) That the gymnasium, stokers' school, and signal tower be removed from Williamstown Naval Depôt to Flinders Naval Base ;

(*n*) That the construction of roads, footpaths, sidings to wharf, and tramway from magazine to jetty be proceeded with ;

(*o*) That the steam reticulation and boiler house proposed by the Department be adopted subject to its extension to include the temporary hospital ;

(*p*) That the formation of recreation grounds be not proceeded with pending the formulation of a general scheme of recreation grounds by the Department ;

(*q*) That the provision of permanent fixtures and fittings be proceeded with ;

(*r*) That the erection of fencing as submitted to the Committee be proceeded with ;

(*s*) That the amount of £1,700 suggested for laying-out grounds and cleaning up generally be approved ;

(*t*) That an automatic local telephone service be installed as proposed ;

(*u*) That the electric clock installation proposed be installed ;

(*v*) That the fire alarms be installed as proposed ;

(*w*) That the amount of £3,345 suggested for general excavations be not approved ;

(*x*) That greater co-ordination be arranged between the requisitioning and the constructing Departments.

SAVINGS EFFECTED BY THE COMMITTEE.

8. If the recommendations made by the Committee are carried out, it is estimated that the following savings will result :—

(*a*) Omission of boiler house	£9,500
(*b*) Reduction of size of detention barracks	1,200
(*c*) Quarters for married officers	3,459
(*d*) Water reticulation—substitution of concrete for cast-iron pipes ..	7,000
(*e*) Sewerage reticulation—use of concrete piping in place of cast iron for 1,602 feet	200
(*f*) Omission of recreation grounds	1,500
(*g*) Omission of amount asked for general excavations	3,345
Total	£26,204

H. GREGORY,
Chairman.

Office of the Parliamentary Standing Committee on Public Works,
120 King-street, Melbourne, 8th March, 1918.

FLINDERS NAVAL BASE (POWER HOUSE, ETC.).

MINUTES OF EVIDENCE

(Taken by First Committee).

(Taken at Melbourne.)

WEDNESDAY, 31st JANUARY, 1917.

Present:

Mr. Riley, Chairman.

Senator Keating,	Mr. Finlayson,
Senator Needham,	Mr. Gregory,
Senator Story,	Mr. Sampson.
Mr. Fenton,	

Richard Arthur Marsh, Naval Civil Engineer, Department of the Navy, sworn and examined.

1. *To the Chairman.*—The plans before us have been brought under my notice. They were drawn by the Department of Works and Railways, formerly the Department of Home Affairs. We in our department made the preliminary sketches on which these plans were based. Some of the plans—the ground plans of the power station and workshop as now detailed—were not placed before us, but they were shown to me in the director's office casually a few days ago; they were not left with us for criticism. The Naval Engineer Constructor fixed the size of the buildings. The original design was very much more extensive than it is now. After preparing the first scheme for this building, the matter was dropped more or less for the time being. The Navy Department received information that we were desired to clear out of Williamstown, and the Naval Works were instructed to go into the requirements of a depôt at Flinders to give the same accommodation as at Williamstown. At the time these drawings were prepared there were 500 men at Williamstown, and that is the number that the proposed establishment is for. The machinery available at Williamstown is to be transferred. The engines at Williamstown are to be used for generating current for the wireless telegraph station. New power engines are, I understand, to be constructed at Cockatoo for the new establishment, and the machinery will be nearly all new. I understand that they are very badly equipped at Williamstown at the present time. The proposed buildings are for a sub-base for submarines and destroyers. Whether the class of machinery to be installed is to be solely for this purpose, or with a view to looking ahead for heavier and bigger work, is a matter for the construction branch. I am not a mechanical engineer, and machinery is out of my province. The proposals shown on the plans are those of the Naval Engineering Construction Department. The boiler shop is 119 ft. 6 in. long by 55 ft. 6 in.; that is the boiler-making shop. The sizes were given to us, and we do not criticise the requirements: it is for the engineering department to say what is to be done in the boiler shop. The Home Affairs Department do not ask us questions about the plant that is necessary, but build according to the requirements shown to them. The machine and fitting shop is 176 ft. 6 in. long by 65 ft. wide. This shop will be fitted with lathes, boring machines, and all the plant of an engineering workshop, with travellers overhead to remove loads from machine to machine. Then there is a power-house for generating current for power and light; that is the west wing of the building. I have not heard the requirements of the power station, as it is out of my province. The boiler shop is the east wing of the building near the wharf. On the wharf there will be a fixed crane to carry 25 tons, and this will be connected by railway with the engineering workshop and power station. The plans for these works have been before my department, and the lay-out is based on our original lay-out. Three years ago a committee was appointed by the Navy Board to ascertain and state the minimum requirements at Flinders Naval Base when the depôt at Williamstown was to be transferred. I was deputed to take the matter up with the various officers at the depôt, and from them ascertain the requirements. I laid all the requirements down, and the plans before you are based on those I made. They represent the minimum of our requirements. The committee I have spoken of consisted of Captain Gordon Smith, second Naval Member; Captain Stephenson, the Officer Commanding at Williamstown; and Mr. Fanstone, Director of Naval Works. The plans were subsequently altered and reduced—cut up in every way. We had definite instructions from Senator Millen, who was then Minister for Defence, to reduce the cost as far as we possibly could; and the minimum requirements were laid down and referred to the Department of Home Affairs for an estimate as to costs. The engineering shop and power station as originally laid down were very much less than now proposed. The first proposal was concurred in by the committee I have spoken of, and approved by the Board. The original length of the boiler shop was 104 feet by 30 feet, and the length of the fitting and turning shop was 212 feet by 60 feet; the remaining portion of the building was to be used as a power station. The power station originally was 62 feet by 52 feet, and the boiler room originally 44 feet by 22 feet, as against 36 ft. 3 in. by 23 feet. In the original proposal the boat builders' shop was to be where the power station is now proposed, but the boat building and carpenters' shop have

been removed to another site. The original proposal approved by the Naval Board was to construct a main building with one wing only, the west wing being left out; so that the new proposal is an increase on the original by one wing. The boat-building shop is nearly completed. According to the drawings the proposed buildings are to be steel frame, panelled in with brickwork, but this I do not think my director would recommend. A workshop should be a building that can be removed if necessary; and to that end it should be simply of steel covered with galvanized corrugated iron. I personally would not recommend the expense of erecting a steel building panelled with brick work. A steel building covered with corrugated iron would be considered a permanent one, and it could be enlarged or removed with comparative ease. The last style of building is cheaper than the other, and just as serviceable for the Navy Department; it is a question of economy. At Williamstown the buildings are of the old type of timber and iron, and some of timber alone. There is no definite time stated for our leaving Williamstown; that is a matter for the Board, and hardly within my province.

(Taken at Melbourne.)

WEDNESDAY, 21ST FEBRUARY, 1917.

Present:

Mr. RILEY, Chairman,

Senator Keating.	Mr. Finlayson,
Senator Needham,	Mr. Gregory,
Senator Story,	Mr. Sampson.
Mr. Fenton,	

Rear-Admiral Sir William Rooke Creswell, K.C.M.G., First Naval Member, Naval Board of Administration, sworn and examined.

2. *To the Chairman.*—I am First Naval Member of the Naval Board. I gave evidence before the Public Works Committee eighteen months or two years ago on the subject of the buildings proposed to be constructed at the Flinders Naval Base, and I am familiar with the plans for construction. I anticipated at that time that we should have 1,000 men at the Base within two years from that date. That anticipation has not been realized. One important factor controlling the transfer of men to the Flinders Naval Base is the difficulty of the water supply. We cannot put men down there until we are assured of a good water supply. If we had to accommodate only a small number, we might at a pinch make use of water supplied from the railway and tank water supplied from the roofs of the buildings. Another factor controlling the time at which it would be advisable to send men to the Base is the dredging work necessary. That is now getting on very well, and I anticipate that we shall have sufficient dredging done for the use of the Base, so far as at present required, within, say, twelve months' time. Previously, the urgent reason for removal from Williamstown was the demand of the State Government for the use of the land we occupy there. I believe that the demand is not so urgent now. At the present time, every possible man we can spare is away from the Commonwealth. All our work is centred in training so as to fill up such vacancies as occur and make up wastage due to the war. I am given to understand that it will be twelve months before we can expect the water supply. I think we have nearly 400 men, and the number is likely to be largely increased. Of course, the whole naval scheme, including provision for a gradual annual increase in numbers, has been thrown completely out of gear by the war. We have a number of men, but have not been able to get forward with training schools, and so on, as we should have been able to but for the war. There is not the same pressure for our removal from Williamstown that there was some time ago, and there is therefore not the same necessity for the early completion of the buildings at the Flinders Naval Base. At the same time, we should not like to be caught napping in any way. No one can say when the war is going to end, and we should like to be in a position to have our training establishment ready to take up their work when it does come to an end. As a result of the lessons due to the war, there may be considerable changes proposed in the character and number of units, for instance; and it may be considered advisable to add several branches of work to the work so far proposed to be undertaken there. We are not in a position yet to say how the flying section will turn out. It is very possible that we may have to deal with that matter. The flying section is neither on land nor on water, and in Great Britain they have clamoured for a separate Department and separate Minister. They are dealt with at present by a Flying Board; but that does not go further than approval of material and machines. The Board does not touch the actual working of the Flying Service. We have decided for the present to forego the construction of the hospital building by using one section of the present buildings as a hospital. Instead of going to the substantial cost of the main hospital proposed, on the other side of the Inlet, it is recommended by the Director of Medical Services that all that is necessary for the present will be to provide for a slightly larger local surgery, and use one of the present buildings as a ward for hospital cases. Generally speaking, my view of the place is, and always has been, that it should be the main place for the producing of trained human war material for the Navy in Australia. Sydney, because of its special advantages, has taken its place as most suitable for establishments dealing with ship-building. It would be most satisfactory if we could have the two alongside one another; but that would be impossible, because of the cost necessary to acquire anything like sufficient land for the purpose in the neighbourhood of Sydney. One of the most important features to be realized in connexion with the establistment of the Flinders Naval Base is the suitability of the climate for the purposes for which the Base is chiefly proposed. I consider that we can get 50 per cent. more work out of men, and with less fatigue, at Westernport, than we could get from the same men in almost any other locality that might be selected. Climatic conditions at Jervis Bay are good, and the necessary land might be available there, but the climatic conditions at Westernport are pre-eminently fine and bracing. At Jervis Bay, during a portion of the year, the climate is rather relaxing. You have no doubt read Admiral Henderson's report, and will know the part which he intended Westernport should play until such time as the Western Base at Cockburn Sound came into use. He meant it to be the main port of rendezvous and main exercising ground for the Fleet. We have added somewhat to Admiral Henderson's view of the place, and propose that it should be a big place of training for the men of the Navy. We shall have stokers and engine-room ratings, and training schools there for the whole of the Australian Fleet. It is not intended to go in for

the manufacture of torpedoes, or anything of that kind, at this Base. We have taken up a very considerable area of land at Westernport, under direct Admiralty prompting. When giving us advice, as they are always most ready to do, the Admiralty have urged upon us that whatever we did we should secure as large an area of land as was possible. What seems to-day to be absurdly in excess of requirements has been shown by experience to be likely within a very short time to be considered absolutely cramped. In support of this advice, the Admiralty sent us a chart showing by different colouring the increases which had become necessary in the Portsmouth dockyard from the year 1600 onwards. These seemed to be good reason for taking up a large block at Westernport; and, if it should be found later that some acquired is not wanted, it will not be a difficult matter to get rid of it to advantage.

3. *To Mr. Sampson.*—I anticipate that it will be from ten to twelve months before the dredging at Westernport will have sufficiently advanced to enable boats to come up to the wharf at the Base. There will be no shipbuilding or new construction at this Base. All docking will be done at Williamstown. The water supply is at present the principal factor controlling the occupation of the existing buildings; but I have said that for a small number of men sufficient water might be obtained at a pinch from the railway and from tanks supplied from the roofs of the buildings. Whilst the water supply is a matter of prime importance, I should prefer also to have the dredging done before we take men to the Base.

4. *To Senator Needham.*—We are at present at war, and all our efforts are otherwise directed than to the question of the immediate occupation of the Flinders Naval Base. We have now to accommodate 400 men, and expect an increase in the number. I cannot say when the number will be increased. We intend to forego the erection of the main hospital at the present time. That proposal has been made, and I believe has receive Ministerial sanction. Of course, it is only of a temporary nature, and, later on, should the full Henderson scheme be resumed, and Westernport become what it was intended it should become under that scheme, the hospital will be a very important item. At present it is not considered necessary to proceed with its construction. I should prefer to leave the question of the desirability of the construction of the power-house to be answered by Admiral Clarkson, or other officers called to deal with engineering subjects.

5. *To Mr. Finlayson.*—Admiral Henderson proposed in his report that Flinders Naval Base should be a training centre for the Western Fleet. We propose that it shall be a training centre for the whole of the Fleet. In the new torpedoes the range has been enormously increased, and for this reason I do not think it will be found possible, as originally proposed, to deal with their adjustment and repairs at the Flinders Naval Base. Admiral Henderson's recommendations include proposals for big training establishments in Sydney. I do not say that these proposals have been swept aside, but merely that they are not now being gone on with. With the exception of the main hospital building, all the works set out in the list you have shown me ought to be proceeded with. I should like to say, with regard to the detention barracks and gymnasium, that we explicitly asked the Department of Home Affairs that these buildings erected at Williamstown should be made up in sections and be transferable. It is somewhat unfortunate that that request was not complied with. I am responsible for proposing the ploughing which you have probably noticed at the Flinders Naval Base. The place was covered with ti-tree scrub, bush, and coarse blady grass. It seemed to me that if there were going to be a settlement there, some pasture would be necessary. I knew that if grass were to be sown, the land would have to be ploughed, and if it were ploughed we might just as well put a crop in. I considered that if the crop could be used for the feeding of army horses, the ploughing would pay for itself.

6. *To Mr. Gregory.*—I do not know whether there is any truth in a statement you bring under my notice that £300 was paid at the Flinders Naval Base as hire for one horse. That was certainly a very unwise arrangement, if it be true that it was made.

7. *To Mr. Finlayson.*—There is an amount set down for electric clock installation, and while I think that is necessary, it has struck me that the cost of the electric clock is very high. On the subject of the sewerage we are slightly at issue with the Home Affairs Department. They have placed their septic tank just half-a-mile away and dead to windward of the buildings. Theoretically, these septic tanks are supposed to be odourless, but experience does not bear out that theory. It was found at Middle Head that in the summer there was a very powerful smell from the Mosman septic tank, which empties itself about a mile to the south-east. I have asked the Home Affairs Department to put the septic tank as far as possible away from the buildings and select a more suitable site for it. There are always consultations going on between us and the officers of the Home Affairs Department. What we did on our side was to appoint a committee of officers to draft the whole establishment of the Base and submit the proposals to the Department of Home Affairs. Generally, they have been fairly well carried out. One matter that came up was with regard to the warrant officers' cottages, which are reduced in size by the Home Affairs Department by one room. If we could remove to these buildings in twelve months' time we should not be so crowded as we are at Williamstown. I have said that the pressure to remove from Williamstown has not been so marked of late; but you could refer to officers of the State Government on that point.

8. *To Mr. Fenton.*—When I previously gave evidence before the Public Works Committee on the subject of the Flinders Naval Base, pressure was being used by the State authorities for our removal from Williamstown, on the ground that it was intended to extend the State shipyard there. I believe a new manager has recently been introduced for the purpose of taking charge of the shipyard. Williamstown is quite lacking in the accommodation necessary for the training of the men of the Fleet. A wireless school will, no doubt, form a very important part of the work to be done at the Flinders Naval Base. I do not know that it is intended to increase the range of the station there at present. The present range is, I suppose, 500 miles by day, and more than double that distance at night. As a matter of fact, with the new appliances, the range may be said to be enormously increased. Before we had the new receivers we frequently picked up messages from ships north of Brisbane at the school at Williamstown, when the

Melbourne station could not get them. There is now no difficulty about having two or three wireless stations established close together, so long as they are properly organized and worked. Everything now depends upon the efficiency of the apparatus and the capacity of the operator. Wireless telegraphy should form a very important branch of the work done at the Flinders Naval Base. There will be torpedo and gunnery schools and a stokers' school established there. It will be necessary for us to be in a position to transfer from Williamstown very shortly after the arrival of the Fleet at the close of the war. It is possible that soon after the arrival of the Fleet our work of training will be doubled. Very likely a large number of time-expired men—who have been away from Australia for three or four years—may be inclined to take a turn ashore, and we shall be compelled to train men very quickly to take their places. I believe that we shall ultimately have a flying school established there, and at least, a branch of the Point Cook school. It would be a simple matter to fly from Point Cook to the Naval Base, and there could be no better alighting grounds than we have there. I think that the area we have there comprises just under 4,000 acres. As long as we have a Navy we shall require the buildings which are under consideration, and I should like to have everything in readiness in not less than twelve months' time. The new quarters would greatly facilitate our operations, and the accommodation would certainly be far better than we have at the present time at Williamstown. At the present time we often have to conduct drill on ground belonging to the Railways Commissioners, and altogether outside the Williamstown depôt, and there is no recreation ground for our men there. I consider Westernport a good harbor for naval exercises. There is good deep water, and the anchorage is a splendid fleet anchorage. If we could get the necessary water supply in twelve months' time, I should like everything at the Base to be in readiness for its occupation at that time.

9. *To Mr. Gregory.*—The engineers will be able to tell you what machinery it is intended to put into the engine-room or factory, which it is said is to cost £41,000. This does not come within my special province in the Department. I understand that it is intended that it should be built so as to be able, if necessary, to take to pieces a destroyer's boiler, or two or three of them, and put them together again. In working operations, it may be necessary to move one over another, and the provision to enable this to be done accounts for the height of the proposed building. There will be no manufacturing carried on here in the same way as at Cockatoo Island dock. All that will be done at the Flinders Naval Base is refitting and repairing. I was recently at Westernport, and inspected some of the houses for officers. No doubt, less expensive cottages might be provided for the junior officers, but, in my opinion naval officers should be provided with comfortable and properly built houses. It may be claimed that a lieutenant drawing from £370 up to £500 a year would find it difficult from his salary to pa as rent interest on £1,400 a year; but the question is not one to which I have given very close attention. I can only tell you what I think, and that is that, if you have a good officer, you should provide him with the best house you can possibly give him. The naval officer has practically no home life, and the positions filled by the officers at the Naval Base should be regarded as prizes given to those who have risen to some eminence and shown special capacity. They will deserve to be generously treated in the matter of the houses provided for them. Personally, I should prefer a one-storied to a two-storied building. I should apply that preference, as you know, to the whole of the buildings carried out at the Naval Base; but that matter was fully thrashed out, and a decision arrived at. On the subject of cost of these buildings, I may say that, generally, it seems to me that the estimated cost is a great deal more than is justified by the accommodation provided. I suppose that I am not singular in this respect, and that officers in charge of all Departments are to be found questioning the cost of buildings they require. My view may not be entirely justified, as I am not an architect or a builder, and cannot express an expert opinion on the subject. I think that we sent in estimates of what we considered should be the cost of the buildings for which we asked when our proposals were submitted to the Home Affairs Department. The Home Affairs Department considered that the accommodation asked for could be provided at a cost less than we estimated. They proposed modifications of our proposals in connexion with the barrack buildings. They pleaded that our proposals did not make provision for sufficient cubic space per man in accordance with legislation already existing governing the cubic space to be provided for shearers and others.

10. *To Senator Keating.*—The Home Affairs Department modified our proposals, and provided the modified proposals, stating that they would cost something less than our original estimate of what the accommodation for which we asked would cost. You can easily understand that that indicates the great trouble anticipated in dealing with the Home Affairs Department. The Department does not act as a contractor to carry out what you require to be done, but always has ideas of its own, which are submitted as improvements upon your proposals. I am certain that there are good grounds for the establishment of a separate construction department for the Naval Department. We have had conferences on the subject, and it has been our idea all through that we should do our own building work. The officers whom we employ to carry out marine works are, in addition to their special knowledge of marine work, perfectly capable of carrying out our general building works. It is my opinion that the Navy Department should carry out for itself such works as the Committee now has under consideration. I was not aware that the Post and Telegraph Department has for years made the same claim to be allowed to carry out its own works. The modifications and alterations upon original plans which are shown in connexion with these buildings is fairly typical of our relations generally with the Home Affairs Department. I cannot speak in detail of alterations which were made in connexion with the officers' quarters; but I know that in the case of cottages for officers of the lower rank, the Home Affairs Department provided for only four rooms where we had made provision for five rooms. I have said that my personal view is absolutely against the erection of two-storied buildings at this place, where it is entirely unnecessary to have regard to the ground space occupied. I should like to see all necessary works completed within twelve months' time, because I am told that that is the time within which our dredging will be completed. If the dredging were completed earlier, I should be glad to have all other work at the place done earlier also.

William Robert Swan, superintendent naval civil engineer, Department of the Navy, sworn and examined.

11. *To the Chairman.*—I am a senior civil engineer in the Department of the Director of Naval Works, and the officer immediately below the Director of Naval Works, who controls the department. I act for him during his absence. To a great extent I have to supervise the plans for the Flinders Naval Base. The Director is responsible for the scheme in our Department. Until December, 1915, Mr. Fanstone held that position. I acted from then until the end of September, 1916, at which time Mr. Settle was appointed I have no control over the machinery part of the works at the Base. Our department has to provide the foundations on which the machinery is to be placed, and the necessary cover in the shape of buildings for them. We have to provide the civil engineering works in connexion with all the other special departments. I have not been employed previously in any naval work or at any naval base. Mr. Fanstone had experience of that kind, being in the Department of the Imperial Director of Naval Works before he came here. Mr. Settle was in charge in some of the dockyards under the Imperial Director of Naval Works. I had experience similar to naval dockyard work in Singapore. We had six dry docks, one of which was the second largest in the world. We had also large engineering, and shipbuilding, and repairing shops. We also owned the whole of the available berthage for cargo vessels, and handled the cargo brought in or delivered on board of the vessels which came to Singapore. I first joined the company as superintendent mechanical engineer of the workshops department. Later, I became assistant general manager of the whole company, and later again a branch manager. Finally, I was in charge of the works of reconstruction involving an expenditure of £2,000,000. The Flinders Naval Base differs principally from the works of which I had experience in that there are many subsidiary departments involving the engagement of experts to deal with them. There is the construction department, which deals with all mechanical matters, and the repairs, maintenance, and building of ships and their machinery. That is identically similar to a department we had in Singapore. There is the naval store officers department, which is identical in many respects with what we had at Singapore. The differences begin principally in such departments as gunnery, torpedo, submarine specialties, wireless, and the handling and dealing with explosives and ships' guns, which come under naval ordnance and other special officers. Those matters require expert officers to deal with them. Nevertheless, engineering officers in our department are expected to have a very fair knowledge of the general principles of the requirements of each department. The King's Regulations under the Imperial Admiralty give a general outline of the particular matters which have to be understood, and directions how to handle them, and it is necessary that an engineering officer in our department should be generally conversant with them. The company with which I was connected at Singapore had to make provision to comply with certain Admiralty regulations. Singapore, although not a naval base, has always been regarded as a naval depôt, where the docking and repairing of vessels of the British Navy, as well as merchant ships, could be carried out. At Singapore we held certain naval stores, and were in a position to undertake Admiralty repairs. No single individual work at the Flinders Naval Base, but the Base as a whole, has come under my notice. I have no direct control over any of it. I have dealt with the wharf, which was first designed immediately before I joined the service, and has been modified since under my direction. It was originally nearly double the width. The departments that were going to use it, principally the construction or mechanical branch, whose duty is to supervise the repairs and maintenance of ships, asked us to design a wharf to carry a 25-ton travelling crane with a 50-ft. radius or overhang, to enable the heavy machinery and boilers to be lifted out of the destroyers, the intention being that the crane should travel the whole length of the wharf. The wharf was designed on those lines prior to my arrival, at an estimated cost of about £45,000. I drew Mr. Fanstone's attention to the fact that by having a fixed crane the wharf could be very materially reduced in size and cost. Fresh designs were got out on those lines, and approved, although the main features of the earlier design were adhered to. My idea was to bring the ship under the crane. In any case, if the machinery had to be lifted out of the ship it would still need to be put on to the truck to be carried to the workshop, as the crane could not take it there. The length of the wharf is now between 700 and 800 feet. A destroyer is about 250 feet long, and the submarines the Australian Navy had were less than that. No ship big enough to use the whole length of the wharf can go into the Base, but the original design was for a channel and basin, 25 feet deep, to accommodate the cruiser class. I fancy it was always in the mind of the late Director of Naval Works that possibly those vessels would require to come alongside. A shorter wharf could always be extended if necessary.

12. *To Mr. Sampson.*—The criticism of the character of the construction comes under my jurisdiction. My department has not seen the most recent plan for the power-house. We asked the Home Affairs Department to forward us a plan, but they informed us they had only a pencil drawing, which they had already forwarded to this Committee. During 1915 I was transferred from Victoria to take entire charge of naval establishments in New South Wales, and was there during the whole of that year as the direct representative of the Naval Works Department. I was at Cockatoo Island, Garden Island, and all the allied establishments. I do not feel justified in criticising the estimate of £22,000 for steel work for the power-house without going carefully into the matter.

13. *To the Chairman.*—I understand that all the plans have been before the Naval Board, and approved of. They have been submitted and resubmitted a number of times. The plan and outline came to our department in a sketch form. That was all that we were asked to advise in connexion with. What you have on the wall is the working plan based on the sketch plan submitted to us.

14. *To Mr. Sampson.*—From my experience I would say that a power-house to be constructed at an estimated cost of £41,000 was an extremely large establishment, but the estimate includes machine and fitting shop and boiler shop as well as oil fuel pump house. My experience is that you will rarely find absolutely favorable natural conditions at any port. A great amount of civil engineering works is usually necessary to make it adaptable in the best sense. Perhaps the situation of the Flinders Naval Base is not ideal if considered only in the light of repairing vessels, but other circumstances would modify that conclusion, due to the fact that it is

a large naval establishment for the entire training of the various arms of the service. The additional work necessary there, in the shape of harbor works, would perhaps be justified on that account where they would not be in other circumstances. I was seven months in charge of the establishment at Henderson Naval Base, and have been relieving officer at Flinders Naval Base, apart from my visits of inspection. I put in twelve months at all the naval bases in New South Wales. During the other portion of my service one of my principal duties was as inspecting officer to the Department to visit Bases and report progress and particulars. From my experience, I judge that a reasonably suitable situation in the southern portion of Australia is desirable for climatic conditions, and it is also desirable that an establishment of this kind should be somewhere near a large centre of population, to avoid extra cost in salaries and wages for the large number of civilians employed, to get near the labour market, and to ensure a supply of stores. The power-house should be put in hand with the least possible delay. It is desirable to have the Base established and in working order as soon as possible. I presume that until the war is over there will not be any great urgency, but the moment it is over, and the Australian Fleet returns, it will be necessary to have an establishment to carry on the training of the men. After the power-station is complete, and the Base is practically ready for occupation, it will probably take four or five months before it can be completely occupied, and the present establishment at Williamstown vacated. There must be an interregnum when both establishments will be partially running until the last portion can be removed from Williamstown.

15. *To the Chairman.*—The construction or mechanical branch, under Admiral Clarkson, is responsible for the requirements of the power-house and workshops. They specify to our department their requirements in the way of accommodation for their machinery and plant. The location of the building was decided in the first instance by a conference between the Director of Naval Works and the Third Naval Member.

16. *To Mr. Sampson.*—Our department is regarded as the professional advisory department on works matters of the Naval Board. Such matters as the character of the construction of the building are submitted to us for an opinion, and we make our recommendations on the whole of the particulars. We give our opinion on the question whether the construction meets the requirements of the Department requisitioning the service, and whether the type and method of construction are suitable and economical. The general lay-out, as a rule, is submitted by the Naval Board to the Home Affairs Department in the first instance. The Director of Naval Works Department, on the requisition of the construction department, makes an outline plan, and submits it to the construction branch to ascertain whether the general lay-out meets with their approval and requirements. A good deal of this is done by consultation with our Chief Draughtsman and their consulting or designing officer, as the case may be. When the Department requiring the service concurs with our outline plans, they are forwarded from the Naval Board to the Home Affairs Department to design the details of the structure. The construction of the building is left to the Home Affairs Department. We practically give them length, breadth, and depth. The next phase is the installing of the plant and machinery. The preparation of the foundation for these is regarded as a function of the Department of the Director of Naval Works. The construction branch inform us that they have so many machines to be laid down, and mark out the position where the machines are to be put. They give us information as to the weight upon the foundations, and any other particulars of that description. Our dement is then responsible for designing the foundations of sufficient strength to carry the machines, and we put them in. When the foundations are ready the construction branch places the machines in position, levels them up, and bolts them down. All I can pass judgment on is the design and character of the foundations. I make my recommendations to the Director of Naval Works. We have approved of this lay-out and the foundations, because they have been concurred in by the Department requiring the service. In this case the mechanical department went further than requisitioning us to design the building for certain purposes. They prepared plans in the first instance, and submitted them to us, together with complete specifications of the type of building they required. That was in the early part of 1913. The plans and lay-out for the Base have been very materially modified, principally by a committee of three, consisting of the Director of Naval Works, the Second Naval Member, and the officer commanding the Williamstown establishment. On the 7th May, 1914, they presented a report to the Naval Board, the idea being to modify and considerably curtail the first ideas in regard to the Naval Base. The committee dealt with the whole of the Base. The modification they recommended with regard to the power-house and workshops has since been approved by the construction branch, which was the requisitioning Department in this case. An officer in our Department was one of the members of the Committee. I have not come closely into contact with the designing work in this case. For more than a year and a half out of the four years I have been in the Service I have been absent in other States. The power-house was submitted to our Department for an opinion by the Director of Naval Works. I have not given that opinion, because I have not seen the full plan. Before I could give an opinion I should need to know the exact service for which the building was required. The engine-shop establishment at Williamstown will be transferred to the Base, and that will require housing, in addition to which I understand that certain machines have been placed on order to supplement what they already have. It is also intended that the boiler shop will handle the repairs of destroyer boilers and work of that kind. Mr. Marsh, the designing draughtsman of our Department, consults with the officers of the construction branch. He dealt with this particular subject. The lay-out for the senior officers' houses and the junior officers' houses has been before our Department for advice, and I understand that we made recommendations to the Board in connexion with them. The Department of the Director of Naval Works selected the position for the buildings, and settled the probable amount of accommodation that would be required. At that stage the matter was handed over to the Home Affairs Department for the details of the type of building to be erected. Those buildings are just as urgent as any other portion of the establishment, because when the place is occupied they will be necessary. They are certainly urgent, because I assume it will be possible to go into occupation of the Base early

next year. I believe the Base will be sufficiently far advanced by that time if all the necessary works are carried on regularly. The permanent water supply, in my opinion, will not be ready for from two to two and a half years, but no difficulty should be experienced in providing sufficient potable water for running the Base in the interim. The Home Affairs Department and ourselves have already provided potable water for a camp of 600 workmen at the base for the last two or three years. We estimated first that we could get water from Frankston by rail for 6s. or 7s. per 1,000 gallons, but so far it has cost us about 10s. Still, we think by modifying and improving the arrangements for taking delivery and distributing, we can bring the cost down to 6s. or 7s. per 1,000. We have a subsidiary reticulation, with the pipes ready to bring the water from the station right up to the Base. Our camp is situated immediately at the back of the barracks, and is all supplied and reticulated, and we can utilize that service for the seamen. I believe that we have to provide in the first instance for only 700 or 800 men at the Base, including both seamen and mechanics. The Base can be occupied for naval training purposes without the workshops if necessary, and we can supply that number of men with a temporary water supply if necessary at from 6s. to 7s. per 1,000 gallons.

17. *To Senator Keating.*—Admiral Creswell must have been mistaken in assuming that the permanent water supply would be ready in twelve months. Mr. Catanach in his report to the Naval Board mentions a period of two years, and we know they have scarcely started on the works yet. I minuted the dockets at the time that I considered the estimate of time and money a very hopeful one, and I still think so. The cost, of course, did not concern us, because all we have to pay is a fixed amount for the water. In New South Wales I was at the Bases at Jervis Bay, Port Stephens, and Sydney. Westernport has not necessarily a peculiar function among the Bases. The only difference, so far as Admiral Henderson's report is concerned, between the original requirements for the Flinders Naval Base and any other destroyer base, is that he anticipated that until the main or primary Fleet Base in Western Australia was ready for occupation, Westernport should be regarded as the Base for the western fleet. Since Admiral Henderson's report was made it has been decided by the Naval Board to make Westernport the main training establishment for the Australian Fleet. In that way it will differ from the Jervis Bay or Sydney Base. In view of climatic conditions, the more southerly the Base the better. I have not seen the Hobart Base, but the conditions there would very likely meet all the requirements I mention with regard to climatic conditions, nearness to population and the labour market, and supply of stores.

18. *To Mr. Fenton.*—I am anxious to see everything in readiness at Flinders in about twelve months time, so that the removal from Williamstown may be made without causing serious dislocation. I would not like to say that the Base cannot be occupied without electric light; it would be quite possible to use other forms of lighting for a time. Until the electric power is available the Base cannot be effectively occupied in its fullest sense. I believe it will take at least three years from the initiation of the water supply works until the water is fully available at the Base. In saying that, I am not considering the whole scheme, including supply to intermediate towns on the peninsula. The Base is the furthest spot which they have to supply. The Base supply will be dependent on two reservoirs, in addition to the service reservoir at the Base. I do not say that it is impossible for the State Rivers and Water Supply Commission to keep the promise they made to the Committee to have the water at the Base in eighteen months from the beginning of this year. I am merely judging by the usual way in which these things exceed the estimated time. Taking all possible interruptions into account, if the water is available in two years from the present date they will have done a most excellent piece of work. If the buildings and other features are available, the absence of the permanent water supply will not prevent the removal of some of the men from Williamstown to Flinders, but, of course, the water supply involves the sewerage. The earth closets which our workmen have used can be still available until the water is laid on. After four years' experience they have proved perfectly sanitary and healthy. The Home Affairs Department submitted to us their plans for reticulation for the water service, sewerage, and surface drainage, and we referred them back for more detailed information. All that work can be proceeded with in anticipation of the water supply arriving at a certain time, leaving very little to do when once the water arrives, beyond connecting up. The works, to be carried out systematically, should be ready at the time the water service is ready. Making a guess from general appearances, and the estimated cost of the work, *i.e.*, power-house and workshop, I should say it would take quite twelve months to complete the galvanized iron and steel work required. The obtaining of the necessary steel work is a difficult matter now. If it is bought regardless of cost, the time can be materially reduced, but if the material has to be imported—and I dare say a good deal of it would have to be—it might be quite nine or ten months before it arrived. I would like to see the buildings at such a stage that when the iron and steel work did arrive it could be put into position and the buildings completed. Our Department has constructed practically all the main and subsidiary roads, footpaths, and railways. The only question remaining is the small tramway service on a 2-ft. gauge, and we propose to carry that out as soon as the buildings are sufficiently advanced. The tramway would be operated by hand power. I do not think there would be sufficient traffic for any portion of it to require power haulage. There will always be a large number of ratings available at the Base for this class of work at no cost whatever. The whole of the works submitted to the Committee, including water reticulation, gymnasium, stokers' school signal tower, roadways and footpaths, steam reticulation, electric street main, hospital, permanent fixtures and fittings, detention barracks, permanent tramways, fencing, quarters for married and single officers, stormwater reticulation, local telephone service, sewerage reticulation, power-house and workshops, pumping house, recreation grounds, &c., are required, and should be placed in hand as soon as possible. As to quarters for married officers, the Naval Board informed the Home Affairs Department, in the first instance, as to the number required. They are included in the first section of the work. The additional twenty on the list supplied to me are not required. Up to the present the Department of the Navy have not expressed any desire for any addition to the first section. We have already dealt with this matter in a docket asking the Home Affairs Department for further information. The same remark applies to the item "single officers' quarters, extension for ten officers." If the list which you have shows

additional quarters for ten married officers, I think those figures are wrong. I believe there are no additions to the first section required. A commencement should be made with all the work within two months in order to have it completed in twelve months.

19. *To Senator Story.*—It is desirable to have a base in the south of Australia to be used for the larger vessels as a depôt until the Western Australian Base is completed. I have seen Port Lincoln, which has the greatest natural facilities of any harbor that I have seen in Australia, and I have been in a great many. No extensive dredging or harbor construction works would be required there. Certain departments dependent on electric current could not come into operation at Flinders until electric power was provided. There then remains the question whether the proposed power-house shown on the plan should be put up at once, or a temporary building, possibly a tin shed over a generating station, provided. The point is whether it would be worth the cost to put up a temporary establishment rather than to look forward a little, and spend a little extra now with the object of getting it back a little later. There is ample water available for all boiler and steam raising purposes, even if it has to go through a condensing or softening process. Drinking water would need to be brought from Frankston by rail, but there is an ample supply of ground water for general purposes. Its only drawback is that it contains a large percentage of magnesium salts, making it not only very hard, but with a tendency to cause dysentry. I quite agree that in view of the high price of steel it would be cheaper to construct some of the buildings of other material, such as bricks, with a roof of timber and tiles or slates. There should be no difficulty in designing a 60-ft. span roof of that kind for the power-house. I built a power-station 100 feet long, with two roof spans of 50 feet, at Singapore. We had about 2,400 horse-power installed. The building was entirely of brick, with steel trusses for the roofs, and tile roofing, and that cost only £25,000, including foundations for the machinery. Labour there is not materially cheaper on the whole, but materials were then considerably cheaper than they are now. The freight on Marseilles tiles from Europe to the Straits Settlements was 35s. per ton, practically the same as it was to here in normal times. My experience, extending over many years, is that engineers very rarely look far enough ahead to put down sufficiently large buildings or establishments in the initial stages, and this frequently involves large expenditure in additions and alterations very soon after the buildings have been occupied. I do not know exactly the amount of power proposed to be installed at the Base, but probably an installation of 500 kilowatts would be required. Possibly that could be condensed into a very much smaller building than is proposed, but one cannot say how much the requirements may extend in a very short time. The question is how much the building can be reduced to make a reduction in the cost worth considering. It would not be wise to make any reduction in size so far as the main features are concerned. The form of construction and type I have not had an opportunity of examining.

20. *To Mr. Finlayson.*—It is proposed to transfer from Williamstown to Flinders when the place is ready the whole of the workshops, the armourer's shop, the stokers' school, the gymnasium, and the plant and gear contained in the boat-building establishment. I believe the power-house, machine-fitting shop, pump house, boiler shop, tool room, and other buildings on the plan before the Committee are designed only to comply with the modified plan of the Base. On the question whether provision is being made in these buildings for extensions of the Base, it will be necessary to get information from Admiral Clarkson's department. The buildings are proposed to be erected with brick walls, with iron stanchions carrying a steel roof and galvanized iron roofing. Personally, I should not make a composite building; I should make either a brick or steel building; I should not insert the steel stanchions.

21. *To the Chairman.*—They are not necessary. I would carry everything on brick piers, with a panelling of brick in between.

22. *To Mr. Finlayson.*—I would not like to say, without going into the calculations, that brick would be cheaper than steel, but it would be cheaper to have either the brick piers alone or the steel piers alone than a combination of the two. In the cross-section of the power-house provision is made for a floor above the ground. That accounts for the height of the room. There is no intermediate floor in the machine shop or boiler shop, but the high roof in those cases is accounted for by the necessity for giving room for the crane. I assume the construction branch planned that as the minimum height of the gantry above the ground to give a clearance for the crane. The construction branch determine the height of the gantry girders. The construction branch control the selection of the machinery proposed to be installed in the building. It is desirable that the various buildings referred to the Committee should be proceeded with in such a manner as to have them ready for occupation in about twelve months. If they were not ready in twelve months, the only real disadvantage to which the Department would be put would arise in the event of the Fleet returning to Australia. If the whole Fleet unit, which is commissioned on a full war footing, were back in Australia, and we had no means of training the men, the probabilities are that we should have to let a lot of them go, or incur the expense of keeping the Fleet on a war footing in peace times. It was intended that Williamstown should be vacated on the 1st January, 1915. The State Government were becoming impatient, and a Joint Committee, consisting of State representatives and representatives of the Home Affairs and Naval Departments, went into the matter as far back as 1912 or 1913. It was agreed then that the Naval Board should vacate Williamstown by the 1st January, 1915, but the State would not object to a reasonable extension of time if there were material evidence that the Commonwealth intended to proceed with the work at Flinders. The war has altered the conditions, and it is just a question of how far peace conditions would justify the Commonwealth in continuing at Williamstown, especially in view of the fact that a large expenditure has been incurred at Flinders which might well be made use of as early as possible. I have been occasionally in consultation with the Home Affairs officers on a few matters connected with the Base, but not generally. Mr. Marsh has generally consulted with them in connexion with designs, and I think Mr. Bellamy has also been in consultation with regard to sewerage and water schemes. I must admit that in the early days of the Director of Naval Works Department, which only came into existence at the beginning of 1912, there was a good deal of emulation between the two Departments, but that has been reduced to an absolute minimum after four years. It is the policy of our Department as far as possible to carry out our own

works. We claim that the whole of the engineering, architectural, and construction works come under the control of the Director of Naval Works. It is so under the Imperial Government, and is laid down by the King's Regulations, but it is not usual for the Director of Naval Works Department of the Admiralty to do the actual construction work by day labour. He calls for tenders, and supervises the construction. I see no reason why a similar system should not be adopted here. If it is a question of day labour, the Home Affairs Department might tender for the work on that basis. I think the Commonwealth can afford to have two professional staffs in the Home Affairs Department and the Naval Department. There should be no necessity to actually duplicate the staff. There are in the Department of the Director of Naval Works certain special officers required only for naval work, and if there were other works to be done under the Naval Department for which the Home Affairs Department had the special officers required there is no reason why their services should not be availed of. At the Base, where both Departments are carrying on work independently of each other, there is necessarily a certain amount of waste and duplicated supervision. That is avoidable. If the two Departments would work together I do not see why one supervising officer should not be ample to look after all the work going on. He should be a naval works officer well acquainted with the requirements of the work for naval purposes. Naval works of all kinds should be under the control of the Naval Works branch. That system would avoid duplication, and should not lead to undue expenditure. I would not like to say that any particular work at the Base would be better if one branch had full control, but it could certainly be more economically done if the officer in charge of the Base right along had been allowed to supervise the whole of the work going on there when the Home Affairs Department came in. Our engineer was there, and was quite capable of looking after the whole of the work. There was no necessity to send a second man. The necessity to refer matters to the two Departments undoubtedly causes a certain amount of delay. The entire supervision and management of such a work as the Naval Base ought to be under the exclusive control of the naval branch. The actual carrying out of the work might be under the Home Affairs Department to-day or a contractor to-morrow. That matter is immaterial. The question of where economies could even yet be effected and duplicated supervision avoided I should like to be put before the Director of Naval Works, and possibly the head of the Home Affairs Department. There can be no doubt that both Departments are anxious to render good service and save useless expense. I have seen Commodore Gordon Smith's estimate of £820,578 for the complete scheme, not including machinery and equipment. The construction branch could give an approximate estimate of the cost of machinery and equipment, but I believe that we have since received a minute showing that that branch estimates the cost of power plant, machinery, and installation at £99,000.

23. *To the Chairman.*—There is no reason why the big concrete tank now at the Base should not be cleaned out and used as a storage for roof water. The only question is whether it can be done economically.

(Taken at Melbourne.)

THURSDAY, 22ND FEBRUARY, 1917.

Present:

MR. RILEY, Chairman;

Senator Keating,	Mr. Finlayson,
Senator Needham,	Mr. Gregory,
Senator Story,	Mr. Sampson.
Mr. Fenton,	

Joseph Risley Settle, Director of Naval Works, sworn and examined.

24. *To the Chairman.*—My appointment as Director of Naval Works dates from the 26th July, 1916, when I embarked on board the vessel at Gibraltar to come out here. I arrived at Fremantle on the 31st August, and have been in Melbourne since the 20th September. I am a Member of the Institute of Civil Engineers. I have visited Flinders Naval Base. I was there yesterday, but that was not my first visit. I do not know what is in the minds of the Naval Board in regard to the completion of this Naval Base. I have not approached the Board on the subject, but I have formed an opinion from the plans which were prepared before I arrived here. The plans seem to be complete in themselves, and they are to be carried out piecemeal as circumstances may require; that is, progressively. I assume that the scheme is already designed. The Home Affairs Department has dealt with the whole of the buildings. I have not asked the question because I have not felt the need to do so, but I assume that the buildings which have been provided for, are necessary for the complete scheme. I have had some experience of naval bases. I joined the Admiralty in 1894. I was employed in the head office at London for about twelve months; first on the Keyhand Dockyard Extension, and then for a short time in connexion with the Portland Boom defences. Afterwards the whole of my time was spent on the design of the Gibraltar works. I did not design the works; I commenced in the initial stages. I got out the preliminary design for what was called the first dock in Gibraltar, the existing mole extension, and also the preliminary design for the detached breakwater. Afterwards I had to do with the ordering of the plant and tools for carrying on the work departmentally, and finally with the initial design for what is now called the North Mole, which was then the commercial mole. That is a large mole with five jetties with varying depths of water. On the completion of these initial designs I proceeded in 1895 to Gibraltar as an assistant civil engineer. The total cost of that work was about £5,200,000. I left Gibraltar in 1907 on the completion of the works. I commenced my training under Sir E. Leader Williams, on the Manchester Canal. I designed the 600-ft. dock for the Manchester Dry Docks and Pontoon Company under Sir E. Leader Williams as consulting engineer, and I was senior assistant to the resident engineer of the Manchester and Salford docks. The whole of my training was acquired on the ship canal under Sir E. Leader Williams, from 1882 to 1894. I was right through the ship canal from its inception to its completion. This statement, I think, covers the whole of my professional training. I am asked to express an opinion as to the utility of the Flinders Naval Base. I think that the question could be better answered if I knew what was the definite policy of the Naval Board. That information, of course, I am not in possession of.

I am now informed that the policy of Admiral Henderson is that this is to be a sub-base for submarines and destroyers, and that it is going to be an important base for training men. Speaking generally, and not in any sense as an expert—because one requires to know its real administrative side before one can decide as to whether the buildings at the base are sufficient or not—I should say that it would fully meet a scheme with that object in view. In the first instance, we are dredging only a small channel, that is a channel 10 ft. 6 in. deep. This work is under my supervision. It is rather difficult to say when the work will be completed, because the turning basin is entirely dependent upon the delivery of the suction dredger which has been ordered from Messrs. Thompson, of Castlemaine. I should say that the cost of dredging the basin and channel will be about £25,000. That sum does not include the cost of the dredgers. It represents the actual working expenses of the dredging. I am fully conversant with the plans, but I had not seen previously the plan on the wall here showing the power-house, the blacksmith's shop, and the engineering shop. I think that the object in making this provision is not only for effecting repairs, but also for training the cadets. The cadets will come ashore there, and, of course, they will have the mechanical experience in the workshops. I think that the object in establishing the power-house is not only to provide the actual power required for repairing ships and other purposes, but also power for training purposes. I understand that the estimates for the works include an item of £90,000 for machinery, and that the machinery at Williamstown is to be removed to the Flinders Base. Why this large shop, and this amount of machinery, are required is a matter which does not concern the Director of Naval Works Department. So far as I have observed, I think the lay-out is suitable for a naval base. When the channel is dredged I think that it will suit all requirements up to what I understand are the final requirements, that is for torpedo destroyers. The proposed channel, with a depth of 10 ft. 6 in., will give ample facilities for destroyers to go up to the wharf.

25. *To Senator Needham.*—I have had nearly 34 years' experience in this class of work. I am quite conversant with all the works necessary for making a naval base. I have just seen the buildings which are being erected for married and junior officers; they are being carried out by the Home Affairs Department. I do not think a cheaper kind of building should be erected for the married officers. I understand that the buildings are going to be permanent. My view is that the idea of permanency should be an underlying principle in connexion with the design and execution of works for the Commonwealth. It may involve a large capital cost at first, but it is cheaper in the long run. I have no idea of the cost of the buildings. My opinion is that the whole of the works at the Naval Base should be carried out by one Department. I do not suggest that the Director of Naval Works should necessarily be the Department to carry out the Naval Works, *i.e.*, the whole of the works including the buildings. I think that either one Department or the other should deal with such works. I believe that, by that means, money and time would be saved. From Admiral Henderson's report I presume that Flinders Base is intended only for small craft. I think that it was necessary to build such an extensive wharf there, because destroyers are increasing in length, and to get at repairs it is necessary to give the vessels a berth alongside a wharf, not to have them double or treble berthed, as the case may be. If it was necessary to excavate a channel to drive some of the piles I should say that there was some reason for taking that course, but that reason I do not know. It is not the usual way to do the work. I am hardly in a position to say whether the design for the power-house is a proper one or not. I have just seen these plans here for the first time, and it is only by discussing the matter in connexion with the work generally that I know what the requirements of the power-house are. I am to some extent handicapped, but I have lost no time in trying to make myself acquainted with the whole of the facts, not only the facts which are apparent, but also those which are underlying. Whether a building of a cheaper design would not meet the demands within the near future for the work to be done there is a question of opinion. It is a question, one might almost say, of the individuality of the man who has designed the building. If he has £10,000 to expend in a building he will probably put that amount into the building, but if he finds that he can expend £15,000 in giving a more substantial building, he is wise in doing so. I am asked to say whether, in my opinion, it is wise just now to spend that amount of money on a steel-framed structure clothed by brickwork, and protected by a steel-framed roof with galvanized iron covering. The kind of structure which I would advise would be a steel and corrugated iron one. It would be much cheaper than the proposed building, and, I think, equally suitable. It would be every bit as useful. We only look upon the building as a shell, covering machinery. I understand that the training of artificers will be continued in the workshops ashore; but I do not understand it as the policy of the Naval Board; I have no information whatever as to what their policy is.

26. *To Mr. Finlayson.*—As Director of Naval Works I will be in full charge of such part of the works as is under the control of the Naval Department. I have made myself acquainted with Admiral Henderson's report. In regard to facilities, I should say that a good selection for a submarine base has been made of Port Western. I think that there will be no difficulty in establishing a Base there on the lines of Admiral Henderson's report. The dredging of the channel in the inlet is now proceeding under my supervision. The depth is to be 10 ft. 6 in. below low-water mark, and the width 120 feet at the bottom. The width at the top will depend upon circumstances. We are not particularly anxious about slopes; we generally allow them to stand at their natural inclination, but if we found them dangerously steep, or likely to go into the channel, we should certainly take steps to flatten them. The excavation of the material is fairly easy. I found yesterday and the day before that the dredger was working in rather a hard sandstone rock which at times drew up the dredger, but she broke through. So far as I can see I do not fear any need for blasting. I think that it will all be what we term free-getting material. I base that view not so much on the reports of borings as on what we term prickings along the line of the channel. The channel widens out to what we term a turning basin. The area of the turning basin is, approximately, 77,500 square yards, equal to 16 acres. It is about 1,200 feet long, and 600 feet wide, and the minimum depth is 10 ft. 6 in. In places we may have a depth of 11 feet or 11 ft. 6 in., it will all depend on the surge of the buckets. I have not dealt with the question of the cost of the original dredging. The maintenance of the channel and the basin at the

minimum depth will not be expensive. The cost of maintenance there, I think, will not be felt. There are no rivers coming in, but just two small creeks. Even the flood water which may come down from the land drained by the two creeks will be so small that I think the detritus in the water will be exceedingly slight. We shall have the natural scour: what is brought in will be taken out. The rise and fall of the tide is on an average 9 feet. It is the custom to allow the destroyers at a base to lie two deep at a wharf, but the boat which is under repair always lies next to the wharf. The accommodation provided at the main wharf will not be more extensive than Admiral Henderson stipulated for. It will accommodate six boats two deep. From what I know of Australian requirements, I should say that it is about the minimum accommodation which is necessary at such a base. I would not recommend less accommodation than that. As regards the character of the construction of the wharf I believe that in every way it will be suitable. I think that the preparation, the style of construction, and the methods of development arranged for will produce a suitable naval base.

27. *To Mr. Fenton.*—There was considerable dredging and blasting in connexion with the works at Gibraltar. Westernport, from a dredging point of view, is a very small proposition compared with Gibraltar. As a base for submarines, destroyers, and small craft, I consider that Hann's Inlet is a very favorable situation. So far as natural difficulties are concerned, the work could not possibly be done more cheaply. There are no natural difficulties at Flinders Base.

28. *To Senator Keating.*—The aggregate cost of carrying out the work at Flinders Base will not be less than what I have experienced elsewhere: it will be more. Suppose, for instance, that the work had to be carried out at Gibraltar, we would do it for very much less. Again, if it had to be carried out in the Old Country we would do it for much less.

29. *To Mr. Sampson.*—I think that Westernport is a very suitable site for a naval base. I believe that it is suitable for the carrying on of the work contemplated there. I am afraid that I am not in a position to say whether, geographically in relation to Australia, Flinders Base is in a suitable position. I know very little about the geography of Australia. I know Cockburn Sound, and I have been to Sydney and to Westernport; that is all I know of Australia. I should say, on the evidence submitted in the report of Admiral Henderson, the selection of Westernport as a site was a proper one. I am not prepared to state definitely whether it is better or worse than any other site. I think that it is an ideal place for a naval base. The erection of the power-house is necessary, and should be started at once. The power-house, I should say, ought to be in working order by the time the channel is cut through, so that any repairs of torpedo destroyers could be put in hand at once. I think it is highly probable that the power-house will be required in the near future. If there are destroyers, and they carry out periodical manœuvres, it is bound to be required. They must be kept in a high state of efficiency. I presume that it will depend entirely upon the close of the war. I think that all this equipment should be in readiness for use immediately peace is declared, if Westernport is going to be made a depôt for submarines and torpedo destroyers. These boats are always under repair. I am asked to say whether the erection of the officers' residences should be started at once. If the Naval Base and the Barracks are to be used for training purposes, it will be necessary to have officers there to train men to take charge. I am informed that a permanent water supply is not likely to be completed for eighteen months or two years. The provision of a water supply is only a very minor matter with regard to the occupation of the buildings at the Naval Base. The buildings are to be erected for a definite purpose, therefore, the minor matters should be pressed on to be completed by the time the buildings are finished. If an order is given that the buildings are to be occupied in fifteen months' time, I see no reason why a supply of water should not be provided. The object of the buildings is a national one, and that is to provide training at the earliest possible date; whereas the question of a water supply is a very minor one. I presume that water is there, and only requires to be carried down to the base by train, temporarily or otherwise. Suppose that the wharf is finished in six months' time, and that the base and the barracks are required for the Australian Forces who come back. If the water supply cannot be laid on to the buildings, they cannot be occupied. But my contention is that if it is decided that the buildings are to be occupied in a year, the water can be put on. I see no reason why it should not be done. I have not gone into the question of the permanent water scheme, but I think it is a very minor question. A supply of water is essential to the occupation of the buildings. At the present time we get the water down by train to Crib Point. If the war is over in six months, and seamen and others are required to occupy the buildings, I do not say that water should be brought down to the base regardless of expense. There are more ways of getting a supply of water than one. If the time is ripe for the occupation of the buildings, I think that every effort ought to be made to provide a potable water supply for that time. I have not considered how the difficulty should be got over, but I look upon it as a minor question altogether. It is a matter which the Director of Naval Works Department has not looked into, but I should certainly say that the difficulty could be overcome. If a water supply cannot be put on for eighteen months, I think that the erection of the officers' residences should be slowed down. It is of no use to complete the buildings to stand idle for six, or nine, or twelve months, until a water supply is provided. I am asked to say whether, if water could be supplied at 2s. per 1,000 gallons, under the permanent scheme, and at 7s. or 8s. per 1,000 gallons by train, the additional expense would be justified in order to secure the early occupation of the buildings. Under ordinary circumstances, I would say, "No," but I take it, sir, that in a case like that which you have cited, the circumstances would be extraordinary. I do not see why temporary condensers should not be put on. I think it is very probable that water could be condensed in sufficient quantity by temporary condensers, which would cost less than that. I should say that the question of the early occupation of the buildings is paramount. The other question should be a minor one in comparison with it. Before any men are put down at the base it will be necessary to have officers. Surely you would never think of putting men down there without officers, and, of course, the officers will need residences. We have not a separate dredging plant for every Naval Base

in the Commonwealth. The dredger, which is working at Flinders Naval Base now, and three barges, were brought from the Henderson Naval Base. All the plant was brought from the west with the exception of the tug, which was purchased specially for the tug work. The value of the dredging plant is £68,000. Shortly we will have the suction dredger which is being specially built for Flinders Base by Thompson, of Castlemaine, and the cost of that dredger will have to be added to the £68,000. The plant, of course, will be interchangeable; we can use it elsewhere.

30. *To Mr. Gregory.*—At Flinders Naval Base there are two authorities—the Home Affairs Department and the Naval Department. I would decidedly prefer to have one authority. I think that there is no doubt about it being more suitable. As Director of Naval Works I ought to say that the Naval Department would be able to carry out these building works better than the other. If the Home Affairs Department has the experienced officers I would say it has just as much right to expect to have this class of work to carry out as our Department has. Let the Department do the work which has the experienced officers. At the present time there are two resident engineers at Flinders Base, namely, one from our Department, and one from the Home Affairs Department. I should say that generally it does tend to greater expense in connexion with the works, but if I am asked to give specific cases I am afraid that I could not do so without going into details. I have not had sufficient time to go fully into the works done at the Flinders Base, and their expense. I have gone carefully through the plans. Generally speaking, I should say that the expenditure in connexion with the wharf down there has been justified. Of course, the work has been carried out under certain guiding principles. But as to what those principles are I have not been able to form an opinion on the subject or to get any information. I am not able to say what the machinery in the engine-room and workshop is going to cost. Our Department has no information whatever as to the machinery which the Naval Board intends to instal. That matter, I believe, would come under the Third Naval Member. The Naval Board merely tells the Director of Naval Works Department what size building they want. We have no idea as to what the machinery at the Naval Base is going to cost, but, perhaps, it might help if I give an explanation. The engineering branch know the machinery requirements for which they have to prepare. When they know the exact machines which they require the sizes are laid down on a plan from which they are able to get, approximately, the floor area. Once they have got that information they notify the department of Director of Naval Works of the floor area of the building which they will require for the machinery. We also obtain from them the height which the building has to be made. It is impossible for them to state in any preliminary inquiry the size of the building which they require. I have no idea of what the plant inside the building is going to cost. If we have the information it has come to us in quite a casual sort of way. I can give no information as to the inside of the building. We merely get our dimensions from the other departments.

31. *To Mr. Sampson.*—Speaking from memory, the value of the dredging plant at Henderson Naval Base is about £450,000, inclusive of the dredger on order, and the two new barges. It does not include the three barges and the dredger transferred to Flinders Base.

(Taken at Melbourne.)

TUESDAY, 27TH FEBRUARY, 1917.

Present:

Senator STORY, in the Chair;

Senator Needham,	Mr. Gregory,
Mr. Fenton,	Mr. Sampson.
Mr. Finlayson,	

Charles Edward Montgomery Whyte, Engineer Constructor, Navy Department, sworn and examined.

31A. *To Senator Story.*—All my experience has been with naval construction. I began at Palmers' Shipbuilding Yard, on the Tyne, and have been connected with Thornycrofts', Peter Brotherhoods', Vickers' Limited, and Thames Iron Works. When I first came to Australia I was for six months at Cockatoo Island. Subject to the approval of the Naval Board I am responsible for the class of machinery proposed to be installed in the power-house at Flinders Naval Base. What has been ordered is quite a small amount, nothing more than the mere outline of absolute necessities, such as turret lathes, capstan lathes, drilling machines, and a few small lathes and tools of that description. They are already on tender. I desired to put in some larger lathes but they have been cut out for the time being. When I commenced to arrange the machines I wrote to the depôt at Williamstown, and asked what they thought they would require when they would be moved to the Naval Base. They were my first consideration. They submitted a small estimate of such tools as I have named, but I was anxious to supplement their requirements with large machines. However, they have not been ordered so far. At present the machinery proposed for the Base is about 300 kilowatts, or 400 horse-power. It is intended to instal three reciprocating compound engines for the time being, allowance being made for a fourth. Each will have a capacity of 250 kilowatts. I consider that engines of this capacity are necessary. I am not familiar with the class of engines at Cockatoo Island. So far as I remember they were very scattered, and there were different units in different shops, but I believe that the plant they are proposing to put in there now is between 3,000 and 5,000 kilowatts. We do not propose to equip the boilers with automatic stokers. They have been arranged entirely from a naval point of view, that is to say, for educational purposes. If automatic stokers are installed a saving can be effected in modern power plants, but our boilers will be of the naval type, two of them being almost identical with the boilers in the *Australia*, and the third being an oil boiler similar to the boilers used in the destroyers. The object is to form a training school for stokers for the Navy. I believe that these boilers will give very average results. I do not think there will be any appreciable loss through not fitting them with automatic stokers. In any case, any loss of economy will be made up by the advantage of being able to train stokers. The top of the engines will be about 10 feet above the floor level. The height of the power-house, as shown on the plan, is 46 feet. The height of the machine shop and power-house has been designed to be the same as that of the boiler shop, which is so arranged as to permit of the lifting of a boiler of maximum diameter by a crane. The Naval Board decided to keep the buildings the same height all through. So far as I know it was a question of policy on their

part. I got my instructions from them to keep the buildings all the same height. This means an increased thickness of walls. I raised the point before I made my drawings, but I received definite instructions from the Naval Board that the buildings were all to be of the same height. In any case I would not reduce the height of the boiler shop. As it is it only allows for a 16-ft. boiler getting a reasonable lift out, and in a Naval Base we have to consider the greatest contingency. It is only right that plenty of room should be allowed for manipulating the boilers with the cranes. The power-house might be reduced in height, but I have not given any consideration to the matter, seeing that I was definitely instructed on the point. I would not be prepared to say that I would recommend that the height of the buildings other than the boiler shop should be reduced until I knew the whole of the reasons that actuated the Naval Board in giving their decision, though I do not see any necessity for having the rest of the buildings the same height as the boiler shop. If we were building an ordinary power station and machine shops, we might have them somewhat lower, but as far as I can remember the shops at Cockatoo Island are very high. Reasons which actuated the Naval Board might be the matter of ventilation and the cooling of the building. Low buildings get very hot, and it is an advantage to have a lot of air space. Future requirements might also have to be considered. Other stories may be put in later in order to have separate compartments. Some firms keep all their patterns upstairs, because if they are left out in the open they warp, and twist, and get out of shape. Some patterns take up a large space. However, these are matters to which I have not given consideration, because I received definite instructions that it was the policy of the Board to have the buildings a certain height. Tenders have recently been called for three dynamos to couple on to the engines, a balancer set for equalizing the current of the three-wire system, and a switchboard. That is all that is required at the present time in the power-house. The engines proposed to be installed will cost about £3,630. Two of the boilers will be Babcock and Wilcox boilers, and will cost about £13,500. The third will be a Yarrow boiler, and will cost about £6,250. I cannot give any idea of the cost of the auxiliary machinery. It has not yet been ordered. The Babcock and Wilcox boilers are of a large size, being of the same standard as the boilers in the *Australia*, slightly reduced to suit the lesser power. The Yarrow boiler will not be used necessarily for the power plant. It will be an oil boiler to be used for educational purposes. Beyond the machinery to be installed in the power-house there will be cranes on the wharf. The Works and Railway Department are dealing with them, and what they are to consist of I have not yet heard. There will be various other units in different parts of the building. The torpedo school will have a small machine, and there will be one or two machines in other places, but they will be nothing of importance. I made an estimate of the cost of a larger plant with a capacity of about 1,200 kilowatts. Some of the machines I was anxious to put in were very expensive, running to as much as £2,000 each. The total cost of machinery will run to £30,800 approximately. The portion already approved by the Naval Board will cost £8,000 approximately.

32. *To Mr. Gregory.*—I am a mechanical engineer. I provide the designs for any new plant under the direction of the Naval Board. In my opinion the building is not too large for a power-house. The Naval Base is to be established at Flinders for the purpose of repairing destroyers and small craft generally, and it is also to be used as a training school. I understand that the depth of water permits submarines and destroyers only to come up to the Base. The length of the boiler in a destroyer or submarine is about 10 feet or 12 feet, but tugs have cylindrical boilers of a greater length. That is why I have estimated that the boiler shop may have to deal with a boiler of 16 feet. No provision has been made for a second floor for the storing of patterns. At present there will be a large open space from the ground floor to the roof. I do not know what has guided the Naval Board in keeping the buildings all at the same height. If I were designing a workshop I would design it to meet my own requirements, subject to the limitations of space and height. For machine purposes the great height provided is not wanted. It could be utilized by having an upstairs floor for the storage of materials or for having separate shops. If it is not proposed to put in a second floor, I cannot say how the height can be utilized. It is waste space except in the matter of ventilation. If it is a question of cutting down expense it is not altogether necessary to have the full height in all parts of the building merely for the purpose of securing ventilation. The Babcock and Wilcox boilers are of the marine type. They are being built at Cockatoo Island. I have estimated that the cost of the machinery and plant ordered for the power-house will be £45,000. I have been in my present position for about eighteen months. The expensive machinery that I thought of recommending for installation consisted of turbine rotor lathes and a large lathe that would take a low pressure turbine cover. If the shop is to deal with the machinery of a destroyer it should be able to deal with all parts of it. Further, a lathe to do shafting work, rotor work, and large covers, with as large diameters as are required with the class of turbine used on destroyers, would be necessary. All this machinery would be needed for repairs. I estimate that the total cost of the plant and machinery for this sub-base will be £70,000.

33. *To Mr. Fenton.*—My experience has been in connexion with plants turning out material for naval purposes. It has not been in connexion with naval bases. The power plants that I have been connected with in England have, as a rule, been disconnected from the rest of the buildings; the boiler shops also have been built separately, and the walls have been built to whatever height was desired. To a certain extent a building for the housing of an ordinary power plant is sufficient without going to any great height so long as it gives protection from the weather and is generally secure; but all machinery should have a certain height above it for the working of the cranes, and to allow for crossovers. I was not called into consultation in an advisory capacity when this design was being set out. The first large design was set out by my predecessor before my time. It was a much larger plan, and I do not know why it was reduced. I could not tell exactly what orders I received when I took over the work, except that I was to get on with it, and provide a design in accordance with what was required. I made proposals to the Naval Board, and received my instructions as to what I should put down. Of course, I did not draw the plans entirely without consulting the Naval Board. It would have been a waste of time if I had done so. because the whole thing might have to be altered.

A design of that description is done more or less in conjunction with the Board. You get your preliminary arrangements as to the machinery, and to the size of the units, and make your drawings accordingly. The building as now shown on the plan consists of long machine shop with two wings housing the power plant and the boiler shop. In the final scheme the machine shop is to be extended, and a third wing built. The present design covers about two-thirds of what was originally designed. It was intended to put in considerably more machinery than is at present contemplated. The boiler shop must have high walls. It must be a sufficient height above the boiler to allow for the sling, and the hooks and tackle and the beams of the crane. After adding all these together, you must still increase the height by the height to which you have to lift the boiler. With a 16-ft. boiler you might allow 4 feet for the sling, about 3 feet or 4 feet for the hook and tackle and blocks of a 30-ton crane, and a further height of about 5 feet or 6 feet for the crane and crane girders. That would mean at least 27 feet to 29 feet. Thus, dealing with the largest boiler, you require to lift a 16-ft. boiler to a height of 10 feet you require at least a height of 37 feet to 39 feet. Thus, dealing with the largest boiler, there would still be from 7 feet to 9 feet clear above everything. It all depends upon the height to which the boiler has to be lifted. The same height is not required for the machine shop, but you must consider what machinery has to be dealt with, and the height of the crane rails. The height to which the material has to be lifted is the same as in any other shop, but, as a rule, machine shops are not as high as boiler shops or erecting shops. Very often an erecting shop is built in a pit in order to secure the necessary height, but that is in the case of establishments where high engines, such as marine engines, are built. There is nothing special about the machine shop to be operated at Flinders. It will be an ordinary machine shop. I am not familiar enough with Naval Bases in other parts of the world to say whether this building is constructed on the model of other buildings used for a similar purpose. The building as projected will not entirely take the larger plant I have spoken of. I have not had the opportunity of seeing plans of the building yet, as finally arranged by the Works and Railways Department. As a matter of fact, I am waiting for them in order to see how the machinery for the shops can be arranged. There will be plenty of room for the machinery for which tenders have been called. The two Babcock and Wilcox boilers are being made at Cockatoo Island. So far as I understand, the authorities at Cockatoo Island have got into touch with the holders of the patent rights, but I cannot say what the details of their agreement are.

34. *To Mr. Finlayson.*—I was asked to prepare the arrangement of the machinery, chiefly that for the power-house. I submit a plan showing the arrangement of the machinery and boilers in the power-house. As arranged, it will occupy a space of 90 feet by 51 feet. That is about two-thirds of the floor area of the wing. Three engines are to be installed leaving room for a fourth. The boilers will be sufficient for the additional engines. The machinery ordered has a capacity of about 300 kilowatts, but that does not include the experimental work, which will represent another 50 kilowatts, or the machinery outside, which is rather vague at present, but will probably consist of a refrigerating machine and odd machines in various departments which will have to be connected up. The engines are each of 250 kilowatts. One will not supply the whole of the power required, but the two will give 500 kilowatts, leaving a fair margin. The third engine is a spare one, to be utilized in the case of a breakdown in order that work will be absolutely constant. It will also enable an engine to be overhauled and repaired at any time without having to stop the work at the base. With the two engines there will be a reserve of about 150 kilowatts on the plant as at present ordered, but that makes no allowance for any cranes on the wharf. I am convinced that work will not proceed very far there before more machines will be needed. Of course, the plant will also cover lighting for the whole of the Base, including the work outside. The lighting will overlap. There will still be a reserve for immediate requirements. Future requirements will have to be provided for by the installation of a fourth engine, for which provision is being made. No provision is being made at present for some repair work that will be required on destroyers. If the Base is to be capable of meeting all requirements, extra machinery will be required, but the power installation at present provided will be sufficient to meet that development. The building had actually been arranged before I drew my plan for the arrangement of the machinery and power-house. I drew attention to the matter of the height of the walls, but I was led to understand that it was the fixed policy to keep them at the same height throughout. I found that the dimensions of the power-house were practically suitable for the arrangement of the machinery, but subsequently I had to slightly increase the width by 5 feet. This was due to the fact that I had no details of the plan drawn by the Works and Railways Department; I had only lines to guide me, and I could get no information from them as to the width of the stanchions. When, ultimately, I found that the stanchions were provided of a certain width, I found it necessary to shift the boilers a few inches, and, therefore, I increased the width of the building. The present dimensions take in the plant nicely. The Navy Department did not provide the drawing of the building. We merely arranged the machinery. We supplied the Works and Railways Department with an outline plan on which to make a start on the building, but we could not secure any further information from them. It was necessary for me to make some arrangement of the machinery, but I did not get from the Works and Railways Department their suggestions as to the arrangement of the building until my suggestions as to the arrangement of the machinery were nearly completed. However, I knew that things would be fairly correct. As a matter of fact, it was only a matter of increasing the width by a couple of feet. I did not see the actual drawings of the buildings as completed until I came here to give evidence. So long as I have the space that I require, and so long as the building is not too flimsy, and will not blow down, I shall be satisfied. There is no need for me to criticise the arrangements made by any other Department unless I find that the place is to be badly lighted or not too well ventilated. We supplied the Works and Railways Department with the measurements, showing the space we required, and all our plans were done from the original outline plan. If the Works and Railways Department were to submit their plans to us before they were finally approved, it would be an advantage. It was not done in this case. The power-house meets our requirements so far as height is concerned. The boiler shop meets our requirements, because it has been arranged to the size we require. I have no suggestions to offer in regard to it. I do not know that there is any particular virtue in

having the power-house and the boiler-shop connected with the machine and fitting shop, except that the leads to the various machines are shorter, and all the wiring is convenient to the machine shop. It is true that it only means a saving of a few feet of tramway or wire. So far as that goes, the power-house could be detached; I do not know that it will make a great deal of difference, but, in my opinion, the arrangement is all right as it is. I do not see any advantage in having the shops detached. On the other hand, when the shops are attached the work passes from one to the other, and the cranes are able to work in conjunction with each other and across each other. It is not necessary to have the crane rails at the same level throughout so long as one crane can work to the end of one shop, where the load can be picked up by the crane in the other shop. In that way the two cranes can work on the one lift. The plant proposed to be installed in the fitting shop is not of such a height as to require a big elevation in the walls of the shop. The height proposed could be reduced so far as the machine shop is concerned. Some firms keep their patterns outside. Patterns for cylinders are of such an enormous size that they must be kept out in the open. The Thames Iron Works had a very elaborate system of keeping their patterns, so that the valve patterns could be used over again. When you have hundreds of valve patterns, differing only in a few dimensions, it is very difficult to pick the required one out, unless they are kept on shelves and numbered. In the plan drawn out, there is reserve accommodation for the installation of the machinery that I suggest will be required in the future. The plant already ordered will not take up a great deal of room, but the larger machines, when secured, will take up a lot of room. The plant, as ordered, will take up about half of the available space. I have no idea how soon before that later machinery will be required. What is now on order is barely half of what will ultimately be required to completely equip the Base. It may be necessary to provide further accommodation for the additional machinery. It is hard to gauge the matter. One big rotary lathe may take 100 horse-power, which would be a third of the horse-power now being put down. On the other hand, you might get as many machines again in the shop not taking as much horse-power. If the drawings from the Works and Railways Department were made available to me, I could tell in a couple of days whether they were sufficient for our requirements.

35. *To Senator Needham.*—The matter of the cost of the building and the material to be employed is a question for the Naval Board, and not for me. The height provided is necessary for the boiler shop. If the extra height were to be used for the storage of patterns they should be stored above the power-house, and not above the machine shop. I merely offered the suggestion as a possible means of utilizing the height of the building. A Babcock and Wilcox boiler when in position is 14 feet high. I do not know the height of the workshops in which these boilers are made. The height in the boiler shop projected is required in order to meet the necessities of dealing with an abnormally big boiler. It was designed to deal with a 16-ft. boiler. I cannot tell any more than any one else can what will be the biggest boiler to be handled. The size of the boiler does not depend on the size of the vessel. Sometimes the smaller boats have the largest boilers. For instance, a tug will have one large boiler instead of two small boilers. We might have to deal with a 16-ft. 6-in. boiler. In designing the boiler shop you would not cramp yourself for a few feet. If you are to deal with a 16-ft. 6-in. boiler, and wish to lift it an extra 2 feet you would sooner allow for a little extra height than not be able to do the work. The boiler shop as designed is not too high. If the Government are not prepared to go to the expense of giving the height required they can say that provision is not to be made for handling more than a definite sized boiler. In that way the height of the wall might be cut down a few feet; but when one is designing a building to deal with big boilers ample space must be given all round. I have not gone into the question of whether the price to be paid for the boilers is reasonable. Of course, a Babcock and Wilcox boiler would cost considerably less in the Old Country. The matter of the price was not referred to me, but I can tell the Committee later whether the price I have mentioned is a fair one. It is the price as submitted to us from Cockatoo Island. I have no analysis of the water to be used there, but it appears from evidence given before the Committee that the water will be as good as that which is supplied in Melbourne. The boilers will get very close attention; they will have quarterly inspections, and all rules will be attended to. I merely designed the actual plant. The upkeep of it will fall upon the Base, so that really the question of the water to be used in the boilers does not come within my purview. I have been in the service of the Commonwealth for about five years.

36. *To Mr. Sampson.*—I have made provision for 1,000 kilowatts. That will be the maximum outlay on machine tools. It was left to me to fix the size of the units, and make a proposition. I estimated the power that was needed to drive the necessary machinery, and the total amount of power that would be required. From these two quantities I arrived at my unit. I arrived at my figure from the knowledge of the work that has to be done on the ships coming in. That information was not supplied to me; it was left to me to estimate it. All the repairs that come in go through my hands, so that I could estimate the work that is done on them annually. It cannot be estimated actually because each time a ship comes in there is different work to be done. All repairs are submitted to the Naval Board so that the information came to me automatically. The only experience I have had to guide me as to the volume of work that will be done at the Flinders Naval Base is the cost of the work in repairing each destroyer. Each vessel has its annual outfit, and the amount of work to be done in that direction gives some idea of what will be required at the Base. Taking the number of destroyers and the total amount of work that is going through, pipes to be renewed, fire bars to be supplied and manufactured, renewal of parts and so on, you get some idea, and a very accurate one, of the number of machines that will be required to carry out the repairs, because all refitting may be required in a great hurry. If we had only one boat to repair in twelve months we would not require all the power provided. The unit was fixed on the estimated amount of work to be done, and that estimate was based on what I thought was a fair figure calculated from the data of the repairs that I know have to be done. It is very difficult to say definitely what repairs are done each time a vessel comes in. I know from the work done by private firms in England where I have worked the amount of work to be done in repairing a vessel. If we were to build a destroyer at Flinders all the power to be provided would be required, and repairing every part of a destroyer at one time

is almost equivalent to building a vessel. As a rule, all the work on a destroyer cannot be done at once. It is a question of whether you can distribute the work to be done over all the machines. There is generally a lot of work that is required from one particular machine. If you have a number of destroyers in at the same time requiring refitting you can pick out the work from each vessel that you can do on each machine. If you have a number of fire bars to supply you can keep one machine busy on them for a long time. If the work is spread over all of the machines it would block all the drilling machines from doing other work that might be urgently required. The plant is designed to keep in repair the destroyer fleet that will be stationed at Flinders. I do not imagine that it will be capable of repairing the whole fleet if it is smashed up at the one time. It is designed to provide the number of machines necessary to run the ships. If you go to Williamstown and speak to the engineers they can tell you what engines they require, and what power they need. But they cannot do any more than they are doing. They are running full tilt all the time, though theirs is a very small plant. The plant ordered for Flinders is a very small one, such as turret lathes, drilling machines, and so on. It will not be hard to keep them busy. The drilling machines will be kept employed very easily on stock work, but when you put down lathes, and they are kept busy they take so much power. If you arrange your machine shop to do the average amount of work, you must put in the power to suit the machine shop. In designing the plant I referred to various other dockyards, such as the Taikao dockyard at Hong Kong, the Methyl dockyard at Fife, the Natal Harbor works yard, and the dockyard at Gibraltar, in order to get some estimate of the size of the plants in vogue. In each case the plant was over 1,000 kilowatts. At Hong Kong the capacity is from 3,000 to 5,000 kilowatts; at Natal it is about 1,000 kilowatts; but that is merely for harbor works to provide for coppersmiths, boiler shops, a smithy, and a foundry. There is no graving dock at Natal. We know definitely what repairs the destroyers need every year. We know the number of destroyers likely to be repaired at Flinders, and the number of submarines, and we estimate the requirements of the Base upon the knowledge of the annual repairs effected to them.

(Taken at Melbourne)

WEDNESDAY, 28TH FEBRUARY, 1917.

Present:

Senator STORY, in the chair;

Senator Keating,	Mr. Finlayson,
Senator Needham,	Mr. Gregory,
Mr. Fenton,	Mr. Sampson.

John Smith Murdoch, Architect, Department of Works and Railways, sworn and examined.

37. *To Senator Story.*—The plans of the power-house and other buildings at the Flinders Naval Base were prepared in the Department of Works and Railways. That Department was requested by the Navy Department to prepare plans of buildings to suit the mechanical requirements of the Navy. The Department of the Navy intimated its requirements, indicated the size and form of the proposed buildings, and requested the Works Department to prepare drawings in detail, together with an estimate of the cost of the buildings. The drawings before the Committee embody the ideas of the Department of Works for putting the naval requirements in to material shape, and the estimate before the Committee is that which has been prepared by the Works Department on the set of plans now exhibited. The material to be used in the construction of the buildings was left open to the Works Department, but the Navy Department has indicated the positions of certain steel stanchions, &c., that are requisite in connexion with the installation of machinery. Whether the buildings should be of brick, how thick the walls should be, and matters of that sort, have been left to the Department of Works and Railways. The ground plan of the buildings is in the form of a U. The largest building is a machine and fitting shop for the mechanical operations of the Navy Department. One of the wings contains the boiler-house, the power-house, the condenser pits, the tool-room, and the store-room. The annexe at the end of the wing contains the oil pump works. The corresponding wing, coming from the main fitting shop block, contains the boiler shop. The machine fitting shop is to be 170 ft. 6 in. x 65 ft., inside measurement. The interior size of the boiler shop is 190 ft. 6 in. x 55 ft. 6 in. The wing, corresponding to the boiler shop wing, and containing the boilers, tool-room, &c., covers the same area as the boiler shop itself. The height of the buildings from the floor level to the top of the walls is 46 feet, all the wings being the same height. In the power-house wing the coal bunkers, store-room and tool-room will not go up the full height of the walls. They are planned to go up only 24 ft. 6 in., so that over this particular area there will be a flat ceiling, which can be used for any storage purposes that the Navy may require. A suggestion which our Department has made is that a part of this flat area might be used for the storage of articles belonging to the functions of the power-house. Possibly it may be convenient to utilize the flat area over the store-room and the tool-room for the storage of spare parts and other articles directly connected with the machine and fitting shops. These two areas we propose to divide by a wire partition. The man in charge of the power-house will then be able to use the flat storage for the purpose I have indicated, while the machine and fitting shop can make use of the other half for its purposes, while at the same time there will be no communication between them unless it be effected by the unlocking of doors. The general walls throughout will be 11 inches thick, with the exception of the walls round the forced draught boiler, which will be under air pressure, and where the thickness of the walls has had to be increased to 14 inches. I may explain that the 11-in. walls are really 9-in. walls with a 2-in. cavity between, in order to prevent water coming in. This applies to the whole of the building, except where there are steel stanchions, where the thickness of the walls has been increased for buttress purposes to 18 inches. At the ends of the machine fitting shop the thickness of the walls has been increased to 27 inches. It is 46 feet from the floor to the take-off of the rafters, and the roof principals will come down and abut on the wall 4 feet below. The height in the centre of the building will be 49 ft. 6 in. The same travelling crane will not go right along the boiler shop to the machine shop. In the boiler-shop there will be a 35-ton crane, and in the machine shop a 30-ton crane. Our Department was instructed by the Naval Secretary as to the height of the buildings required. We

were informed that it would be necessary to have the machine shop that height. The lines of the buildings are exactly in accord with what was laid down for us by the Navy Department. We did not question what height the buildings should be. It is the combined opinion of our office that steel stanchions should be used with light brick walls. Personally, I would prefer to have a heavier brick wall, without the stanchions. However, the proposition is a difficult one. It must be remembered that, according to the plan, there is to be a wall 179 ft. 6 in. long and 46 feet high, with no intervening floors to stiffen it. The wind pressure on that wall will be enormous. If we assume that it will range from 40 lbs. to the square foot at the top, to nothing at the bottom, we will get an average of 20 lbs. to the square foot. To counteract the overturning tendency of that wind pressure we must have something very stiff. We secure that stiffness by the use of steel stanchions, which are also required to carry a travelling crane. But there is no reason why brick piers should not be made to serve the same purpose. For this particular height we calculated the sectional area of each pier at about 17 feet, or, approximately, 5 feet by 3 ft. 6 in. But if by any chance it were possible to lower the height of the building by say, 10 feet, I would at once recommend the substitution of brick piers for steel. If that were done, we should require a sectional area of about 13 superficial feet, or 2 ft. 6 in. x 5 ft. Off-hand, I think that the steel stanchions would be better than brick if the building is to be 46 feet high. But if the height could be reduced by 10 feet, I think it would be cheaper to substitute brick for the steel work. Certainly, it would be preferable to construct the building of brick, because all the expenditure would then be kept within the country, and we should not have to draw on the steel market—a step which it is desirable to avoid at the present moment. Whether the securing of the steel stanchions would materially delay the construction of the building, would depend on the stock of steel that is held just now. So far we have obtained fairly prompt deliveries of the steel that we have required, but how long that condition will continue I cannot say. The steel stanchions will not go up in one piece. After they reach the level of the travelling crane—that is, a level of 31 feet—the girder rail will be introduced, and subsequently a thinner section. It is necessary to have the steel stanchions to carry the travelling crane and to counteract the windage on the building. Brick piers would take up a little more room, but they would be quite as efficient, and, personally, I would prefer them. Our Department prepared these plans, which provide for steel stanchions and light brick walls as the best which could be designed for a building of this height. I am not altogether responsible for them; it is shared with the engineers of the Department. The construction of the roof opens up another avenue of discussion. The question arises whether something could not be devised which would be cheaper than a steel roof. Of course, a steel roof is a fine thing, but at the present moment it is very dear. I have gone into the question of what a timber truss would cost, and at a later stage I propose to lay before the Committee the saving which I think might be effected by substituting such a truss for a steel one. However, the saving would not be so much as one would imagine, because a steel roof in the form in which it is designed would assist considerably in counteracting wind pressure. By substituting a wooden truss we should not get the same wind resistance. The roof of the building is to be covered with galvanized iron. That is the lightest material that is available. All the other buildings at the Base proper are roofed with galvanized iron, and consequently the roof of this building would harmonize with them. The space between the stanchions is 18 ft. 6 in. in the machine shop. I have gone into the question of the cost of construction if corrugated iron were substituted for brick work. On the whole building the saving which might be thus effected is, roughly, £1,700, but whether it would be true economy to discard brick is doubtful. It is proposed to finish the inside brick walls in the boiler-shop and machine-shop with a lime wash. It would be a pretty big proposition to set up an iron building of the height that is proposed in a place which is subject to high winds, and this trouble would be considerably increased by the length of the walls. The two wings are a great help from the standpoint of wind pressure. The substitution of iron for brick does not appeal to our engineers at all. I suppose it is only natural for enginers to take an ideal view of machinery, and, seeing that this building will be filled with very costly machinery, they are of opinion that it should be constructed of brick, especially as it is not apparent that a very considerable economy would be effected by substituting iron for brick. Of course, the saving that would be effected by that substitution would be considerable in normal times. One of the naval engineers told me that the idea he had in his mind for the building was that it should be a lightly constructed one, which would be capable of being moved about. I cannot understand that view, because it seems to me it would be impossible to move a building which has a water circulating system, condensers, and engine-pits. If we once put the power-house on the site selected it will be there for all time. In reply to the statement made by Rear-Admiral Creswell in regard to the detention barracks and gymnasium at Williamstown, I wish to say that it is proposed by the Navy to erect a new detention barracks at the Flinders Naval Base, using a proportion of material from the Williamstown building. As to the gymnasium, the proposal is to demolish that building at Williamstown, and re-erect it at Flinders.

38. *To Mr. Sampson.*—The Navy Department gave us a general idea of the kind of buildings they required by means of drawings. Those drawings supplied details such as the lay-out and form of the buildings. They specified the size of the structure and the position of the supports in it. It is the desire of the Navy Department to construct all the floors themselves, and also the engine beds. The sub-division of the building as shown on the plan is in accordance with the lines laid down by the Navy Department.

39. *To Senator Needham.*—I do not apprehend any danger to patterns being stored above the boiler house because of heat. The saving of £1,700 which I said might be effected by substituting corrugated iron for brick in the walls of the building was not based upon a reduction in the height of the walls. I do not suggest that their height should be reduced. All I know is that we have been instructed by the Navy Department to design a building of that height, and I do not say that its height could be reduced at all. If, however, it were reduced by, say, 10 feet, an additional £2,000 might be saved, but whether it would be as suitable a building for the purposes for which this structure is intended I cannot say. My own view is that the building must suit the machinery which is to be installed in it. As I do not know what that machinery is, and as I have no expert knowledge

of machinery, obviously it would be wrong on my part to suggest that the size of the building should be altered.

40. *To Mr. Finlayson.*—During the preparation of these plans I had no consultation with the Naval officers in regard to the construction of the buildings. The naval officers asked us for the completed plans, but just at that time we were anxious to get the project before Parliament on account of the likelihood of men at the Base being displaced, and so the plans were sent to the Committee before they were actually completed. I cannot understand the constructing engineer of the Naval Department stating that he had experienced some difficulty in getting the details of the building, and that in several instances he had been obliged to alter the position of his machinery by reason of the style of building that had been adopted. All that I can say is that the placing of the machinery was given to us by the Navy Department, and that the building has been designed according to the plans submitted to us by the Navy authorities in every particular. I cannot express an opinion as to whether there is any virtue in having the three main buildings joined together. That is a matter for engineers to determine. I cannot see any objection to having the machine and fitting shop at a lower height than the other two shops. It would not be a monstrosity to have that portion of the building 10 feet lower than the other portion. Indeed, it would make for variation, and from an architectural standpoint would be an advantage. It would also relieve the wind pressure, and enable the Commonwealth to save a considerable sum in construction. If the height of the building be reduced by 10 feet, I would have no hesitation in recommending the use of brick piers instead of steel stanchions. I have already stated that the substitution of corrugated iron for brick walls would result in a saving of £1,700, and I believe that a reduction in the height of the walls would enable a further saving of probably £2,000 to be made. It will be quite possible for me to confer with Mr. Whyte, the constructing engineer of the Navy Department, before I again appear before the Committee upon the question of whether the machinery and fitting shop can be reduced in height in order to secure the advantages which I have pointed out. The Navy Department is itself undertaking the water circulating system for the condensers, as well as the construction of the engine beds, and all the floors of the building. Probably that is a wise policy for it to adopt, seeing that the Navy will be installing all the machinery itself to its own design. The floor construction is a matter which is closely related to the position of the machinery, &c., so that it is a sound proposition that the Navy Department should undertake the construction of the floors. These, I take it, will be of concrete, although a portion of them may possibly be of brick. Personally I like brick floors. They seem to last quite as well as concrete, they are easy to repair, and not so dusty. Our estimate of the cost of the building does not include the cost of the floors or of the engine beds, or indeed of any of the services which the Navy Department itself is to undertake. It simply provides for the erection of the shell. I am aware that the Navy Department desires the whole to be under its control, and there is something to be said in favour of that view. If I were a naval man I would probably take the same view myself. I have never seen the gymnasium and detention barracks at Williamstown. But I take it that they have been constructed in the ordinary way. I cannot say whether they were erected in such a fashion as to be removable in sections for re-erection at Flinders.

41. *To Mr. Fenton.*—I had a good deal to do with the building of the machine shop at the Lithgow Small Arms Factory, and, speaking from memory, I think that the height of its walls is some 13 or 14 feet. But the purpose of the machine shop at the Naval Base is of an entirely different character. I do not think we could have a machine shop at the Flinders Naval Base with anything like a similar height. At Lithgow, for example, they work with nothing heavier than parts of rifles, but I take it that at the Naval Base they will be handling huge parts of engines, boilers, &c., which will necessitate height. In the machine shop there the authorities will be dealing with the component parts of engines, and these parts will have to be moved about by means of a travelling crane. A considerable height of wall will therefore be necessary, but exactly what height I cannot say. There is no reason why the height of the walls in the machine shop and the power-house should not vary, speaking from a builder's stand-point. If the height of the walls could be reduced 10 feet I would recommend constructing them wholly of brick. I have already stated that my estimate of the cost of the buildings relates only to the items set out in our schedule. It does not include the cost of the condenser pits, the engine beds, floors, &c.

42. *To Mr. Gregory.*—Whether a portion of the works to be carried out at the Flinders Naval Base should be undertaken by one Department, and another portion by another Department is entirely a matter of policy. It might be more economical if all the works were under one control instead of being under dual control. The construction of the power-house is largely a matter for engineers, but that remark does not apply to the erection of other buildings. Great economy of time would result if the whole of the work was under the control of one Department. It would obviate much writing and criticism which is the cause of waste of time, but I do not know that a great deal of economy would result in the matter of staff. Of course, directness of working makes for efficiency all the time. I think that the staffs of both Departments are imbued with a desire to do the best they can for the country. The Public Accounts Committee, I understand, have inquired into the whole question of single and dual control, and have suggested that there should be unified control. If the Navy Department controlled the whole work of the erection of its buildings the same efficiency would be obtained so long as equally competent officers were employed. But it would have to engage another staff—that is, create an architectural staff. The plans now before the Committee were not submitted to the Navy Department. I have already explained that they were rushed before Parliament with a view to getting the Committee to report on the project during the recess. The Navy Department was advised that the drawings had been sent to this Committee, and could be seen here. This is the only set of drawings in existence. It is true that they have not been approved by those most interested in them—the Navy Department—but the details are exactly in accordance with the plans of that Department. Mr. Swan is in error when he says that—

> The power-house to be constructed at an estimated cost of £41,000 was an extremely large establishment, but the estimate includes machines and fittings.

The estimate of £41,000 simply covers the work

which the Department of Works and Railways has to carry out. Then Mr. Swan, in giving evidence before the Committee, said—

> The buildings are proposed to be erected with brick walls, with iron stanchions carrying a steel roof and galvanized-iron roofing. Personally, I should not make a composite building; I should make either a brick or steel building; I should not insert the steel stanchions.

That is not an axiom at all, because nearly every building that we erect is a composite one of steel and brick. I do not think that Mr. Swan quite means what is stated in the report of his evidence. I have already pointed out that the substitution of corrugated iron for brick walls would only result in a saving of, approximately, £1,700, and would not look so well. In years to come, it would require a lot of attention in the way of repairs, so that whether it would be true economy to use corrugated iron I cannot say. Personally, I would prefer to use brick. It seems to me that it would be more in keeping with a building which is to contain a lot of fine machinery, and, moreover, it would mean spending the money in our own country. If corrugated iron be covered with cement and oil, you can get almost an indefinite life out of it near the sea coast. But if it be left to itself it will be rusted out in twenty years. It would not be as dustproof as would be a brick building. From the stand-point of efficiency, I do not think there would be much difference between an iron building at the Flinders Naval Base and a brick building. But, of course, if an iron building were erected it would have to be lined with 5-8-in. boards. In view of the small additional cost, I would recommend the use of brick, but if the height of the walls could be lowered in the way suggested, I would recommend the substitution of brick piers for the steel work. I have no knowledge of the class of work which will be carried on in these workshops, but I assume that it will consist of repairing the engines and boilers of submarines and destroyers—in other words, of light naval craft. That probably would be about on all-fours with the class of work that is carried out in railway workshops. The average marine boiler in a destroyer would probably be a little more in diameter than would a large locomotive boiler. I have been through the Newport workshops, and I do not think there is any wall there which is 46 feet high. But the most complete railway workshops that I have seen are those at Ipswich, Queensland. Those workshops are built of brick. The new workshops in Western Australia are, I understand, very complete, but the walls would be under 30 feet high. There are other buildings to be erected at Flinders Naval Base besides those I have mentioned. There are further quarters for senior officers, for junior officers, and for warrant officers. But the only buildings now before the Committee are the additional houses for senior officers and for junior officers. I note that Rear-Admiral Creswell stated in evidence—

> I have said that my personal view is absolutely against the erection of two-storied buildings at this place, where it is entirely unnecessary to have regard to the ground space occupied.

All I know is that the Navy Department proposed two-storied buildings. The drawings of these houses have previously been before this Committee, and at that time the only plans in existence were those which had been prepared by the Navy Department itself. We have already completed a large number of buildings down there, and their actual cost, I regret to say, does not compare very well with their estimated cost. In December, 1914, all these buildings at the Naval Base were referred to this Committee, and an enumeration of them is given on page 24 of the Committee's report and evidence. On page 25, at the bottom of the letter submitting the list of these buildings, I informed the Committee—

> With regard to the buildings marked with an asterisk on that list, the estimates of cost have been prepared from sketch drawings supplied by the Navy Office, and the drawings indicate the accommodation suggested; but working drawings, which in all probability may embrace considerable modification of the Navy Office plans, have not yet been completed by the Department of Home Affairs, so that it is possible a final estimate of the cost of these buildings may vary somewhat from the amounts stated above.

At the time I gave that evidence the Department of Home Affairs had not prepared any drawings for the married officers' houses. A rough estimate had been made on the sketch plans submitted by the Navy Department, which were exhibited here, and which showed the accommodation required by the Navy. I pointed out that before working drawings could be made considerable correspondence must ensue between the Navy Department and the Department of Home Affairs. That correspondence took place, and certain modifications were made in the Navy plans. The same accommodation was kept, and the idea of having the buildings two story was maintained, except in the case of warrant officers' houses. But the general form of the buildings was materially altered. I have previously said that their actual cost exceeded the estimated cost. This is principally due to the general rise in the cost of building material. That rise has been rather severe at Flinders on account of its situation. Then, the payment of separation allowances and increased wages has helped to build up the cost. The price of timber has increased, as has also the price of all forms of iron. According to the calculations of our engineer at the Base, this increase in cost amounts to 26 per cent. Another factor which has tended to increase the cost of these works is that the sites selected for some of the buildings have proved rather unfortunate ones. Only the other day, when the Committee visited the Base, its members saw that in two of the houses especially, on account of damp ground, the foundations had had to be made very deep. At the time that I gave my evidence as to the estimated cost of the buildings, those sites had not been selected. Then, again, the overhead charges at the Base have been unduly high. By "overhead charges" I mean the staff keeping cost—the employment of cooks, and the running of the workmen's mess. These charges represent about 11 per cent. of the cost of the work. I am not aware of the exact figures, but a separation allowance has to be paid to the men employed there, under an award of the Court. I cannot say whether it is a fact that a number of men who live at Hastings, and drive daily to their work, draw 2s. a day extra, but I will make inquiries into the matter. I do not suppose that we are getting increased efficiency as the result of the payment of increased wages. Whether the daily output of plasterers and bricklayers is less or more now than it was ten years ago, depends, I think, upon their boss. I estimated the cost of the buildings which have already been erected at the base at £111,000, and I believe that this amount will be exceeded by a little more than 26 per cent. In my overhead charges I do not allow anything for the office expenses in Melbourne. But the individual services at the Base peculiarly belong to the work there, and ought to be charged against it. Probably we should require a bigger staff if the works were carried out by contract, but it is hard to say whether we should get more economical results. Nowadays, contractors look for big profits, but whether their profits balance the inevitable slowing-down which takes place on day-labour works, I

cannot say. I have always contended that they just about equalize things. The carrying out of works by means of day labour imposes great anxiety on the staff at the head office. Nevertheless, its members do their best whatever system is adopted. There have been one or two instances in which we have called for tenders, and in which the tenders received were so high that we have decided to carry out the works by day labour. This remark applies especially to Canberra, where I am informed engineering works carried out by day labour have cost well within the amount of estimates. I quite admit that a contractor will get more work out of the ordinary man than is given by a day labourer, but whether his profit does not eat up the saving thereby effected I do not know. I do not believe in the system of paying a contractor a percentage on the cost of the work which he is carrying out. That is wrong in principle, although it seems to be growing in favour with many people. In such cases incentive to economy is removed. I do not think it would be dangerous to have other than a steel building where there is so much vibration as there is in a workshop. The effect of adopting the wooden truss would be the lowering of the walls to 42 feet, which would give the same clearance as the Navy authorities desire. On the other hand, we would not get the buttress against the wind pressure which the steel truss provides, and consequently the section of the steel stanchions would be increased. A wooden truss would be designed to take the weight required. It would take its own static weight, and also the wind load, but it would not look so well. It would have to be composed of oregon.

43. *To Mr. Sampson.*—On 6th May, 1913, the following letter was forwarded to the Director-General of Works, Department of Home Affairs, Melbourne, by the Director of Naval Works:—

As requested, herewith are forwarded in triplicate prints of the undermentioned plans of workshops for Flinders Naval Base:—No. 3, structural plan of workshops; No. 4, roof truss, 60-ft. span; No. 5, roof truss, 50-ft. span; No. 6, details of columns for workshops.

On 3rd September, 1915, a letter was sent to the Naval Secretary, Melbourne, by the Director-General of Works, stating—

It will be necessary to take into consideration at an early date the provision of a power-house and power-house plant at the Naval Base, Flinders, and, as the matters of designs and construction will take some time. I shall be glad to be favoured with the views of your Department as to what accommodation and special features, if any, should be provided.

On the 30th November, 1915, the Navy Department furnished the Department of Home Affairs with plans giving details of the power-house and of the machine shops and boiler shops which had been referred to in previous correspondence. On that date the Naval Secretary forwarded a letter to the Director-General of Works, which reads—

With reference to your memorandum of 30th September, No. D.G. of W.V., 15/11/74, relative to the provision of a power-house and power-house plant at the Flinders Naval Base, I beg to inform you that the necessary data for the design of the power-house is now being obtained, and will be forwarded as soon as completed.

On 6th March, 1916, the Acting Director of Naval Works forwarded to the Director-General of Works, Department of Home Affairs, a letter stating—

With reference to the above building (particulars of which, together with site plan, have been previously supplied, see drawings B/26 and G.P./22), it has been decided by the Naval Board that the first requirements, shown on drawing No. B/43 attached, be referred to you for execution.

The above-mentioned drawing, No. B/43, supersedes drawing No. B/26, and shows modifications found to be necessary to accommodate the plant to be installed.

The portions coloured red on plan, namely—

(*a*) the circulating water culverts,
(*b*) the condenser pit,

are being executed by the Naval Works Department.

Subject to your concurrence, it is proposed that this Department should also complete the foundations for stanchions, from particulars to be supplied by you.

It will be seen, on reference to plan, that some of the stanchions are carried on the walls of the condenser pit. The foundations for these will require to be taken into consideration as the works proceed. I should, therefore, be obliged if you would forward me particulars of your requirements for these bases as early as convenient.

As it is proposed to omit all floors until the foundations required for the machines are completed, these items will be carried out by this Department as required.

The whole of the construction work, with the exception of supply and erection of plant, to be done by your Department.

On receipt of your reply requisition will be forwarded.

That is the plan upon which I have been working, with the modifications suggested by the Navy Department.

(*Taken at Melbourne.*)

THURSDAY, 1ST MARCH, 1917.

Present:

MR. RILEY, Chairman;

Senator Keating,	Mr. Finlayson,
Senator Needham,	Mr. Gregory,
Senator Story,	Mr. Sampson.
Mr. Fenton,	

Engineer Rear-Admiral William Clarkson, C.M.G., Third Naval Member of the Naval Board, sworn and examined.

44. *To the Chairman.*—All the dockyards and naval bases are under my control. I have seen the plans of the boiler shops, mechanical shops, and power plant. The complete plans have not been before me. Some years ago I had plans made showing the requirements. I do not know what has happened to those plans since, except that the total requirements have been materially cut down. As to when these shops will be required opens up a big question. We have to give the men a certain preliminary training; and it is very necessary to be in a position, almost at once, to give that training. That we are doing to a certain extent at Williamstown, but the arrangements there are very inadequate, and we should like as soon as possible to have efficient arrangements. We propose to install boilers; and the steam generated from these boilers we will use for driving the power plant and carrying out all the lighting of the depôt, and, in addition, the boilers will be used for training stokers. That opens up another question in regard to the boilers. It might have been thought that we should install all the latest appliances, such as mechanical stokers, for economy's sake; but these mechanical stokers cannot be used on board ship, and we require appliances which are used in ships, in order that the men may have proper training. Then we are putting in boilers there for oil fuel. That is not on the score of economy, but in order to train the stokers in the use of oil fuel, which is used on ships. Further, we propose to install appliances for testing coal, and we ought to have tanks and all sorts of other gear for measuring the water evaporated, and the coal burned, so that we may ascertain the true value of the different coals obtainable in Australia. This would enable us to come to some determination as to the best coal to be used for our ships. There is not a proper plant for that purpose in existence in Australia at present. New

boilers are being continually proposed, and some of them, as shown on paper, would appear to possess many advantages. We require a place at Flinders capable of taking in any boiler which might be invented or proposed, and which was thought sufficiently promising to build—a place in which boilers may be tested before being installed on the ships. It is necessary that we should do many of our own repairs, in order that we may give the men, who will eventually be on board the ships, a certain amount of training; and to do that we, of course, require workshops and machines. The propelling machinery used on board ships at the present day is special, and it would not pay the proprietors of private engineering shops to install such machinery and tools as are absolutely necessary for repairs. For instance, a lot of these cruisers and destroyers have very long propeller shafts, and there must be proper lathes for those shafts—lathes with an extraordinarily long bed. Such machines, at times, would not be earning interest on capital expenditure, and it would not pay private firms to install such machines in ordinary shops, because they would be used only at odd times, when we happened to require them. There are such machines at Cockatoo, but if ships were damaged outside the Melbourne Heads, it would never do to have to send them to Sydney to be repaired. It would be necessary to run in such ships quickly to Flinders, and do the repairs in a few hours, whereas to go to Sydney would occupy weeks. We have a very long coastline, and it is necessary to have repairing shops, at least, at two or three points on the coastline. These are our requirements, and no one knows how soon we may want them met; there are possibilities that they may be wanted soon. On the other hand, of course, it may be years before they are wanted, or they may never be wanted. It is purely a matter of policy how soon the dockyard equipment at Flinders should be provided. This, again, depends on the provision of the necessary money; and I know nothing about that. We, on the Board, feel that it would not be wise to put it off too long, and that is about all I can say. It does not, perhaps, matter how much we do of the work now so long as it is done on some settled plan which will allow of adaptation and extension in the future. It is not necessary to have the dredging, &c., complete at Flinders before we do a certain amount of training there, but to move before the fresh-water supply is complete is out of the question. The provision of that fresh-water supply, I take it, has been delayed; but I do not know anything about the matter. So long as you work on a plan, and the works are completed after a shift is made, that will suit the requirements of the Board. I should say that, for the time being, part of the machinery shops, fitting shops, and boiler shops could be cut out; this work can be delayed until such times as it is required. There is very little machinery in the workshops at Williamstown. There are one or two lathes and a few small machine tools, but really very little indeed. Most of the work is done outside by private firms, but those private firms cannot do it as it could be done at Cockatoo or Garden Islands. We propose to have a new plant installed in the machine shops, but I really could not give you any idea as to the cost. We are calling for tenders now for a great many of the tools, but these tenders will not be received until April, and I cannot give you an estimate from memory. I can, however, supply such an estimate to the Committee. The plan now before the Committee represents only about half of what was originally proposed. The machinery should be provided as soon as possible, as some machines are very essential. Machines such as I refer to are not in existence elsewhere in Victoria, and at any time we may be severely handicapped through not having such machines here. I do not think there would be any possibility of keeping a stock of shafts here. In former days, that used to be done to a great extent, but it does not work out. In very many cases you may have to alter a shaft. When a shaft comes out of a ship it may not be altogether condemnable, and a few alterations may make it good for several years to come. When you make these alterations, the spare shafts do not fit, and further alterations have to be made. Besides, if you are going to stock spares of everything, you will get together an enormous and costly accumulation which may be never required. It is not the modern practice to keep such things in stock. The machinery shop is absolutely necessary for the training of men and for urgent repairs. In view of the high cost of steel, I should certainly have a wooden roof, and would have corrugated iron at any cost. When you use bricks, you tie yourself up, so that you cannot make alterations. Nothing is settled, especially in regard to machinery, on war ships; and any shops provided for tackling machinery ought to give sufficient latitude for alterations without any great expenditure. It is absolutely necessary to have a travelling crane to carry 30 tons, so that boilers may be shifted from one part to another. It is quite usual to have shops of the kind at the height proposed, and, besides that, as the requirements may demand the re-arrangement of the shops at any time, it is foolish to tie yourself in regard to height. The dredging at Flinders Base is under the supervision of the First Naval Member of the Board, but I arrange for providing for the dredges and all the gear. One of the dredges at present employed is a bucket dredge, which delivers the stuff into hoppers, and by them it is discharged into the sea. A suction dredge is being built at Thomson's, at Castlemaine, and the pontoon on which it will be based will be built at Flinders. This dredge is to deepen the basin at the Base alongside the wall, and to pump the stuff on to the land, so as to reclaim part of the foreshore. The present dredging would not be sufficient to do all the work. At the start, I put in hand two dredgers for the work, but it was considered that they were more required at the Henderson Naval Base, Cockburn Sound. One of these has since been sent back, and is at work at Flinders; and I really think we might get another dredge to hasten the work there. I have no idea when the dredge at Thomson's will be completed; there has been tremendous delay. I should not like to say from memory what is the cost of the dredges employed at the different bases. The cost of the dredging of the channel at Flinders is not under my jurisdiction, but under that of the Director of Naval Works, who is under the First Naval Member of the Board.

45. *To Mr. Finlayson.*—I can supply a complete list of the machines for which tenders are now being called, but as to a list or statement showing the ultimate requirements, I am afraid that partakes rather in the nature of prophecy. As to what portions of the building should be erected now depends on what is going to take place in the future. Just at present we require very little, because nearly all the ships are away, and the number of men we can get into training is not very great. We desire to provide for what may happen in the future, and we do not know what may happen. The minimum requirements at present are almost nil, but three months hence we may require the lot very badly. Although the power ultimately required—at any rate, for some considerable time—is not more than 300 kilowatts, which is far from being the load of the two

engines, I still think that we ought to have a spare engine. There is a good reserve in the two engines of 200 kilowatts, but there ought to be a spare one; and three engines are the minimum. I am certain that the power-house could not be further curtailed; it has been curtailed already. I am anxious to have this power-house of galvanized iron, because it may have to be increased for future requirements. In the meantime, I look on the present plan as only sufficient for immediate requirements. As to the height and length of the machine and fitting shops, I can only say that I have seen hundreds of similar buildings, and I have inspected such places, all over the world. I have been sent specially to inspect buildings of the kind, and I do not see why the conditions here should be any different from those in Japan, America, Great Britain, France, or Italy. It is the usual class of construction for this class of shop. I should have an iron frame, and iron sheeting, as sufficient for our requirements. The height of 46 feet from floor to ceiling is not for the sake of uniformity, but for the sake of latitude in any future necessary re-arrangement. In my opinion, this height will prove essential in the future. I dare say that the cost could be reduced if the building were reduced in height, but that is not the question. My idea from the start was to design a building with the ultimate requirements in view; to add each part of the work necessary from time to time; and this, of course, would necessitate re-arrangement as the requirements grew. These re-arrangements will not be very costly, so long as we have not to pull the building down, and so on. In a brick building you have not the same latitude in re-arranging in order to meet requirements. I suggest that the erection of the boiler shops should be postponed for some time; there is no necessity to go straight ahead with that immediately. The power-house, however, should be proceeded with, and it would be quite sufficient for it to be constructed of steel frame and iron. In the future this building may not be used as a power-house at all, but may be used as a foundry, the power-house being removed somewhere else. It would be a great disadvantage to have these buildings separated. The economic way is to take the raw material in at one end and to turn it out at the other completed; and it is to secure that continuity of treatment that the buildings are associated. My idea is that the buildings should be constructed so as to make them easy of further development. As to an advantage in deciding definitely on the site of the power-house, bearing in view the heavy machinery to be installed, I should say that the power-house at present contemplated is situated in the best position for the present small scheme. However, with a larger scheme, and when things are completed, these conditions would not prevail. My suggestion, I think, would ultimately result in less cost. I cannot say whether the power ultimately will be provided from the present point or not, but I do not want a building of such a nature that, if it were necessary to shift the dynamos and other machinery, it would be necessary to entirely pull the building down and rebuild it elsewhere. You must not understand that I have a preference for a wooden-trussed roof; if you can get steel, put it in by all means. If we cannot get steel, however, why bother about it at present? In all probability the wood would have to be replaced, and it could be replaced with steel, if it were available at reasonable cost. The steel has the advantage of being easily removable if required.

46. *To Mr. Gregory.*—I have not seen the plans before now submitted to the Committee. I cannot tell from a rough glance whether the plans before you are as the Naval Board requires or not; but, so far as I can see, they show what we indicated as necessary. If you want an expression of opinion as to that, you must give us some time to look into the matter. I cannot tell you whether the plan for Flinders Base has yet been completed. There is no complete plan at present in regard to the Cockburn Sound works. I cannot give you much information about any allegations of extravagance in connexion with both these bases. The expenditure is on works principally, and such expenditure comes under Admiral Creswell. The Naval Board is responsible for recommending to the Minister the expenditure at the bases; but you ask rather a large question when you ask me whether I am satisfied with the expenditure that has taken place already, and I do not see that I should be called upon to answer it. The Naval Board is endeavouring to follow closely Admiral Henderson's report. In that report, Admiral Henderson recommends small workshops at Flinders Naval Base. We are making provision for fairly large workshops; but we must recognise that Admiral Henderson was not inspired, and could not know everything. You must not take all his words as sacred and in their literal meaning. I have shown you my reasons for installing the machinery, and I think those reasons are fairly sound. If Admiral Henderson had had more time to look into things, and had been more familiar with local conditions, he would have probably altered that recommendation, even to the extent of saying that very large shops were required. We must not look on his report as a Bible, actually inspired, and not to be departed from in any particular. In addition to submarines and destroyers, the Base will be used for repairing ships. The Base is absolutely necessary for this purpose, for we cannot depend for our repairing on Sydney, in view of the immense coastline we have to look after. At present, the channel has to be dredged to a depth of 10 ft. 6 in. to 11 feet, but it is suggested that it should be further deepened later. On this point, so far as I know, a determination has been come to, and the channel will eventually be deepened to take large ships. It is not now necessary, however, to take the ships right up here, for there is deep-water anchorage outside, and gear requiring repairs may be taken ashore. I do not know that the wharfage accommodation there is ample for big ships, and more than is required for torpedo vessels and submarines. If you get six destroyers and a number of submarines there, you require some wharfage accommodation, considering that each destroyer runs to about 250 feet in length. The Naval Board is responsible for the expenditure on these works, inasmuch as they propose the amounts which appear on the Estimates. The pile driving and the cutting do not come under my supervision at all; we have a Director of Naval Works, who has come from the very heart of things. I am afraid that, as a matter of fact, we have not been as careful in the past. The work to be done in the buildings is the repairing of boilers and engines as well. I should say the material handled there is in many cases considerably heavier than that handled in railway shops. Parts of the machinery of the cruisers are considerably heavier than anything to be lifted in a railway workshop, where, I should say, it is very seldom that it is necessary to lift a locomotive fully assembled. As to the height of the proposed workshops being 46 feet, I imagine that if you were to ask railway men, they would prefer a greater height to their shops than they have got. All I can say is that the height proposed is not as great as that of many workshops I have seen in other parts of the world. The proposed height is nothing out of the usual at all; in fact, I think, if you were to ask the people at Cockatoo Island

whether their workshops were too high, they would tell you that they could do with a little more height. The proposal is the usual thing, and I strongly recommend it. As to the dual control of the work at Flinders Base, I should not object to the Home Affairs Department doing the whole of it, so long as they paid some attention to our requirements. The trouble is that they pay no attention, or there is a disposition to pay no attention. They say to us, "We are going to do it this way," and the idea is that we have to put up with it—they ignore us to a great extent. It is impossible for any one to put down exactly his reasons for recommending this, that, or the other; to do so he would require to write a book, which, possibly, no one would read. I have no control over the present system of day labour there; I do not come in until the thing is finished. That is a matter for the Director of Works, who is under the First Naval Member.

47. *To Senator Keating.*—The height of 46 feet is not at all unusual; in fact, many such places are much higher. It is not fair to consider a proposition of this character in comparison with shops that have been in existence for a number of years; if those who have to use those shops now had their choice, they would probably ask for something very different. The height is determined to a large extent by the requirements of the travelling cranes. The articles carried by the cranes are boilers and parts of machinery, and we do not quite know what will be the type of machinery required for different ships in the future. Diessel engines are very much talked about, and it seems as if they were coming in. These engines are very high, and we would require sufficient height to erect them; and, not only to erect them, but sufficient height to get things over them. When you require to shift a boiler, and there are other boilers and gear in between, you have to get over the latter. I regard the proposed height as quite moderate for this class of shop, and I was rather surprised at the matter being questioned, especially in light of possible future requirements.

48. *To Senator Needham.*—The height the Diessel engine depends entirely on the power and on the design; these engines necessarily run into great heights. I consider the proposed height of the workshop as moderate, in comparison with that of shops designed for similar work in other parts of the world. You will see shops on the Clyde and on the Tyne a great deal higher, and doing exactly the same kind of work. We propose to install one Babcock and Wilcox boiler and one Yarrow; and if it has been said in evidence that the price of the former will be about £7,000, I should say that is out of the question; it cannot cost all that. If our Engineer of Construction, Mr. Whyte, said that, there must be something wrong about it. You tell me that the estimate for a steel and brick building is £41,350. At the present time steel is very expensive and difficult to get; but I do not think that should weigh altogether. I am against brick in any shape or form, but without going into the question I could not say whether my idea would prove cheaper than the one previously submitted. It would be outside my line altogether to give an estimate. We are going to train artificers in all sections of work; they will have to go through a regular course. We shall do all the repairing of ships, but we have no intention of making boilers or anything of that sort—repairing more than making. The policy I have in mind is one of preparation.

49. *To Mr. Sampson.*—The provision of the boiler shops, and a portion of the machine and fittings shops, might be postponed for this year. I regard the power plant, and that portion of the machinery and fitting shop adjoining, as the minimum amount of construction that should be undertaken at once.

THURSDAY, 8TH MARCH, 1917.

(Taken at Melbourne.)

Present:

Mr. RILEY, Chairman;

Senator Keating,	Mr. Finlayson,
Senator Needham,	Mr. Sampson,
Senator Story,	Mr. Gregory.
Mr. Fenton,	

William Montgomery Shannon, Chief Mechanical Engineer, Victorian Railway Department, sworn and examined.

50. *To the Chairman.*—As Chief Mechanical Engineer, I am in charge of the Newport Workshops. Before one can give an opinion as to the class of buildings required for the Flinders Naval Base power-house, one must consider the character of the work to be done there. At Newport, the machine shop, the erecting shop, and the boiler shop are all of the same height. The blacksmith's shop is lower. But at the Ballarat and Bendigo workshops, which are the most modern under the control of the Victorian Railway Department, all the shops are of the one height. We could have built the blacksmith's shop lower, but we wanted all the shops under the one roof, and it was not an economical proposition to lower the roof covering the blacksmith's shop. The height of the roof in the machine shop must depend on the character of the work to be done there. Presumably there will be overhead cranes at the Westernport workshops, and that means that you must have room to allow of the work being lifted to whatever height is required. The overhead cranes in turn require a certain amount of space, and those two considerations—the space for the cranes and the height the work is to be lifted—determine the height of the shop. At Newport we run the locomotives into the shops, and by means of overhead cranes lift the locomotive on to the pit road, from which it is afterwards lifted high enough to remove the wheels; should it be necessary the boiler is also lifted out and removed to the boiler shop. The Newport shops were built 30 years ago, and they do not altogether meet our requirements. The new shops at Ballarat and Bendigo are higher, and are designed to meet future developments. The height of the side walls at Newport is 26 ft. 6 in. I am referring to the erecting shop, which was built in 1888. It has what is known as a "hip roof." We should not erect a roof of that kind nowadays. What is required in Australia is a saw-tooth roof. At Ballarat and Bendigo the height of the walls is 37 feet. The runways of the cranes at Newport are 20 ft. 10 in. from the ground. There we use for lifting locomotives two overhead cranes of a capacity of 30 tons each, but our locomotives are increasing in size, and 30-ton cranes are hardly powerful enough for our requirements. At Ballarat and Bendigo we have installed two 50-ton cranes, because we can see that locomotives will be heavier in future. I may explain that the runways, which are 27 feet from the ground at Ballarat and Bendigo, are the rails on which the cranes travel, and they have to be built, usually of steel girders, supported on columns, to carry a concentrated weight equal

to the lifting capacity of each crane. The girder of the crane and the chain and hook take up a certain amount of height, so that we have an 18 feet lift at Newport and a 24 feet lift at Ballarat and Bendigo. The material of which the shops are to be built will depend on their position and purpose. Certainly provision must be made for the extension of your workshops to meet the increased requirements of the future, and the question of relative costs must be taken into consideration. Putting the question of cost aside, a corrugated iron building is just as good as a brick one for covering purposes. The Newport shops are constructed of brick, but we would not build of bricks nowadays. Certainly the Department built a brick car shed in the middle of Flinders-street railway yards recently. Costs were compared, and it was found that brick and cement concrete worked out at about the same figure. Corrugated iron would have been cheaper, but there was an objection to placing an unsightly building in the middle of the city. The Commissioners therefore decided on a brick building with a certain amount of reinforced concrete construction. At Ballarat and Bendigo the shops are of wood and iron, with steel runways. The runways are, of course, the most expensive portion of the shops. Corrugated iron buildings are quite warm enough in winter, and will cool quicker than brick in summer. If a brick building is constructed, and you expect extensions in the future, one end should not be bricked up, so that the runways may be continued without pulling down any brickwork.

51. *To Mr. Fenton.*—It is immaterial whether the walls are made of corrugated iron with a steel framework, or brick, or reinforced concrete. If heavy work is to be handled you must put in steel principals and runways for your cranes, no matter what material is used in the walls.

52. *To Senator Story.*—The size of the marine boilers likely to be handled in the shops must be the controlling factor in deciding the height of the boiler shop. I assume that the marine boilers will be 15 feet or 16 feet in diameter. Provision need not necessarily be made for lifting one boiler over another. In the planning of the shop, provision could be made for a centre runway or clearing space which would not be obstructed at all. Boilers or locomotives brought into the shops would come along the centre avenue, and from there be lifted to the place where the work was to be done. I am not prepared to say that 46 feet is an extraordinary height for the buildings, because I have not the slightest idea of the work to be done in them. I am of opinion that galvanized iron walls with wooden frames are generally suitable for any workshops, but the difference in cost between iron and brick may be found to be so little that a preference would be given to brick. A wood and iron building is more readily removed. It must be remembered that the shop is only the shell, and that the work is done by the runways which are much more expensive than the building.

53. *To Mr. Finlayson.* — I gather from the plan that electric power is to be used. I should say that the power-house need not necessarily be attached to the other buildings, but if it is intended to use a steam hammer and steam in the shop, it is desirable to have the power-house close by in order to get the steam more readily. I do not think I can give an opinion as to the wisdom of having the boiler shop and the machine fitting shop associated. You might be able to use some of the machines in the machine shop for both boiler and engine work, whereas if you had the boiler shops a long way off, it might be necessary to duplicate the machines in order to do the boiler parts. At Newport we have a separate boiler shop. At Ballarat the boiler shop is at the end of the erecting shop. The locomotives are brought in and dismantled in the erecting shop. A steel crane then picks the boiler out of the framing and runs it lower down into the boiler shop. Thus we avoid double handling. The designer of the Westernport shop may wish some of the boilers to go into the machine shop, or some of the work in the machine shop to be done in the boiler shop, and for that reason it may be necessary to have the two shops close together. As to the height for the machine and fitting shop, I can only say that that must be governed by the work to be done there. Does the designer contemplate taking an engine out of a ship and bringing it into the workshops as we bring a locomotive? It may be desired to bring in an engine whole or in part. If it is contemplated that an engine may be brought into the shop only in parts you will not require the walls of the machine and fitting shop to be of the same height as a boiler shop in which 16 feet boilers are to be handled. A new marine engine may be assembled on land before it is put into the ship. The height of the machine shop must be determined by the size of the biggest piece of work to be coped with. Machines will be located all over the shop. There will be a certain amount of shafting, and then the overhead crane will be above that. By the time accommodation is found for both the shafting and the cranes you may be well up to the height of the boiler shop. For locomotive work it is an advantage to have the boiler shop and erecting shop running in the same direction rather than at right angles, because the boiler has to be lifted out of the locomotive and attended to separately from the working parts. The design of the building must depend upon the character of the work to be done. I should be more inclined to build the power-house of brick than the workshop. There is not the same necessity for permanency in the boiler and machine shops as in the power-house, and there are some advantages in having those shops so constructed that they can be extended or removed.

54. *To Mr. Sampson.*—I think that a wood and iron structure gives equally good cover for workshop purposes as does brick. One might be inclined to say that he would prefer a brick building if he could get it at the same cost as an iron building, but the probabilities of the future must be taken into consideration. It may be that thirty years hence the site will be found to be too congested or wrongly located, and the Government may desire to remove the shops. I cannot give a more definite answer without giving the matter fuller consideration. Generally a wood and iron building is just as suitable for workshops as a brick building. I have had no experience in naval engineering work. The possibility of buildings becoming antiquated in design must also be borne in mind when you are deciding of what material you will build. Whether the height of the power-house can be reduced depends entirely upon the design. In a modern power-house the boilers are usually installed on the top floor, so that the ashes may be gravitated, and the coal bins are placed above the boilers. If I were designing a power-house, I should do it bit by bit. I would allow the height I thought requisite for different purposes, and if the total height were near that of the other buildings, I would have a uniform

height for the lot. But if there were a big difference between the height I required in my power-house and that required in the shop, I should economise by keeping the height of the power-house down to what I considered necessary. If the Deparment requires a store at Westernport and the upper portion of the power-house would be suitable for the purpose, it would be justified in building that structure to the same height as the rest of the buildings. By that means it would obviate the building of a separate store.

(Taken at Melbourne.)

MONDAY, 12TH MARCH, 1917.

Present:

Mr. FINLAYSON, in the chair;

Senator Keating,	Mr. Fenton,
Senator Needham,	Mr. Sampson.

Thomas Hill, Engineer, Department of Works and Railways, sworn and examined.

55. *To Mr. Finlayson.*—I have seen the plans for the power-house, boiler shop, machine and fitting shop, proposed to be erected at the Flinders Naval Base. In a general way they are suitable for the proposition put forward by the Department of the Navy. Dealing with the power-house I can see neither an advantage nor a disadvantage in having it isolated from the machine and fitting shop. I think the site is quite suitable for the purpose, as it is close to the water and close to the coal. I am aware that the boilers proposed to be installed will be of the same type as on naval vessels, and that provision is being made for the immediate erection of three engines of 250 kilowatts each for the generation of the electric power at the base. The estimate of the immediate requirements is about 300 kilowatts, which is less than the load of two engines, but I think it is absolutely essential that there should be a stand-by engine. With regard to the nature of the building I would point out that it is hardly to be completed in brick, as I understand the term. It will be a steel frame structure with brick lining or casing, and the main stresses are to be taken up by the steel stanchions with the assistance of the roof principals. Mr. Murdoch has assessed the difference in cost of a building of wood and iron, but still retaining the steel stanchions, at £1,700. I also understand from the evidence of Rear-Admiral Clarkson that the reason for using corrugated iron was that it lends itself to additions or alterations, but I should say that, assuming it is desired to make any extensions, the brickwork between two stanchions or piers could easily be removed, and the sashes containing window lights could be taken out bodily. Therefore I would discard that as a reason for the use of corrugated iron as against brick, especially in view of the value of the two classes of buildings when erected, the life of the structure, and the maintenance costs. I also have in mind the present price of corrugated iron, and the fact that it has to be imported. Brickwork may be removed, perhaps, not quite so easily as corrugated iron, but with not much more difficulty, assuming it were decided at some future date to remove a power-house to another site. If the base were developed, as seems to be suggested, I should say the power-house would have to be extended or, perhaps, a fresh site obtained, though I hardly think the latter is likely. The main part of the power-house, including the engine bases and plant generally, would be expensive to move. I think the lessened cost in maintenance charges of a brick structure would repay the Department for a slightly increased cost of construction. I have been looking into the question of having solid piers of brick, thus eliminating the steel stanchions, but I have not yet arrived at a conclusion. I do not say that, at present, a proposition for brick piers in place of steel stanchions is practicable, but I think we could replace the steel stanchions with reinforced piers, and fill in between them with brickwork. The advantage of this course would be to reduce the size of the piers. Brick piers would be very large, but with the use of reinforced concrete the size could be reduced without impairing the strength or stability of the building. My objection to both corrugated iron and steel at present is the difficulty in obtaining the material, and the fact that we would be using an article that is very much wanted elsewhere just now. I do not think the use of reinforced concrete piers would add anything to the cost. There would be no limit to the life of these piers, because the steel would be encased in the concrete, and all would be safe. Mr. Murdoch and I also considered this morning the height of the buildings, and reached the conclusion that, assuming that reinforced concrete or brick piers were used, the height could be reduced by 4 feet without interfering with the requirements of the Navy Department. The walls could come down from 46 to 42 feet, and the steel trusses for the roof would be replaced by ordinary composite trusses of timber and steel, so designed as to distribute the weight over two stanchions instead of on one. There would be economy in adopting this course, but it would take some days to work out what the amount would be. I have not given any attention to the location of the oil store, or tool rooms, as I accepted them as representing the requirements of the Navy Department. So far as I am able to judge from the plan they seem to be in a suitable location. I think, however, the Navy Department might be approached with regard to the height of the engine-room, for I notice from the evidence that the upper portion is to be used as a pattern shop, and for store-room purposes. I think similar space could be obtained at less expenditure somewhere else. For engine-room purposes this height does not seem to be necessary. I do know of power-houses and engine-rooms where this height is required, but that is where there are overhead bunkers and mechanical stoking, which, I understand, is not required at the base, as hand stoking will be employed there for the purposes of training the men. I have never seen such a high roof to an engine-room, where hand stoking has been resorted to, and I cannot see the need for the height proposed with the boiler arrangements contemplated.

56. *To Senator Keating.*—I have discussed this matter with Messrs. Settle, Whyte, and Marsh of the Navy Department, and had an interview with the Director of Naval Works about a month ago, when I placed before him several points for his consideration, but the Navy Department maintained the view that their requirements would be met by the conditions of the plan as before the Committee. I do not know that this matter of the height of the building was exactly pointed out to them, so much as the nature of the plant to be installed, but I think it was certainly mentioned during the interview. It is not quite so easy to move a brick as a corrugated

iron structure, but with the lighting arrangements contemplated in the plan it would not be much more difficult. The multiplication of the window lights would not affect the problem very much as the window sashes could be taken out bodily and the bricks below the sills knocked away.

57. *To Mr. Fenton.*—I do not think there was any disagreement between the naval authorities and myself concerning the details of the building, and it is not quite correct to say that the Home Affairs Department does what it likes with regard to buildings for the Navy Department. I can only speak from my own experience. I know that if the Navy officials say certain conditions must be complied with, the Home Affairs Department gives way. These consultations between experts of both Departments do not mean delay, as the interviews are usually arranged on the telephone in the morning, and the whole matter is very quickly dealt with. Once the Navy Department definitely say that certain conditions are wanted, that ends the matter. If reinforced concrete piers were adopted and the rest of the building carried out in brick and glass, I think the cost would be about the same as if steel and corrugated iron were used; I am taking the price of bricks at 49s. per 1,000 delivered at the Base. Cement is always available at a reasonable figure, as we have been able to import this article on the troopships. The steel required for reinforcing the concrete would be the ordinary round rods and I should not imagine there would be anything like the difficulty in obtaining them as in obtaining the larger sections for the stanchions. My remarks, I might add, may be taken as applying to the whole building scheme, and include the machine shop and boiler shop. The proposal to lower the walls of the engine-house and machine shop from 46 feet to 42 feet is certainly worthy of consideration, but the height of the boiler shop might be retained. It is, however, purely a matter of what the Navy Department have in view. I can quite understand that in a boiler shop they might contemplate handling big weights, but I doubt if this would apply also to the machine shop.

58. *To Senator Needham.*—I think the present site of the power-house will lend itself to considerable extension in the future if required, and when I said that, probably, a fresh site might have to be obtained, I did not have in view the removal of the proposed building. I was thinking of what Engineer Rear-Admiral Clarkson had said in his evidence, that they might move it, or that such an occasion might occur. I would say that the site of the power-house is the best available, and that extensions could be made to it without requiring the removal of any portion of the plant. It is the custom to have an extra engine always available in a power plant. It would not do to have an engine-house depending upon engines of the bare requirements. The saving to be effected by a reduction of 4 feet in the height of the whole of the building would be about £3,000. This reduction would not affect the overhead carriers. It is merely a building detail. It is an advantage to have all the plant together, to insure continuity of work, and economy in labour. If my suggestion is adopted by the Navy Department the lifting height of the building will not be interfered with at all.

59. *To Mr. Sampson.*—In my interview with the experts of the Navy Department I do not think the question of the height at 46 feet was settled, because they wanted a certain overhead space. I believe they asked for 42 feet as the height for the carrier, and we added the 4 feet to take advantage of the horizontal roof trusses to distribute the stress from one side of the building to the other. I do not know Mr. Whyte's load factor, but I know that in determining the power plant he took account of certain other loading, such as lighting, and some small amount of sewerage pumping, in addition to 300 kilowatts in the machine shop. I notice that in his evidence he said that, "With the two engines there would be a reserve of 150 kilowatts on the plant as at present ordered, but that made no allowance for any cranes on the wharf." From this I assume he had some other load in his mind. I do not think the three engines will be an excessive provision in the circumstances. The only point we did raise with regard to plant was whether a smaller set should not take up the night load for lighting, as against the use of the storage batteries for lighting purposes. I prefer a brick building with either steel or reinforced concrete piers on account of the present price of corrugated iron, making a brick structure to cost a very little more than corrugated iron, but the maintenance charge would be much less. In addition to that we have the material available, whereas it is doubtful if we could get all the steel we require on the Australian market without importation. Bricks will give a much better power-house and machine shop, both from the point of view of change in temperature and freedom from dust. It would be a much better building also for workmen, because an iron building gets very hot during a summer day.

60. *To Mr. Finlayson.*—There is ample space alongside the site of the power-house for any future extension, the available area being about 150 feet by 200 feet. I should think, however, that from what Rear-Admiral Clarkson said that, if there were increase of power, it would be pretty great, and that the design of the proposed power would have to be considerably modified. Perhaps they would go in for a different kind of boiler with overhead stoking, and probably this would mean the erection of a new power-house, because the one now proposed is only a small building. The association of the power-house with the machine shops would not limit the extension of the power-house later on. If it were decided to have the buildings the same height all round, consideration might be given to the question of omitting the boiler shops for the present, and using portion of the fitting shops as a boiler shop temporarily. I would not give a definite opinion on this point, but I think it could be done that way. I should think there is an advantage in keeping the fitting and machine shops of uniform height, in case, later on, it were found necessary to adapt them to some other purpose, but as regards the power-house I do not see any absolute need for that. The question of having the boiler, machine, and fitting shop in continuous line rather than at right angles, and without brick division walls is worthy of consideration, but, on the other hand, there is something in keeping the boiler shops separate from the machine shop. The noise is one reason why there should be a dividing wall, and the widths are different, the machine shop being 65 feet wide, and the boiler shop 55 ft. 6 in. Over that length of building I do not think one travelling crane would be sufficient. The water supply for the power-house has been analysed, and found to be perfectly suitable, as it is pure mountain water. Mr. Swan stated the price at 10s. delivered at the Base. At the present time the Railway Department are only charging half

rates on the freight, namely, 6s. 8d. per 1,000 gallons, but, at the beginning of this year, that Department objected to carrying any more water at that rate. I notice in my evidence that I mentioned 25s. per 1,000 gallons. I think I made a mistake, as it should be 25s. per day. We were using about 2,000 gallons a day at that time. We do not know how long the Railway Department will carry the water for us at the present rate, but I think the Department will always be favorably disposed towards us. I believe the Water Supply Commission will be able to keep their promise, and that we shall have a water supply next year. At the present rate of progress, if nothing unforeseen occurs, the water should be available for us within twelve months, and it will take about a year to erect the buildings now under consideration.

(Taken at Melbourne.)

TUESDAY, 13TH MARCH, 1917.

Present:

Mr. FINLAYSON, in the chair;

Senator Keating,	Mr. Fenton,
Senator Needham,	Mr. Sampson.

John Smith Murdoch, Architect, Department of Works and Railways, further examined.

61. *To Mr. Finlayson.*—When I gave evidence on this subject on the 28th February, the Committee asked me to look into certain matters, and I promised to do so. In the course of examination by the Chairman, I was asked to go more fully into the question of substituting timber for steel roof trusses for the power-house, and to inform the Committee as to the saving which I thought might be effected in that way. I said that I thought the saving to be effected would not be as much as might be imagined, because the steel roof in the form designed would assist considerably in counteracting the wind pressure, and that in substituting wooden trusses for steel we would not be able to secure the same wind resistance. By substituting a composite roof truss of timber and steel for a roof truss wholly of steel it would be possible to lower the height of the walls from 46 feet to 42 feet, and still secure the same clearance for the travelling crane as would be secured with a steel roof truss and a 46-ft. wall. The saving would amount to about £1,378. This applies to the whole building, and not to the power-house wing only. The saving may not appear to be material, but, according to our engineers, if we were to adopt this course it would be necessary to increase the sectional strength of the steel stanchions. If a timber roof truss were adopted, the top of the stanchion could not be regarded as a fixed point; whereas, with the assistance of the steel truss, the top of the stanchion could be regarded as a fixed point, and the calculation could be made accordingly in connexion with the resistance of the building to wind pressure. I was asked by Mr. Finlayson if I would confer with Mr. Whyte, of the Navy Department, as to the possibility of reducing the height of the mechanics' workshop. Mr. Whyte informed me that in fixing the height as he did he was working under instructions from the Naval Board, and he, therefore, had no power personally to consider a reduction of the height. He said that Engineer Rear-Admiral Clarkson had given evidence before the Public Works Committee which would explain the reason for the height decided upon. Mr. Gregory asked me whether certain workmen, employed by Works Department at the Flinders Naval Base, had been drawing 2s. a day separation allowance. I undertook to make inquiries on the subject, and I find that men living in the vicinity of the Naval Base have no allowance given them, but men living more than 3 miles from the Naval Base are given a travelling allowance, which is called a "walking allowance." They are allowed a quarter-of-an-hour's pay, but it is not a separation allowance. This allowance is made in accordance with an award of the Court. I understand that some of the men use bicycles, and can cover the distance more quickly than if they walked, but in their case the wear and tear of the bicycle may, I suppose, be taken into account. These are the only questions that I was asked to make clear to the Committee.

62. *To Senator Needham.*—Under both steel and timber roof truss schemes there would be a clearance of 10 feet at the wall above the rail of the overhead carrier, and a clearance of 13 ft. 6 in. in the middle if the steel truss scheme were adopted. In either case there would be ample room for a man working on the overhead carrier to stand erect.

63. *To Mr. Sampson.*—At the present juncture I recommend the adoption of the wooden truss scheme, because, whilst equally good, it is cheaper. It would permit of the lowering of the building 4 feet, and so far as I know that would suit the Navy engineers. Apart from the saving, I would prefer a steel roof as being more modern, but one would be as efficient as the other. For stability and durability the timber scheme would, for all practical purposes, be as good as the steel scheme. I understand that Admiral Clarkson recommends an iron building, rather than a brick building. I have previously stated that the use of iron would result in a saving of £1,700, but it is very doubtful which would be the more economical construction to adopt, because of the cost of upkeep of an iron building. You will remember also that, in my previous evidence, I directed attention to the fact that if the building were constructed of brick every £1 spent upon it would be circulated amongst our own workmen, since the bricks would be made here. In the adoption of the other scheme, a good deal of money spent upon it would be sent out of the Commonwealth. I may mention, for the information of the Committee, that only this morning I had a telegram from our office in Sydney asking what I could do in the way of supplying some galvanized corrugated iron. The price in Sydney this week is £50 per ton, and in the course of another month, according to the information possessed by the Sydney office, the price may go up to £60 per ton. In normal times the price of galvanized corrugated iron runs from £18 to £20 per ton. Personally I would prefer brick construction to iron. The brick is more fire-proof, more dust-proof, and requires practically no expenditure in the way of repairs, whilst it would make the building cooler. It would, I think, also be more appropriate for a building enclosing a lot of fine machinery. It is important to keep dust away from machinery and tools, and a brick building is more dust proof than is an iron building. Do what one will, dust will get in at the joints where corrugated iron is used in construction. If the cost of iron is to go up as it has been doing lately it is doubtful whether we should save anything at all by using iron instead of brick. It should be remembered that we have not yet purchased the iron for this

job. I should say that a brick building would be better for the workmen in both winter and summer. There is a prevailing impression that an iron building costs very much less than a brick building, but it is not justified by the facts, and particularly at this time when iron is so expensive. I have visited the site of the proposed building, and there is ample room at the site for the expansion of the boiler shops to the north, for the expansion of the machine shop, and also of the power-house. It would be possible to more than double the accommodation of the present buildings by putting out wings to the westward. Of course, if expansion were anticipated it would be necessary to reserve the space now available for the purpose. The site chosen is a suitable site, because it is close to where the fuel is landed, and is central enough for the general lay-out of the institution. If the Committee would approve of a scheme for brick piers, or reinforced concrete piers, in view of the doubt which exists about our being able to get the steel required, I should say that the whole building could be put up in about ten months, and the power-house and part of the machine shops in eight or nine months.

64. *To Mr. Fenton.*—When I am informed that Admiral Clarkson seems to be under the impression that if brick construction were adopted we should tie ourselves up, because of the difficulty in making alterations, I have to say that I do not think there is much in that objection. To secure a series of openings 10 ft. 6 in. wide in the brick wall into any new shed that might be erected, all that it would be necessary to do would be to remove the panels of 11-inch brickwork under the windows. The supports of the wall would be left just as they are. If it were decided to make an addition extending over four, five, or six of such openings, it would be necessary only to take out the panels of brickwork in the way I have mentioned. Possibly the expense, should alterations be necessary, would be less with brickwork than with an iron building. Personally, I would prefer a brick building. I have said that the total saving, if corrugated iron were used instead of brick, would be £1,700, but the brick building would last longer, whilst a building of timber and iron would require much more attention in the way of painting and repairs. There is always some deterioration of iron at coastal places, and it is greater the nearer you get to the tropics, as, owing to the heated air, a larger percentage of salt moisture is evaporated and deposited on the buildings, and condensed there. The effect upon a building from this cause would be about the same at Stony Point as at Crib Point. I would prefer brick for this building, even though alterations should be contemplated in a very short space of time. It would be a very simple matter to extend the building if it were constructed of brick.

65. *To Mr. Finlayson.*—In estimating the saving to be made by reducing the height of the walls by 4 feet, and substituting a timber truss for a steel truss, at £1,378, I have taken into account the increased cost involved in strengthening the stanchions should the timber truss be substituted for the steel truss. With the steel truss scheme we should require 145¼ tons stanchions, and for the wood truss scheme 196½ tons stanchions; £1,378 would be the net saving on the adoption of the timber truss scheme, after making provision for stronger stanchions. My recommendation as to the use of stanchions of steel, reinforced concrete, or brick, would depend on the height of the building. If the building, or a material part of it, could be reduced in height by, say, 10 feet, I would not hesitate to recommend the Committee to cut steel out of it altogether. With the present height of 46 feet, brick piers would be bulky and costly, and I could not recommend them. If the height of the building is to remain at 46 feet, it becomes a question between reinforced concrete and steel stanchions, and, in view of the present price of steel, and the probability of difficulty in getting it at all, to the sections that we should require, I should be inclined to recommend reinforced concrete. I should take the same view if the height of the wall were reduced to 42 feet, but if the height could be cut down to, say, 36 feet, I think the calculations would show that it would be advantageous and economical to go in for brick piers. I have said that Mr. Whyte, of the Navy Department, felt that he had no power to treat with us in regard to reducing the height of the building, because he was merely carrying out the instructions of his superior officers.

66. *To Mr. Sampson.*—In the steel truss scheme the height from the centre of the ceiling to the floor would be 49 ft. 6 in., and in the wood truss scheme, 42 feet; that is a difference, in the centre, of 7 ft. 6 in. between the two schemes. At the walls the clearance would be the same in both schemes.

66A. *To Mr. Finlayson.*—I do not think that the adoption of the wood truss scheme, with a 42 feet clearance, would interfere with the ideas of the Navy Department in connexion with the building, but it would be necessary to consult them on that point. The extra 7 ft. 6 in. clearance in the centre with the steel truss scheme is probably not essential, and is given purely for structural reasons. I do not know the object in building the power-house of the height proposed, but I understand the idea is to put in a floor in future. The extra floor shown on the plan may be said to be an incident, due to the fact that it was necessary to have a roof over the boiler house and bunkers. A flat roof is provided 25 feet above the ground floor, and that gave an extra floor, which might be used for storage purposes. A mechanical coal shoot is provided. The coal is hoisted to a certain level, and then comes down into the bunkers. Could the height of the power house as a whole be reduced, and the extra floor eliminated without loss of efficiency in the power house, it might be possible to reduce the height over the whole building by 12 feet. If this were done, a considerable reduction would be possible in the strength of the walls and stanchions, and it would be possible to eliminate steel from the building altogether. I desire, however, to make it clear that my opinion as to whether the height of the building could be reduced or not is not worth very much until you know what the mechanical engineers of the Navy Department have to say concerning the use they propose to make of the space provided by the height of the building now proposed.

67. *To Mr. Fenton.*—When I am informed that Admiral Clarkson says that this building may not in future be used as a power house, but may be used as a foundry, and the power house established somewhere else, I have only to say that I cannot imagine this power house ever being used for any other purpose. There is a tremendous expenditure involved in connexion with the building for condenser pits, circulating system, coal bunkers, boiler room, and a boiler room to

stand the pressure of forced draught, and I cannot understand such a building ever being used for anything but a power house. This expenditure would all have to be incurred again if the power house were removed to another location.

68. *To Mr. Finlayson.*—I will supply the Committee later with an estimate of the saving which I think could be made if it were found possible to reduce the height of the building by 12 feet, and thus eliminate steel construction entirely. There is one matter which I might mention for the information of the Committee as suggesting a reason for reducing steel work wherever possible. At present we have a large contract in our department, and the contractor has a sub-contract with a British firm of structural steel manufacturers. Under this sub-contract the steel was sent out to Australia, fitted and riveted here, and erected in the building. The British Government took over the works of this firm in England, and refused to permit the firm to any longer fulfil their contract by sending out steel to our contractor. The Commonwealth Government used influence with the Department of Munitions at Home to try to have the steel we required released. We want 800 tons of steel, and if we do not get it the contract to which I have referred will of course be held back. We have made two attempts to get the steel, but the position in England with regard to steel is so acute that the British Government do not think it judicious to release steel even for this purpose. This goes to prove the necessity at the present time of eliminating the use of steel in construction wherever it is possible to do so. With respect to the space occupied by steel stanchions, reinforced concrete or brick piers, I said the other day that if brick were adopted the space covered at the base would be about 17 super. feet. But I find that it would be considerably more. I said it would be 5 feet x 3 ft. 6 in. I think now that the space required would be over 20 super. feet—that is 6 feet x 4 feet. That is for a wall 46 feet high. If concrete were used the base would be about 15 super. feet—5 feet x 3 feet. If steel stanchions were used the base would be 4 ft. 6 in. x 18 inches brickwork—that is 6 super. feet, and then the naked steel stanchion of 2 feet web. The adoption of a wider pier could be effected without reducing the internal area of the building, and there would therefore be no trouble if the wider piers were adopted in the placing of the machinery.

(Taken at Melbourne.)

WEDNESDAY, 14TH MARCH, 1917.

Present:

Senator STORY in the Chair;

Senator Needham	Mr. Finlayson
Senator Keating	Mr. Gregory
Mr. Fenton	Mr. Sampson.

Engineer Rear-Admiral Wm. Clarkson, C.M.G., Third Member of the Naval Board, further examined.

69. *To Senator Story.*—The travelling crane in the machine shop should be the same height from the floor as that in the boiler shop. I do not think it is the idea of the Navy Department to put lean-tos on the outside of each long wall, in order to buttress up the building against wind pressure, as you say is done at Cockatoo Island. It seems to be a poor way of supporting a wall, and I do not see what useful purpose annexes of that kind would serve. The building can surely be made strong enough without putting wings of that sort on it. It would not be necessary to put lower buildings on each side to make room for workshops, if my original plan had been followed. We are getting right away from the original into all sorts of side tracks, and I do not know where we are going. I produce my original scheme, with complete drawings, showing four wings. In plan No. 20, sheet No. 2, I show—facing east, towards the main wharf—the fitting and turning shop. This is the long, or general, machine shop. Then, facing north, I show, as the first wing, the boiler shop for working boilers, boilers under test, and boilers required for the instruction of stokers. Next, and to the south of that, I show yard space for the boiler shop. Next comes the wing containing the power station, with engines, dynamos, generators, &c., and the tool shop and tool room. Next I show yard space for carpenters and joiners. Next the third wing, containing carpenters' shop, with a joiners' and cabinetmakers' floor overhead. Next the yard space for foundry and smithy, and last the fourth wing, for the foundry and smithy. Dotted lines are shown where the wings can be extended. There is also shown a detailed floor plan of the joiners and pattern-makers' top floor. I put the power-house in a certain position on the ground, but it has been shifted right away to another position. What I call section 1, that is the first wing facing north, has been taken for a boiler shop, boilers for power plant, and power plant, all put into the one wing. It seems that one alteration is made, which immediately necessitates another, until we have got right away from the original plan.

70. *To Mr. Gregory.*—The alterations appear to have been made by the Department of Works and Railways. The original plan produced by me was approved by the Naval Board.

71. *To Senator Story.*—In the original plan the height of all the buildings was 46 feet. The idea was to give room to lift and shift boilers wherever necessary. You may have to lift the boilers out of one part into another, so that the same height of building is wanted everywhere. The height provided by me is no higher than in every other modern machine shop I have ever seen. We anticipate that the height of the machines that will have to be dealt with in the machine shop will require a high building. Seeing the present difficulty in getting material, I would suggest putting any old cover over the engines and boilers for the time being. Do not try to make a permanent job of it at present, until the war is over. That is, do not try to make it the beginning of a permanent job. Make it purely temporary at present, to house the absolute bare necessities; put in your foundations for the generators and the boilers, and then put any cover you can over them—of wood, iron, or anything that is cheap. Even if you are told by the officers of the Works Department that galvanized iron would cost practically the same as brick, I would still have galvanized iron, as it gives you more latitude for alterations.

72. *To Mr. Gregory.*—Even in the building of the power-house, I would prefer galvanized iron. You may possibly have to take a wall down to get a boiler out, and you cannot do that with a brick wall.

73. *To Senator Story.*—Things are so critical at the present moment that you do not know what is going to happen, and we should be prepared, and have a shop at Westernport capable of doing repairs, not only to our own Fleet, but to ships which, in all possibility, will come here from Europe to assist us. We should have an up-to-date plant, in order to carry out all repairs to ships. In the eventuality I speak of, we should have a crowd of ships here, and ought to be in a position to keep them in repair. That demands up-to-date shops at Westernport. We cannot altogether depend upon Sydney, the distance is too great. If ships want repairing, they want it quickly. We cannot afford to send them to Sydney for something which might take only a few hours, and we cannot do these repairs unless we have machinery capable of undertaking the work.

74. *To Senator Needham.*—In my plan I wanted the power-house put close to the main wharf, along the inlet. It has been put further away, and the whole block has been turned half round. Instead of the long machine shop facing east as in my plan, the buildings have been turned round so that it faces south, and apparently they have also been shortened. A road comes in, and the four wings that I planned cannot be got in or extended without going across the road. I also place the oil tanks much nearer the wharf than they are plotted on the plan on your wall. So far as the present site of the power-house is concerned, I am satisfied with the general location. It must not be separated from the rest of the block, because steam is wanted to test turbines and machinery. If it is erected where now proposed we can get all that we require. I believe that eventually you will have to come back to my plan, shifting the engines out of the power-house as at present proposed and extending the boiler room. You will have to come back to my plan to have the boiler shop in the same wing. That is one reason why I do not want the height reduced. Another wing could be put on with the power-house in its present position. Galvanized-iron will give the machinery in the machine shop all the protection from dust that is necessary. It is used all over the world now. I would put up any old machine shop at once, even simply a shed for the time being, until conditions alter and we can get material at reasonable prices. We want up-to-date machinery in the machine shop, boiler shop, and power-house, and I advise the Committee to go right on with the foundations of what will be a permanent site. The height of 46 feet for the walls is very moderate, considering the height of shops built in other places. It would be extremely foolish to allow any less height, for we must provide for contingencies.

75. *To Mr. Finlayson.*—The fact that the Works architect stated that brick walls could be removed practically as easily as galvanized-iron walls, and erected practically as cheaply, would not weigh with me at all. I want corrugated iron. Even if a brick building could be put up twelve months earlier than a steel and galvanized-iron building, I would recommend you to put up a temporary building, and when conditions improve, to go on with the galvanized iron and steel framework. The universal practice now is to put up steel stanchions. If brick is used at all between the stanchions instead of galvanized iron the brick is used only as a shelter, and the main weight is taken on the steel. There are many cases of failure of brick piers or reinforced concrete piers, which you say the architects advise could be substituted for steel stanchions. If the architects and the Works engineers advise the Committee that they can guarantee equal strength, stability, and efficiency with reinforced concrete or brick, and have the work gone on with without delay, I reply that the universal practice now is to put in steel standards to carry the cranes. If it is suggested to the Committee that the walls of the power-house are made high because of the introduction of a second floor over about half the building, and that, if that floor were removed and provision made in some other building for the accommodation there, the walls of the power-house could be reduced by from 10 feet to 12 feet, eliminating steel and making a big saving in cost and time of erection, my reply is that that floor has nothing whatever to do with it. I said last time, and say again this morning, that it was proposed to put the boiler shop and the boiler house in the one wing, and that that height of wall was required for lifting boilers about in the boiler shop, and lifting boilers from the boiler shop into the boiler house, and back again into the boiler shop if necessary. Here is the boiler house, and here are the generators in another wing altogether. Now it is proposed, in order to economise, to put them all into one wing, but that arrangement cannot last. You will have to shift the generators eventually to where I planned them. I quite agree that the boilers must be near the generators, but so they are in my plan, although they are in a different wing. The steam can be taken quite easily across the yard space. It is necessary to consider the height of the power-house in relation to the other buildings. The place where boilers are repaired and built should be in the same wing as the boiler house, the place where boilers are worked. We want to shift them backwards and forwards for test purposes and for educational purposes, and the height is required to allow of shifting them. The boiler shop is at present in a wrong position for the finally-completed plan. It is only a makeshift in order to reduce the present cost. If you are advised that the boiler shop was put there to provide for easy extension with the development of the place, my reply is that you will get any amount of advice. The question for the Government to consider is "who is the man to advise?" Having decided that, they should then follow his advice. If you go on getting advice from every one I do not know where you will land. If you say that the Committee are not being given that assistance which they should receive from the experts in the Navy Department and in the Home Affairs Department, may I ask if you are not putting yourselves in the position of experts in this matter? If you say you are not, and you are not experts, all you have to do is to find out some person who is an expert and whom you can trust and take his opinion upon it. I do not ask you to take mine. I am giving you my ideas on the subject—ideas formed after travelling all over the world by direction of the Government to see what is being done in other countries. I came back here, and they made me third naval member, with control of dockyards. They said to me, "What do you want at Flinders?" I said, "This is what I want." Apparently that is not sufficient. All sorts of other people are dragged in to give their ideas on it, and in these circumstances you can never hope to get finality. That is quite impossible unless you consider yourself sufficiently expert to hear what every one says and decide

off your own bat. If you were told that the plans presented by the Works Department meet the views of the Navy Department, they do not meet my views. The finally-completed plan is the plan I produce, and nothing but that. Those are the views which I put forward at first and which I stick to. If you have not the money and cannot get the material, I say, "do what you can, but do not go away from the original plan." As to any efforts made by the two Departments to arrive at a common understanding as to what is necessary, I only know that I put this plan forward as my requirements. I also know from tittle-tattle, but not officially, that all sorts of people have been cutting my plan up and chopping it about and making hay with it generally, and really I have very little idea of the final stage at which they have arrived. I have had no consultation with the officers of the Works Department. They have not approached me at all. They have approached my officers. The present plans are not suited for what I consider should be done as a completed work. They are only makeshifts, but as makeshifts they can be altered if you build them of galvanized iron and keep the specified height. They can be altered later on if necessary to come back to my original ideas. I have laid down the buildings and the general scheme in such a way as to provide for future contingencies. I recommend the Committee to put down nothing permanent unless it is part of the permanent scheme. The power-house, machine shop, and boiler house, as at present before the Committee can be made to fit in with the permanent scheme if you preserve the height and dimensions. They can be shifted at some future time back to the position on my plan. The outside walls, so long as you keep the height, will fit in with the permanent scheme. The inside arrangements will have to be re-arranged. The arrangement of the outside walls on your plan is the same as on mine, except that there are two wings instead of four, and the whole thing has been turned half round. If you depart either in height or in other dimensions from my proposal, they will not fit in with the permanent scheme. With regard to the plans on your wall for roof truss construction, I certainly prefer steel to timber, but if you cannot get steel, make the trusses of whatever material you can get and put in the steel afterwards. Wood will not last any length of time. I would say "use wood until steel is available," but the present position with regard to iron and steel is so acute that my advice is "Do not go ahead with anything permanent in the way of overhead buildings, but just house the things as best you can at the present time with any old cheap material available and go ahead with your permanent establishment at some later date."

76. *To Mr. Fenton.*—My officers designed these buildings in the first place, and sent almost detailed plans over to the Works Branch, which has cut them up. The present plans are not the ones I have produced. I am very firm in regard to corrugated-iron construction, because it is the universal practice in other countries. I could write a book about the advantages of steel and iron. Even though the cost of the materials which I have advocated has gone up to an almost prohibitive rate, and the materials are at present almost unobtainable, I do not advise you to let the Works Department put up brick buildings or brick or reinforced concrete piers, which they say would be just as serviceable and quicker of construction. I simply say, "Put up temporary shelter and wait until the conditions alter. They may alter very rapidly directly."

FLINDERS NAVAL BASE (WORKSHOPS, ETC.)

MINUTES OF EVIDENCE.

(Taken by Second Committee.)

(Taken at Melbourne.)

TUESDAY, 2ND OCTOBER, 1917.

Present:

Mr. GREGORY, Chairman;

Senator Henderson	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

Joseph Risley Settle, Director of Naval Works, sworn and examined.

1. *To the Chairman.*—I was formerly in the Navy Department, but was recently transferred to the Works Department, supervising naval work. I have had nothing to do with the erection of buildings at Flinders Naval Base, but I presume that, under the new arrangement, I shall. I have not had an opportunity of going through the plans and specifications dealing with the additions to be put up there. I cannot give you any date as to when the new arrangement was entered into for me to take control of these works, but I have understood that I had to do so for a matter of, I should say, six weeks. There is no definite document by which I could show that I have taken the work over; it is in process of being taken over. I presume that the reason of my appointment is to prevent the duplication of authority. Hitherto, I understand, the line of demarcation was low-water level, all above that being carried out by the Department of Home Affairs; but now I understand that all works below and above low-water level will be under one authority. I am aware that certain works have been referred to this Committee, but I cannot give any evidence as to the plans and specifications, probable work, or the necessity for the works. I cannot say of my own knowledge that the works now referred to the Committee have been approved by the Navy Department. I have not yet come across any record of the buildings now there having been referred to us. We are carrying out all works, such as dredging, the building of sea walls, and so forth. My evidence as to buildings applies to engineering works, water reticulation, and sewerage.

2. *To Mr. Mathews.*—We have had control in earlier work of the kind.

3. *To Mr. Sinclair.*—As to my qualifications, I may say, in the first instance, that I am a member of the Institute of Civil Engineers. My training was obtained during the whole construction of the Manchester Ship Canal from its inception to its completion, under Sir Edward Leader Williams. I worked as a pupil on that work. Up to the time of my leaving the Canal Company and joining the Admiralty, I was Assistant Resident Engineer of the Manchester and Salford Docks, under Mr. James Deas. I joined the Admiralty in 1894, and was employed in the London office on the design of the Gibraltar works—the purchase of material and plant, and the carrying out of the work. I proceeded to Gibraltar in 1895, was on the construction of the works from inception to completion, and left Gibraltar in 1907. I was in charge of the completion of the works, and had the responsibility of issuing the final certificate. I was in London with the Admiralty for a little while, and left the Admiralty in January, 1908, and a little later on in the year I joined Messrs. Topham, Jones, and Railton Limited, the contractors who constructed the whole of the naval works at Gibraltar, as their Chief Engineer in London; and I remained with them until I joined the Commonwealth. During the time I was with these contractors I dealt with the extension works at Portsmouth, and also with the Rosyth Naval Base for the purpose of tendering for the works. This firm did not obtain the contracts. In addition, I had a large amount to do with the Buenos Aires dockworks, the contract for which the firm with which I was connected also lost. I had the supervision in London office of the construction of the Singapore new graving dock, and also of the Lagoon wet dock, both of which works were constructed by Messrs. Topham, Jones, and Railton Limited. How I came to join the Commonwealth service was that, when I was about finishing the Gibraltar contract of the commercial mole, I applied for the appointment of Director of Naval Works as advertised in November, 1915. The commercial mole was really a part of the old naval works, and was intended to have been carried out with those works. The original mole was so carried out, but was, before completion, taken over by the Admiralty for naval purposes, and in lieu of it the Admiralty designed a new mole to serve the commercial interests of Gibraltar. As, however, there was some hitch in regard to payment for the work, there was delay, and consequently it was not carried out during the time of the naval works. Subsequently the Admiralty again designed a mole to meet the requirements of the colony, and finally towards the end of 1912, it was decided to carry out the work under Admiralty supervision. Messrs. Topham, Jones, and Railton tendered for the work and obtained the contract, and as we were somewhat slack in the London office at the time, I went out in charge, and completed the works, and left Gibraltar on 26th July, 1917, for Australia, to take up the appointment as Director of Naval Works. I hope to have in Australia four or five foremen in charge of the various sections, to be responsible to me for the carrying out of the work, but I cannot speak of that at the present time. It would be impossible for me to attend to all the details myself, and subordinate officers must be provided for the purpose.

John Smith Murdoch, architect, Department of Works and Railways, sworn and examined.

4. *To Mr. Mathews.*—I am the senior architect, though I am not actually called the "chief" architect. The whole of the architectural work of the Commonwealth is not under my supervision. Most of it passes through my hands, but it is too big altogether for one man to supervise. We have officers in the various States who do the actual supervising, but the work does come before me in some shape.

5. *To the Chairman.*—I am the head of the architectural branch, and I am responsible for everything I do. I have seen the plans submitted to the Committee in connexion with the Naval Base, and I am responsible for the building plans, which have the concurrence of the Navy Department. These plans have not been submitted to the Naval Board; but, perhaps, the best thing I could do would be to generally explain the relationship that has existed between the two Departments about these buildings up to now. The initiation of such buildings is brought about by the Navy Department writing to our Department, and asking us to proceed with certain buildings according to plans which they enclose. These are not always completed plans, but plans in the sketch stage. As is almost inevitable, we have often to differ in our views from the Navy Department about the construction of buildings, and, if so, we immediately put ourselves in personal touch with the works staff of the Navy Office. There are meetings between our officers and the Navy officers, and at last a plan, mutually agreeable, is decided upon, and we proceed to elaborate the working drawings, which are those placed before the Public Works Committee. But from what I hear now I understand there is some objection to our not sending the finished plans to the Naval Board for criticism and final approval. That, however, we have never done up to now. The working up of the scheme to the point of completion has always been done in touch with the Navy officers, and our Department would not do anything in opposition to what the Navy requires; every particular is done in accordance with Navy views. Every week, and, perhaps, several times a week, our officers and the Navy officers are in actual personal touch over the details of those works. I think that, if the records were consulted, it would be seen that some of the correspondence comes from the Naval Board, and some from the Navy Works office—not always from the Board, but I think very often. I consider that a responsible Board, such as the Naval Board, should absolutely give their approval before plans can be looked upon as completed. I think it would be a most orderly thing to refer plans back to the Board, and ask the Board formally whether it approved of them. I know that plans suggested by the Naval officers, and completed by ourselves, have not been submitted for approval by the Naval Board. In the case of the hospitals, Admiral Creswell has been asking to have the plans sent to him, and we have just sent the completed plan. At the same time, those plans have been elaborated in close touch with his officers; but the formality of sending the completed plans to the Board has not been observed. Personally, I am very sorry if they were expected to be sent, and were not sent. I find that the Navy Department sent on their original scheme to us in March last, and asked to be informed as to the cost of it. As I have already tried to explain, our officers and the Navy officers, including the Navy Fleet Surgeon, got together and evolved a new plan different from the original submitted. It might, of course, under the circumstances, be possible for Admiral Creswell to come here, and in evidence say that he did not approve of the plans, or some of them. I can see that it would have been a precaution to have his approval before submitting the plans here, and I am sorry that has not been done; but it has not been done in the case of any other building. I remember that in the case of the barracks, the Navy Department wanted a one-storey building, while my Department was in favour of a three-storied building; but that was at the sketch-plan stage. The Naval Board has always had to do with the buildings at that stage, but when the drawings have been so far elaborated, and estimates made, they have not hitherto been sent to the Navy. As to the authorizing body, the Naval Board authorizes the requirements, and the Works Department authorizes the expenditure. Requests from the Navy Department come to our Secretary, and are referred by our Secretary to the Works Branch, which is under Colonel Owen. I am one of Colonel Owen's officers. Any reference in regard to water reticulation, for instance, would go to the engineering branch. My responsibility is merely for the plans, specifications, and estimates in the case of buildings. I can give you some particulars as to the buildings referred to the Public Works Committee. The buildings now referred consist of a hospital, a detention barracks, armourers' workshop, quarters for senior married officer, quarters for junior married officer, five quarters for married warrant officers, according to plans called No. 1, and five quarters for married officers, according to plan called No. 2. There are also workshops adjoining the power-house, consisting of a machine and fitting shop, and a boiler-making shop. In connexion with the workshops I have given evidence before the Public Works Committee on previous references. I understand that the late Committee got a certain distance in their consideration of these shops, when further proceedings were postponed. The power-house is the largest and most expensive building at the Base. It is to supply light and power to the whole Base, and is situated at the south-east corner of the Base proper. That differentiates the actual working Base itself from that part where the houses are to the north-east, the Base itself being to the south-west. All this, however, will be more understandable by the members of the Committee when they have visited the place. The building is U-shaped, and the main cross wing of it will consist of the machine and fitting shops. The two smaller wings will be used respectively for the generation of electrical power, and for the making of boilers connected with the Base. The late Committee had this large work, which was estimated to cost, I think, £41,000, under its consideration. It had completed its consideration so far as permitting the power-house wing to be built, as suggested, with certain amendments in regard to height and other details. This leaves to the present Committee the consideration of the large machine and fitting shop, and the boiler house, which are estimated to cost about £25,000. As to the power-house wing, as soon as the Works Department had the approval of the Committee they proceeded to make new plans, embodying the alterations suggested by that body. This necessitated a new set of drawings, because the alterations required were fairly radical. When the drawings were completed they were, according to the Committee's views, sent to the Navy Office in June last, and they have been under the consideration of that office until a week or two back. We have now got them with a few suggested alterations, such as substituting tiles for the iron roof-

ing originally intended. This I regard as quite a sound proposition; and there are a few other minor details. This work is just about ready to be started, subject to the concurrence of the Minister. The work now before the Committee is estimated, as I say, to cost £25,000. The length of the machine and fitting shop is 179 ft. 6 in. by 65 feet, and the length of the boiler shop 119 ft. 6 in. by 55 ft. 6 in. The height of these buildings to the eaves, where the roofs take away from the walls, is 46 feet; and I may say that all these dimensions are according to the instructions of the Navy Department. We propose to have brick walls, with tile roofs. The Navy Department has asked us to substitute tiles for galvanized iron; and, as tiles at present would certainly cost no more than iron, I should say that all the buildings will be roofed in the same way. That will make them rather different from the other buildings down there; but I do not think that will matter very much. The question of building the walls of the workshop with galvanized iron was gone into previously, though then in connexion with the power-house. The buildings are all of the same class of construction, and, speaking from memory, I think the Department then came to the conclusion that brick would be as cheap as iron, especially if we could reduce the height of the building. If you remember, the original height is 46 feet, and that required us to put in steel stanchions to carry the roof. In giving evidence at the time, I suggested that if the building could be lowered to 33 feet, the necessity for steel stanchions might be avoided, and support got from brick piers. The Committee, of course, understand that steel is now exceedingly dear, more than twice its normal price, and the advantage of having brick piers is that we should be dealing with a locally-produced article, the expenditure upon which would circulate in the community. I think that with a height of 46 feet we shall require steel, but I should like an opportunity of looking over my calculations in that regard. If the height could be reduced by 10 feet it would be cheaper to substitute brick for steel. If corrugated iron had been approved for the whole building, the saving, as then considered, would have been £1,700; but, of course, it would not have been such a stable building, and would have required more repairs. At any rate, the Committee approved of the power-house being made of brick. Admiral Clarkson, who was the engineer in charge, expressed a preference for corrugated iron for the workshops. The argument he used was that in the event of having to add a wing he could easily knock out a bay, and much more quickly than he could in the case of brick. I think I explained that, as a matter of fact, the brick is only 9 inches thick, and practically almost as easy to move as galvanized iron. I do not think it is a very material point. I was asked by Mr. Fenton, then a member of the Committee, whether it would be possible to extend a brick building, and I said that it would, because all that would be necessary would be to remove the panels of 10 ft. by 6 ft. under the windows. The brick material would remain for further use, just as would the iron material, and without weakening the wall. Of course, if the Committee think that galvanized iron would be better, there is no reason why it should not be used, though I think brick is preferable. I have had no recent special experience in the building of large workshops where large machines are handled. The only factories I have had anything to do with in the Government service are the Geelong Woollen Mills, the Small Arms Factory, the Harness Factory, and so forth; but those are nothing like the work under consideration. I have no opinion whatever as to the necessity for the height of the building being 46 feet; all I say is that if the height can be reduced, the building may be otherwise constructed. The estimate I gave last year was the same as I am giving to-day. Structural steel is about 125 per cent. higher in price than normal, and 25 per cent. of that has occurred in the last year. I do not anticipate any danger from the wind on the walls of this workshop, considering that it is buttressed by two huge wings. Both brick and galvanized iron would present the same area to the wind, but I cannot imagine the wind being any trouble at all. The Navy Department has selected the site for every building there. I think we can carry out the work for the estimate I have given. As to the buildings previously erected, there is considerable discrepancy between the estimates and the completed cost, but that discrepancy will not apply to the buildings now before the Committee. We now know what the buildings down there are costing, and the estimates before the Committee now are based on knowledge that we have—on the rise that has occurred in the cost of material on account of the war. I think the original estimate was under its value somewhat. I do not think that we realized that the general or overhead charges would be what they turned out, and then there was the increased cost of material and labour. There have been a good many references to the Arbitration Court, and many awards have been made in favour of the men that we did not anticipate. We carry out all the works by day labour, and the result as regards buildings is good. I think that it is rather costly. The general volume of work has fallen off; I do not think that we get quite as much out of the men as we did some years ago, owing to the abundance of employment. The estimated cost of the two blocks for the seamen's barracks, which was before the Committee in 1915, was £30,104. At the 30th June, 1917, the actual expenditure on these buildings had been £30,175. The estimated cost to complete, including all charges, was £4,300. The total is expected to be £40,596, or an increase of 25 per cent. The increased cost of material and labour together, between May, 1915, to August, 1917, was, we consider, 30 per cent. I am now quoting from a financial statement up to the 30th June, the end of the financial year, prepared for the information of the Minister.

6. *To Mr. Sampson.*—The price of galvanized iron now is somewhere about £60 per ton, and it is almost unobtainable. I should like to say that the Commonwealth Government have gazetted a notice forbidding the use of galvanized iron in walls, though it may be used in roofs. I dare say the Department may be exempted, but I do not think that is desirable. I think that the price of galvanized iron has gone up since I made the estimate of a difference of £1,700. Every plan we make for the Navy Department is approved; we never take the power of initiative. The Navy Department sends us sketch plans and their views as to what the building should be. We merely occupy the position of architect and constructor of buildings under the instruction of the Navy Department. I do not say, of course, that eventually the Navy Department's original ideas in regard to what the building should be are carried out. As a rule, each project undergoes a good deal of modification as a result of conferences between our Department and the Navy Department. When we

constructed the barracks we designed a three-storied building, whereas the Navy Department desired to have a single-storied building; and we at that time had no larger power than we have now. At that time the Navy Department sent our Department a sketch of this one-story arrangement, and the responsible head of the Works Department thought it was not a good one. His idea was that the men would be better placed in a three-storied building, which would result in considerable economy, and enable the money saved to be devoted to providing them with dining-rooms. The Navy alternative was to make the men eat in their dormitory. Our design was substituted, but that was done in touch with the Navy; it was not done arbitrarily, but was the subject of many conferences. Eventually the Minister had to decide which scheme he would have, and he decided in favour of three stories. We still have the power to vary any of these schemes. I have never been consulted so far about the height of the building.

7. *To Mr. Mathews.*—We do what any Department asks us to do; but the Navy Department is on rather a different footing from that of other Departments, inasmuch as they have a technical branch of their own, and there arise questions on technical points of construction which are not met with in the case of other Departments, such as the Post Office. We supplied plans and complete specifications in connexion with all the buildings under review. Ours is the erecting Department, and the Minister for Works has an engineer at the Base. As to where Mr. Settle comes in, up to the present the arrangement between the Departments has been that the Navy Department does all the work connected with the water, such as jetties, dredging, and so forth, while the Works Department, which used to be the Home Affairs Department, does all the work on land. The Department for Home Affairs has now been made the Works Department, with the result that the whole of the Navy work has been transferred to the new Department. That means that all the work that used to be done by the Navy Department is now done under the Minister of Works. Mr. Settle is not a navy officer, but an officer in the same Department as myself. As to whether he is to be confined strictly to navy work is a matter in the discretion of the Minister; but I presume that he will. I take it that the idea of substituting tiles for iron on the roofs of the proposed building is that tiles are more lasting, better looking, and cooler—altogether a superior roof, with the advantage of being made locally. I think it probable that any large work would deplete the structural steel market, but up to now we have been able to get all we require. For instance, the Custom House in Sydney was a pretty large job, but a firm in Melbourne came to the mark, and did it well. Of course, the cost is very high, being something over 100 per cent. above its normal price of £16. I think that structural steel could still be obtained for this building, but it would have to be from Newcastle, and we would have to pay the current market rates; we cannot hope to get steel from England. As to exporting steel from Australia, I think the British Government asked for some, but whether we have been able to supply it, I do not know. I think the power-house at the Federal Capital is about the same height as that suggested for the one at Flinders. As to day labour and contract, I should say that in contract work there is a decided incentive for a contractor, not scrupulous, to scamp his work. Officers, of course, are expected to keep that man in check, whereas in the case of day labour there is no incentive whatever to scamp. I would not altogether say that contract supervision is more costly than the supervision of day labour, because the supervisor under day labour has to do contractors' work; he has to do the ordering of material and everything else. The actual police business of looking out for scamped work does not exist in the case of day labour. In the case of the barracks the original estimate and plans were altered; indeed, I might say that, in the case of a considerable number of buildings, the plans were materially altered. The original view taken as to the requirements of the buildings was modified or extended, and, in one or two cases, to such an extent that, when we realized that it meant a considerable increase in cost, we did not actually go on with them until the Public Works Committee had had a further opportunity for consideration. It is quite true, however, that a good many of these buildings were altered. In the case of any alteration there should be no increase in price under a well-formed contract. Before a contract of any magnitude is entered into, there is a scale agreed upon which applies not only to the necessity for extra material, but for any reduction in the quantity of material used. In my experience I have found that contractors have been pleased with alterations, as giving them a chance of profit; but that is rather an obsolete idea nowadays. Contracting is now more scientific than it used to be, and contractors are well bound under such conditions as I have indicated.

8. *To Mr. Sinclair.*—The drawings for the power-house are completed, and we are ready to begin work as soon as the Minister approves. I think that the Navy Department has accepted the recommendation that the height shall be reduced to 33 feet, and we have its written authority to proceed with the work as modified. Workshops will consist of one floor, the idea being to afford every facility for moving large pieces of machinery about on cranes. I take the responsibility for the estimates supplied to the Committee, and I have taken out quantities, and had proper schedules prepared. At the present time galvanized iron of 26-in. gauge is worth about £3 5s. a square, whereas the normal price is 30s. The life of galvanized iron used close to the sea depends on locality. Down at Flinders I do not think that the corroding effect of the sea air is very severe, whereas in North Queensland, where evaporation and the deposited salt are excessive, the life of galvanized iron is very short. I have known a galvanized iron tank in North Queensland to be finished in two years, while in other coastal places a similar tank would last 20 or 30 years. Speaking generally, the life of iron near the sea is shorter than in the back country. At Flinders I have not seen any special evidence of incrustation, but I think it would be a very good thing to treat the buildings there with cement and oil. We have used acres of asbestos for walls, though at the present it is rather prohibitive in price. We have used it at the Military College, the Naval College, and at Flinders Base. Asbestos sheeting is being made very well at Adelaide, and I think in Sydney, but, in my opinion, it will prove dearer than iron. I should not regard it as imperishable, though it may be long lasting; it is, however, very fragile. In the case of the machine shops we shall carry the weight at the top of the walls; there is a 35-ton crane in the boiler shop, and a 30-ton crane in the machine shop. I do not think that a 9-in. wall would carry that weight, and the weight is carried on steel stanchions behind the brick wall. I suggested brick in the place of steel, if the height of the shop should be reduced, but not otherwise.

(Taken at Melbourne.)

WEDNESDAY, 3RD OCTOBER, 1917.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

John Smith Murdoch, Architect, Department of Works and Railways, further examined.

9. *To Mr. Sinclair.*—If Australian hardwood stanchions were used for supporting the fitting shop roof, it would be necessary to employ a section of considerable size; and, having regard to all the circumstances, I think that steel stanchions would prove as cheap. If we could not obtain steel, then hardwood would be the next best material. It would be inclined to bend laterally, but if it were attached to the brickwork at frequent intervals, it would be worth considering as an alternative. It would not, however, be of much value from the point of view of economy. The stanchions would not be in one piece; we should have to scarf them. Speaking offhand, I should say that we would start with a section of about 16 x 16, and end with a section of about 8 x 8. At present, I am not in active supervision of these works. Their direct oversight is vested in the engineer, who is constantly on the work. He is assisted by a clerk of works, and has power to discharge an employee should he think that course necessary. The estimate of costs are for the completed buildings. They include overhead charges, and embrace the latest knowledge we have of inflated prices due to the disturbance of commerce brought about by the war.

10. *To Mr. Mahony.*—If we did away with the steel stanchions we would have brick piers, placed at intervals under the steel roof stanchions, which would bear all the weight of the roofs and the travelling cranes. Between the piers, the filling up would consist of thin brick walls which would be practically for no other purpose than to keep out the weather. All the weight of the structure would be concentrated on the piers erected at intervals.

11. *To Senator Needham.*—I stated yesterday that, whereas the estimated cost of the barrack buildings was £30,000, the actual cost may be £40,000. I should not like to assert, positively, that any portion of the increased cost was due to the construction of those buildings under the day-labour system. At inquiries of this kind, I have frequently been questioned on the subject of day labour, and am fairly satisfied in my own mind that I am right in saying that under the day-labour system there is inevitably a slight slowing-down; but that, taking into account contractors' profits, the day-labour system does not, I believe, cost more than the contracting system. I would emphasize the point that at the present time contractors are looking for large profits. There is so much uncertainty as the result of the war that contractors, in tendering for work at present, are inclined to ask big prices, and a comparison of such prices with the day-labour costs is in favour of the day-labour figures. I cannot say definitely that the increase in the actual cost as compared with the estimated cost of these buildings was due to the day-labour system. The buildings that we are now inquiring into are to be placed on the permanent sites. I mentioned yesterday that the difference between the cost of brick and corrugated iron walls in the case of the buildings under construction would be only £1,700. Having regard to future maintenance, I would prefer brick walls. The majority of the buildings at the Base are of galvanized iron. Many people would describe them as "temporary" because they are constructed of iron, but I should not. They are first-rate structures, and there is no reason why, with care, they should not have a life of 100 years. Dealing with the question of the height of these buildings, I said yesterday that if the Committee decided on the walls being 46 feet high, it would be necessary to have steel piers. If steel is unobtainable, hardwood might be a possible alternative. I think, however, that we should be able to get the steel rolled at Newcastle. I do not think the substitution of brick piers would be a practical proposition. In addition to weight-carrying capacity, the capacity to withstand wind pressure must also be considered; and, to carry the weights to be provided for, the area of the brick piers would have to be so great that I doubt whether any economy would be effected where the piers had to be carried to such a height. If the walls were reduced by, say, 10 feet, I could say with considerable certainty that brick piers would be the best, and possibly the most economical. I should not like to express an opinion off-hand as to what material should be used in the case of intermediate heights. Coming to the question of roofing, I may explain that the use of tiles was suggested by the naval authorities. The original plans before the Committee provided for an iron roof for the power-house. After the publication of the Committee's report on that branch of the work, amended drawings, embracing all the recommendations of the Committee, were prepared by us, and sent to the Navy Office for approval. Subject to a few suggested alterations, the Naval authorities agreed to them. One of their suggestions was that we should use tiles for the power-house roof instead of iron. We now propose to use tiles for the workshops roofs. The suggestion made by the Navy Department is quite a valuable one. The use of tiles will conserve the iron market, and, even allowing for the heavier structure required to support them, will effect a little saving. It will give us a better roof, and will provide more local employment. If I could secure a tile roof for the same cost as an iron roof—and I think that we can at present—I should certainly prefer tiles.

12. *To Mr. Laird Smith.*—The system of co-operation mentioned by Admiral Creswell, when before the Committee on a previous occasion, as existing between the Department of the Navy and the Department of Home Affairs, will be continued under the re-organized scheme. Admiral Creswell, when giving evidence on a former occasion said, "My personal view is absolutely against the erection of two-storied buildings at these places, where it is entirely unnecessary to have regard to the ground space occupied." The Admiral raised this question in connexion with the residences, and the sketch plans sent to us by the Navy Department actually provided for two-storied buildings. The Admiral evidently was not aware of that fact. I am aware of the regulation issued under the War Precautions Act in regard to the use of galvanized iron for other than roofing purposes, and I think that we ought to respect such a regulation, especially when we can secure locally a suitable substitute. The Commonwealth has power to go behind both State and municipal regulations: but, as a rule, the policy of our Department is to respect all such regulations unless their observance would involve some

flagrant waste. I have not had any experience in the use of asbestos for roofing, but it should be good for the purpose. The great cost of iron is giving an impetus to the local production of asbestos sheets, and to other industries of the kind, so that some ultimate good will probably result from the inflated prices; I do not anticipate that asbestos will be able to compete with iron, when prices return to their normal level; but it cannot be denied that asbestos would provide a cooler, and, probably, a more lasting, roof than iron. I should have no objection to giving it a trial; I am always pleased to inquire into any new material brought under my notice. The bricks used in the buildings so far constructed at the Naval Base were obtained from Melbourne. I do not think we have investigated the possibilities of making bricks locally. The prospective number of bricks to be used would not warrant the erection of local brickworks. From the very outset, bricks have been purchased on the most favorable terms. Their price has not materially increased. We have good working plant at the Base—a building plant valued at nearly £10,000. If the height of the boiler shop and fitting shop were reduced from 46 feet to 36 feet, the saving in cost of construction would be, in round numbers about £2,000.

13. *To the Chairman.*—I am prepared to give the Committee a description of the various other works shown on the plan, and included in the present reference to the Committee. The largest work in the reference is that which you have now commenced to consider—the construction of workshops. The next in order of importance is the group of hospital buildings. The Committee will probably remember that the site allotted to the hospital under the original scheme was at a point on the promontory overlooking Westernport Bay, and near the mouth of the inlet. The original scheme of hospital buildings was a fairly pretentious one, and a good many sketch drawings were prepared in connexion with it. A new Fleet Surgeon, however, was appointed, and he came to the conclusion that a less ambitious scheme would satisfy the requirements. He also favored the bringing of the hospital nearer to the working Base proper, his suggestion being that it should be located on a site to the south of the barracks. The hospital block is coloured red on the plan. Then, again, instead of erecting the hospital wholly of brick, we now propose that it shall consist partly of brick and partly of wood. In working out the details, we have been in close touch with the Fleet Surgeon, and also with the works officers of the Navy Department. The scheme, now reduced in size, is that which is before you for consideration. When the Committee visits the Base, the proposed site of the hospital will be pointed out. I do not wish to influence the Committee in any way, but I think a more suitable location for the hospital could be found. The reduced estimate of the cost, exclusive of heating, is £8,842. A general scheme of heating is under preparation. The next project is that for the erection of detention barracks. I understand that misdemeanants are dealt with, first of all, at the guard-house, and are subsequently removed to the detention barracks. These detention barracks will be erected at a point to the west of the barracks as shown in red on the plan. They are isolated from the other barracks buildings, and will consist of brick with concrete cells, and a brick stockade wall. Timber buildings for the accommodation of the warders will also be provided. The Committee will see the site of the detention barracks when visiting the Base. The site originally selected was to the north of the present suggested site; but as it presented some sewerage difficulties, it was agreed that the site shown in red on the plan should be chosen. Coming to the armourer's workshops, I may say that the buildings have already been before the Committee. They were passed by the Committee in 1915. The original proposal with which the Committee dealt was a small one, involving a cost of something under £400. Since then there have been considerable changes, and the building now proposed to be erected will cost, it is estimated, over £1,700. In view of this increase, we did not proceed with the work, thinking that the Committee should first have an opportunity to reconsider it. As to the quarters for married officers, the Navy programme for this year is to provide one senior officer's house and one junior officer's house. The proposal is to erect, as shown on the plan, a senior officer's house to the west of the recreation-ground; while the junior officer's house will be erected at the point marked on the plan. We have erected a house for the captain of the College, two senior officers' houses, and two junior officers' houses. They, together with two warrant officers' houses, were passed by the Committee in 1915. The original view with regard to the accommodation to be provided in the warrant officers' houses underwent a considerable change, and these houses have not been proceeded with pending further consideration by the Committee. The accommodation to be provided is in excess of that originally suggested by the Committee. It is proposed this year to erect ten warrant officers' houses, in addition to the two that were passed two years ago. The other works relate for the most part to engineering matters, concerning which Mr. Hill will give evidence. There are accessory works which have not yet been referred to the Committee. The data relating to them have not yet been completed, but will be submitted later on. All the data of the buildings concerning which I have spoken this morning are available for the Committee. There is not much work going on at the Base at the present time. The accommodation to be provided in the hospital will comprise two wards of sixteen beds each, a special ward of two beds, and an observation ward of one bed.

14. *To Mr. Mathews.*—You say that the site of the hospital is very close to the workshops, the noise from which might disturb the patients. I should not like to express any definite opinion on the subject. The site was selected by the Fleet Surgeon. I do not think I would have selected it; but it is a matter for the Committee to deal with. The selected site is, as you say, very close to the seamen's barracks. There are other barracks to be erected close to the hospital site. The power-house and stores are about 400 yards distant from it. The hospital site comes, so to speak, between the men and their activities. I do not think it is altogether a desirable one.

Thomas Hill, Engineer, Department of Works and Railways, sworn and examined.

15. *To the Chairman.*—I have seen the reference to the Committee which is now under your consideration. A certain proportion of the works included in it comes within my control. I have the sketch plans here, and shall deal with them in their order. The first relates to water reticulation within the Base. On a previous occasion the Committee dealt with the question of the main water supply, and I have brought with me a sketch map—kindly supplied by the State

Rivers and Water Supply Commission—showing the development of the main scheme of water supply for the Mornington Peninsula. The map shows the catchment area at the head waters of the Bunyip River—an area of 29 square miles—the offtake from the Bunyip River, and the line of the pipe mains and aqueducts for a distance of, approximately, 50 miles, to the service reservoir of 1,000,000 gallons, which is, approximately, two and a half miles from the main buildings of the Naval Base. Upon that portion of the scheme the Committee has already reported. I propose now to deal with the reticulating scheme which starts from the 1,000,000 gallons service reservoir—that being the work included in the present reference to the Committee—and which is to provide for water supply and fire service in and around the Base buildings. The main water supply is being carried out by the State of Victoria, and is part of a general scheme, as shown on the sketch plan, for supplying the whole Peninsula, with an ultimate extension to Sorrento and to Point Nepean, opposite Queenscliff. The off-take at the head of the Bunyip is at a reduced level, above low water, of 410 feet, and the service basin near the Base is at a level of 160 feet. It is from that 160 feet level that we take the supply. On the small sketch plan, starting from the service reservoir of 1,000,000 gallons, is shown a 12-inch main, approximately 225 chains in length, to the main buildings in the Base. Thence the 12-inch pipe is carried to a point near the guard-house, where it is broken up into small sized mains. A 9-inch pipe is laid southerly along the front of the main stores buildings, the torpedo and mining school, and the power-house. At the power-house it breaks down to a 6-inch pipe, and thence goes westerly, along by the boat builders' shop, and north-westerly, to a point near the proposed hospital site. There it again becomes a 9-inch pipe, and goes northerly, at the rear of the seamen's barracks, and easterly, by the single officers' quarters, to the 12-inch main. Intermediate mains of 6-inch pipes are distributed amongst the other buildings of the Base, including the drill hall, gymnasium, and magazine. A 4-inch pipe, taken from the 9-inch pipe, near the stokers' school, is carried to the wharf for the use of vessels lying there. For the supply of the buildings east of the Base, consisting of warrant officers' and senior officers' quarters, and also for the possible position for the hospital, the 9-inch pipe is taken from the 12-inch pipe, near its junction with the main guard room, easterly along the main roadway, to a point near the tennis court. From there it is reduced to two branches of 6 inches, which reticulate the various quarters. The sizes of these pipes were submitted to the Chief Officer of the Fire Brigade, Mr. Lee, who kindly visited the Base, and, having inspected the buildings, agreed that the sizes shown were sufficient to give an ample supply of water for fire purposes. Mr. Lee also made a recommendation as to the distance between the hydrants, and that recommendation has been adhered to. He recommended that the maximum intervals should be 600 feet, but in no case has that distance been reached. In and around the main fire risks the distance has been reduced to something like 200 feet. The pillar hydrants will be of the double-headed type, and reference to the plan will show that at any point among the main store buildings or at the seamen's barracks, at least four hoses can be quickly brought to bear on any outbreak of fire. The capacity of the mains is such that there would be practically no reduction in pressure. There will be an ample supply for all the hoses. This plan was submitted to the Department of the Navy, which concurred in the scheme except in regard to the provision of a 6-inch main in the roadway eastward of the barracks. The Naval authorities suggested that that main might well be excised, inasmuch as the main to the westward of the barracks would be ample. They also suggested the deletion of a small portion of the 6-inch reticulation near the magazine joining up with a 6-inch pipe to the east of the boat builders' shed. The original proposition provided for a 6-inch pipe running from the guard-room to a point close to the tennis court, to serve the settlement near the railway station, but the Naval authorities asked that that should be a 9-inch pipe. We concurred in their suggestions with the exception of the proposal to excise the 6-inch main in the roadway to the east of the barracks. Mr. Lee thought it would be advisable, if possible, to retain that main for fire protection purposes, and I have, therefore, retained it on this plan.

16. *To Mr. Mathews.*—The reticulation forms a complete circle round the main buildings, with the exception of the prolongation of the 6-inch pipe to the south of the magazine. I have prepared a detailed estimate of the cost of this water reticulation and fire service.

17. *To the Chairman.*—The piping throughout is of cast iron, that being the most reliable for the purpose. It will permit of future tappings at any point. Reliability is a most important factor from the point of view of the use of the service for fire extinction purposes, and I think the cast-iron pipes are the most reliable. The Committee, in its last recommendation with respect to these works, accepted the evidence of the State Rivers and Water Supply Commissioners that the 1,000,000 gallons service reservoir would be part of the State scheme, and would be paid for by the State. Special mention of that statement was made in the recommendation. Since then, however, correspondence has passed between the Commonwealth and the State Rivers and Water Supply Commissioners, who now ask that the reservoir shall be a charge against the Commonwealth, urging that at the present time the Base would be the only area supplied from such a basin. In their estimated cost I think they put down £1,000 as the expenditure necessary to provide for this reservoir. The next point that arises is as to the site of this service reservoir. I consulted with Mr. Shaw, the engineer of the Commission, and a site has been selected, as shown in the sketch plan, at a distance of two and a half miles from the main buildings of the Base. The level is considered suitable. In accordance with the Committee's recommendation, a small area of land will have to be acquired, as well as an easement over private property, for the 12-inch pipe, for a distance of about 1 mile between the reservoir and the Naval Base property. The suggestion has been made that when constructing the reservoir we should put in a by-pass from the State Rivers and Water Supply Commission's 8-inch water main supplying the service reservoir, and so take advantage of the head that can thus be obtained, should it ever be required, from the nearest reservoir controlled by the Commission. That reservoir, I understand, is at a level of about 220 feet. We should, therefore, get a further pressure of 60 feet by opening a valve and letting in from the 8-inch pipe. We should then have only the capacity of this 8-inch pipe as against the 12-inch pipe that we propose to put in from the service reservoir,

but would have an increased pressure. I think the pressure would be ample without this addition, but it is a wise precaution to take, and it can be made at small cost. The nearest State reservoir will be to the westward of Hastings, and will be at a level of 220 feet. It is to have a capacity of 80,000,000 gallons. The levels of the buildings at the surface of the Base vary from 10 feet at the wharf to 40 feet at the seamen's barracks, so that the service reservoir will be 120 feet above the surface of the ground at the seamen's barracks. The next subject I shall take is that of sewerage reticulation. The Committee dealt, in a previous report, with the disposal of the sewage as from the septic tank to the outfall, and in that report it urged that the tank should be at least 700 yards from the nearest barrack building. The site of the septic tank is shown accordingly, on the sketch plan, at a point across the creek, the outfall discharging thence in a south-easterly direction into Westernport Bay at a point bearing about ¾ mile inside the Commonwealth boundary. It is from the septic tank that the reticulation now before the Committee starts. The main portion of the sewage to be led to the septic tanks is from the seamen's barracks at a level of approximately 30 feet at the floor levels of the buildings. Fully 90 per cent. of the flow will be from that point. Being at that level of 30 feet, as against the septic tanks level of 10 feet, we can deal with the sewage by gravitation. The plan shows an 18-inch pipe commencing at the level of 24.3 at the furthest proposed building, or at 22.3 at the barracks, as at present existing. We propose to have an 18-inch pipe running to a point to the north-west of the proposed hospital site. From thence we show a 12-inch pipe in stoneware, and partially in cast iron—where it passes over the creek—to the septic tank. The 18-inch pipe will have a grade of 1 in 400, and the 12-inch pipe a grade of about 1 in 200. The rest of the sewage from the main portion of the Base, inclusive of the hospital and detention barracks, on the sites mentioned by Mr. Murdoch, is to be carried by gravitation to a proposed pumping station near the magazine station. From there it will be lifted to a height of about 25 feet, in a 4-inch pipe, and flow into the junction of the 12-inch and 18-inch mains to the north-west of the hospital. The rising main is shown on the plan by a blue line. The quantity of sewage to be dealt with in that way is small. It will consist only of the flow from the workshops, torpedo and mining school, signalling school, stores, drill hall, gymnasium, administrative offices, and one group of warrant officers' quarters. The remaining sewage of the Base—again a small quantity—is that from the warrant officers' and senior officers' quarters, near the Crib Point Railway Station, as well as that from another group of single officers' quarters to the north of the parade ground. It is proposed to lead it by gravitation to a small pumping well, at a level of approximately 4 feet, to the east of the main guard room. Thence it will be taken by a 4-inch cast-iron main, as shown in blue on the plan, and lifted into an 18-inch stoneware pipe, at the rear of the Chief Petty Officer's Barracks, at a level of approximately 22. This will mean a lift of, say, 28 feet by means of a 4-inch cast-iron rising pipe. The proportion to be dealt with there is also small, comprising at present the sewage from some twenty-two quarters, and from a group of single officers' quarters. It was thought that the officers' quarters near the Crib Point station might be dealt with by a separate system, in a septic tank discharging into the Inlet, but the acting engineer of Naval Works at the time, Mr. Swan, took exception to that suggestion. After consideration, it was decided that such sewage could be readily dealt with at low cost by the pumping scheme suggested. Thus the whole of the sewage at the Naval Base would be gathered into one septic tank, and would have the one discharging point into Western Port Bay, and would involve only such attention as was necessary to the one point, namely, the septic tank. The pumps will be of the centrifugal type driven by electric motors, automatic in action, working by a float. The cost of the pumping will be small. As a set-off, it must not be forgotten that with separate septic tanks there would be two points of maintenance. The estimate prepared in detail for this work is £12,750. Those figures include provision for two sewage pumps, motors, and everything connected therewith. An item of £400 would install the two pumping stations. The piping is to be of tested vitrified stoneware throughout, with the exception of that leading across the creek near the septic tank, which will have to be carried for a short distance on trestles, and will, therefore, consist of cast iron. We propose to use cast iron rather than stoneware at this point because, as the Committee is aware, the stone-ware pipes are only 2 feet long, and would, therefore, involve more trestles than would be required if cast-iron pipes were used. Cast-iron pipes are not cheaper than steel pipes, but I do not think it would be considered wise to expose steel pipes to sewage. All the drains would be tested in accordance with the most modern practice adopted in Melbourne and other cities. The drains will be self-cleansing. It has been estimated that 90 per cent. of the sewage will gravitate, while the remaining 10 per cent. will require to be pumped to the extent of the low lifts I have mentioned. Ventilators are to be provided at intervals, and will be carried as far as possible on the nearest buildings, so that they will not be an eyesore. Where no buildings are available for the purpose, then the cast-iron base and sheet-iron vent pipe, as used in the streets of Melbourne, will be adopted. This plan provides for everything from the septic tank to the actual building, finishing at the gully, or the disconnecting trap, as the case may be. Some of the pipes which were intimately connected with certain buildings, such as the seamen's barracks, have already been put in to avoid any tearing up of the surface in the future, and to permit of the other plumbing connexions being made. Beyond that nothing has been done. A small section of the 18-inch main, towards the back of the barracks, was commenced over a year ago, but some trouble arising with the men, the work was allowed to stand over. This sewerage plan has been submitted to the Naval authorities, and has met with the concurrence of Mr. Swan, acting engineer for naval works. It was his suggestion, as I have already mentioned, that we should have a second small pumping station. The next matter to be dealt with is that of storm water reticulation. The storm water scheme is to provide for roof waters and discharges around the buildings into a number of stoneware or open drains that have already been constructed. The drains which have been constructed are shown in dotted black lines on the plan at 100 feet to the 1 inch. The open cut storm water drains are shown in either dotted or full black lines. The pipes proposed to be laid under this scheme are shown on the two plans in green lines. The piping varies in size from 18 inches to 4 inches. Good stoneware, but untested, pipes will be used in accordance with the

general practice. Although they have not passed the test to which pipes are subjected for sewerage purposes, they are still quite good enough for roof discharges. The estimated cost is £7,300. I submit the estimate in detail. The estimate does not include the extension of storm water drains, which will be required as further buildings are erected. The scheme has been planned, however, to permit of such extensions being easily made in the future. These extensions are shown in dotted green lines. Our present proposal is only to connect up the buildings actually constructed or known to be in contemplation at the present time. The discharge points are all into Hann's Inlet. There can be no objection to that, as only surface and roof water will be discharged. As I have mentioned, the largest pipe will be 18 inches, and the smallest—used for small branches connecting the foot of the rain-water pipes with the main pipes—will be 4 inches. Electrical distribution is the next point to be considered. I produce two plans, on the same scale as the others, showing the proposed lay-out of the electrical mains. The question of generators, voltages, and pressures were matters for the Department of the Navy, who advised us, in 1916, that they had decided on a voltage of 230—460 direct current. They are supplying the power and generators accordingly. The particular proposition now before you commences with the switchboard in the power-house. It provides only for distribution from the switchboard in the power-house, and no provision is made for any of the generating plant. Three alternative suggestions were prepared and submitted to the Navy, namely, underground, partially underground, and overhead mains. Varying estimates, according to the several alternative suggestions, have been made, and the matter is receiving the consideration of the naval authorities. The estimates made at the time varied from £15,000 to £28,000, according to whether underground or overhead mains were adopted. The object of the scheme is to distribute power and light to the various buildings within the Base. The workshops are included; being close to the power-house they are really part of the scheme. This plan deals only with the mains, starting from the switchboard and finishing at the distributing point of each building. It does not touch the actual connexion with the motors, but deals only with the wiring. The scheme also includes some of the lighting, such as street lighting, but not all the lighting in the various buildings. Some of the works in connexion with the lighting of buildings was carried out while those buildings were in process of construction, so as to enable them to be completed. You will see that the wiring of the seamen's barracks is ready to be connected up. The work has also been held up because of the increased price of copper and electrical materials, but I thought it advisable to instruct the electrical engineer to prepare plans and estimates of definite proposals to place before the Committee. The plans now before you are the result of that instruction, and provide for an overhead scheme which our Department thinks is the system that should be adopted. The assistant electrical engineer will explain to you the actual details of the routes of the overhead proposal, as prepared under my direction. The cost of this scheme is estimated at £16,500. From the power-house one set of mains will go westerly and northerly at the rear of the seamen's barracks, with branches into those buildings, and will finish at the proposed site of the detention barracks.

17A. *To Mr. Laird Smith.*—The length of that main will be about 4,000 feet. It is proposed that another set of mains shall proceed from the power-house due north along the roadway to the east of the drill-hall, commanding all the administrative offices, stores and gymnasium, until it reaches the roadway running easterly. Thence it will go easterly along the main roadway—passing the guard-house—to the officers' quarters near the Crib Point railway station. That is a distance of 7,000 feet. There is, of course, the possibility of an extension to connect with the proposed hospital. The position of the poles for the suggested street lights are shown in red. The service poles are shown in blue, and the general poles necessary in black. The longest length of mains is that running to the married officers' quarters, which is shown on the scale as being 7,400 feet. The lengths of the various mains are shown in the table on the plan. The electrical engineer will submit the schedule for the full proposal, and the estimate of cost, including fittings. This is essentially an overhead proposition, which takes into account the least unsightly situation for the poles. It gives what is thought to be reasonable street lighting by providing for the street lights being placed on poles that will of necessity be there to carry the mains. The cost of undergrounding the cables would be much heavier. We have also taken into account the desirability of avoiding any unnecessary interference with buildings. It will be observed that there is a minimum of interference. Short of absolute undergrounding, within the main portion of the barracks, the proposition that we should have overhead mains is the best. A number of other matters are ready for the consideration of the Committee. The heating and hot water schemes will be ready very shortly, together with the schemes for local telephone services and clock and fire alarm installations.

18. *To the Chairman.*—This scheme provides for the distribution of electrical power to the various buildings. The Navy authorities are putting in the engines and generators. We provide for the whole of the lighting, and for the power that will be required for the pumping station, as well as any other power that the Navy may need for its various works. In short, we provide for light and power, as far as we can estimate the requirements. Most of the power apparently will be required in the workshops, which are close to the generating station. Some little power will be required for the sewage pumps. The single officers' quarters have some fireplaces in them, and it is not proposed to supply them with hot water heaters. In the seamen's barracks, hot water heating will be provided.

Fleet Surgeon (R.N.) Algernon Carter Bean, Director of Naval Medical Service, Adviser to the Naval Board, sworn and examined.

19. *To the Chairman.*—I have been in the naval service just over 20 years, and with the Commonwealth since June twelvemonth. I am concerned only with the hospital, although I might be called on to advise on sanitary work so far as health is concerned. I have not looked into the proposals for the sewerage of the Base, because they do not come within my province. I have looked into the plans for the proposed hospital, and generally made suggestions. The recommendations in the reference to the Committee regarding the hospital have been approved by me. I have been able to give only a short glance at the latest plans, because they

did not reach me until yesterday, and I have not been able to consult with anybody about them; but I have generally looked into these plans. The work for which they provide is partly permanent and partly temporary. The intention is to make the administrative block or depôt surgery permanent, and the wards or hospital proper temporary. The temporary proposal was suggested by myself to reduce the expense of the hospital until we could absolutely decide what our requirements would be. They are to consist of wards to be so constructed that they can be taken away afterwards, and made use of as infectious blocks, so that the primary expense may not be absolutely lost. The depôt surgery will be a permanent building, because it is necessary to have a surgery at the depôt to deal with cases as they come on the sick list, and are drafted from there to the hospital. Provision is made for 35 beds, but the officers' block, to cover from four to six beds, would bring the total up to about 40. That would be essential for the first requirements. It is very difficult to say what will be required, but there will be no difficulty about adding extra rooms in case of necessity. For some time, from four to six rooms would be ample in the officers' block. The permanent hospital would be built of brick, and be a much more expensive item. The original estimate for that, which included living and dwelling houses for the nursing staff and for the doctors and nurses, ran into something like £20,000. That was the latest estimate. The site chosen for the permanent hospital is on the hill, well away from the barracks, a very fine site, although somewhat exposed. I believe provision is being made in regard to the general lay-out of the whole Base for all the facilities of electric lighting, water supply, sewerage, and storm-water drainage, to be available for the permanent hospital. It is clearly understood that the present hospital proposal is only temporary.

20. *To Mr. Mathews.*—The position of the temporary hospital site was selected because it seemed the most suitable place for a surgery depôt. The permanent depôt must be in such a position that it is convenient for all places, and we put the temporary hospital really alongside the surgery depôt. The site was not bad, so far as the contours went. I did not consider the proximity of the big workshop. I do not think that would affect it very largely. The original intention, of course, was to have the hospital well away on the hill. That was the best idea, but it was a question of the large expense. We should have to have houses for the staff, including the sick berth staff. Here we have not provided for them, because the sick berth staff will live in the barracks. If we had to provide separate quarters for them, it would add a good deal to the cost, and it would also be necessary to build an administrative block. The administrative offices that we are building will be used as a depôt surgery afterwards. Ultimately, of course, there will be a permanent hospital elsewhere.

21. *To Mr. Sampson.*—That will be on the original site on the promontory.

22. *To Mr. Mathews.*—I do not know what the total strength of the establishment will be. My great difficulty in estimating the size of the hospital is that no one can say what is going to happen after the war. That is why I suggest a temporary, instead of a permanent, hospital to begin with.

23. *To Mr. Sinclair.*—The permanent portion of the hospital that we are now proposing to construct will be used for the depôt surgery, which will consist of a consulting room, a dispensary, a surgical dressing-room, a small ward with two beds, an observation ward for doubtful cases of infectious disease, a dentists' room, and a room for the treatment of venereal cases which do not require to go to the hospital. It is not proposed to have, in addition to the hospital, a first-aid station or room connected with the works. The depôt surgery will be the first aid. It is conveniently situated for all the buildings. It is also intended for a dispensary where out-patients can get their medicine three times a day. We put it in such a position near the living blocks that the men who have to get their medicine at certain hours do not have far to go. When the permanent hospital is established, this building will be used for first aid purposes. I believe it is intended to have a doctor always at the depôt surgery, and that, probably, there will be one, two, or three doctors at the hospital.

24. *To Senator Needham.*—In cases of injury through accident, I think all employees, including artisans engaged at the Base, will have the advantage of the hospital; but I do not think that will be so in cases of sickness. The general rule with naval hospitals is that they are for naval ratings only, and not for civil employees; but cases of accident are always different. In cases of ordinary sickness, the men go to their homes, although they may be some distance away. Any system whereby civil employees could have the same use of the hospital as the naval ratings would make it a general hospital, and one would have to consider the women and children as well. Between now and the establishment of the permanent hospital, men engaged in constructional work, and their families, could get first-aid treatment from the hospital in an emergency. They could get the advice of the resident doctor there for emergency cases of sickness, because we always attend to anybody in an emergency; but cases of sickness would not be treated. A naval surgeon is entirely for naval purposes. It is a very difficult question whether the men engaged in the constructional work between now and the establishment of the permanent Base can have the benefit of the temporary hospital, but I think not.

25. *To Mr. Laird Smith.*—It would be a great convenience to the men in cases of accident to have the temporary hospital adjacent to the works, fitting shop, and so on, even if later on it is to be only subsidiary to the general hospital. The object of the depôt surgery is to be able always to admit cases of accident, and deal with them there first, and dispose of them afterwards either to the hospital or elsewhere. Nobody who met with a serious accident at the Base would be refused treatment.

26. *To the Chairman.*—I do not know that I could recommend another site for the temporary hospital to the north of the barracks away from the workshops, because on its present site the depôt surgery is most conveniently situated for all parts of the Base. As it is to be a permanent surgery, this is the best place for it. Cases would come from the drill sheds, workshops, and barracks. The general lay-out of the plans is satisfactory, with the exception of one or two very minor details.

27. *To Mr. Sampson.*—Of the estimate of £8,842 for the hospital, £2,315 is to be expended in building the surgery depôt of brick. That will be permanent, and essential even when the permanent hospital is erected elsewhere, because a large number of cases do not require hospital treatment. There must be a dispensary, and also a place for the sick to be seen in the morning or during the day. The surgeon there would select

the cases to be sent to the hospital. The staff there would not be large, but we cannot avoid having two staffs, one for the depôt surgery and one for the hospital. I do not think we could have one establishment in a more convenient position to cover both requirements. It would not be desirable to have all sick cases at the hospital. Besides, the depôt surgery will be also the dental establishment.

28. *To the Chairman.*—All the temporary buildings can be used later for infectious cases as portion of the permanent building.

Thomas Hill, engineer, Department of Works and Railways, recalled, and further examined.

29. *To the Chairman.*—The original arrangement was that the 1,000,000-gallon service reservoir should be completed by the State Water Supply authorities, but they are querying the point. I should think that might be a departmental matter for the Ministers to settle. There is no change in the original design of the water supply work or pressure. I recommended cast-iron piping for the reticulation. I recommended a 12-in. cast-iron pipe from the service reservoir at the Base. At present prices I do not think it will cost much more than a steel pipe. It will be much more permanent, especially as its route is across a creek or swamp of brackish water for some distance. I would not like to put a steel pipe there. For other portions of the route a steel pipe would have the ordinary life of such a pipe, well coated. Well looked after, and the coating looked after, I would expect a steel pipe to last fifteen years; a cast-iron pipe I would expect to last from 60 to 80 years, or an indefinite period so far as is known. Under present conditions there is a better chance of getting cast-iron at a cheaper rate than steel. Steel plates are very dear. The last quotation was about £70 a ton, whereas we got cast-iron at £12 10s. a ton. I have estimated the cast-iron pipes for this work at £13 10s. a ton delivered, which is not so much of an advance over prices before the war. There is a better chance of getting cast iron, and it would be a cheaper proposition at the present time. From the reservoir to the Base, there would be 220 chains, or 2.86 miles, of 12-in. pipe. I gave some thought to the question of putting a wooden main or a concrete main there, but as it is the main connexion from the service reservoir into the Base, it has to be ready to meet an immediate demand in case of fire, and only the most reliable material should be used in that position. It is to be an 8-hour main,. If it was to be a 24-hour main as between two large reservoirs, I would probably have used other material, but in this position I say only cast iron. In considering the water supply in the first case, the hospital was taken as being on the promontory at the furthest distance, and Mr. Lee's advice was given with the knowledge of the hospital being in that position. The 6-in. main originally proposed to be put in that direction was with a view to the hospital being at the end of it. A 6-in. main is advisable with the idea of extending the pipe to further buildings as they come in. It would not need much of an extension to justify taking up a 4-in. pipe if it was laid there at present, and re-laying with a 6-in. pipe. Four-inch pipes are used in the city only in branch streets where there are a few houses, and are generally reinforced from a large main at each end if possible. There are very few dead-ends laid with 4-in. pipes. In the case of this line, you might have three double-headed pillars going at once. This main will supply much more than ordinary domestic purposes. In fact, all these mains are based more on fire protection than on domestic requirements. They are very ample for domestic supplies. Their sizes are designed to meet ample demands in cases of fire. I would not say we have a big pressure. It is a fair pressure, due to the size of the pipes. If we could put another 100-ft. head on the service reservoir, we should be justified in reducing the size of the pipes, but with the head we have I should say these sizes are warranted for fire purposes. With the present sizes, the hydrant would not throw the water from the surface over the barrack roof. On Mr. Lee's advice, to meet that difficulty, we have run pipes up the outside walls, and made provision on the balconies on each floor with a hose and nozzle alongside, so that there will be ample pressure at all those points to deal with any fire that breaks out. The ordinary static head from the reservoir at the top of these barracks would be 60 feet. All the mains, both before and behind the buildings, are essential for fire safety. These works will be under the charge of Mr. Settle, Director of Naval Works. They will not come under my control that I know of. No decision has yet been given as to the carrying out of the work by day labour or contract. Whichever way it was decided to carry out the main works, I would include the water supply works under the same method. To me it is simply a matter of which policy is adopted. In any case, the supply of the pipes and all the fittings would be by contract, leaving only a portion, viz., the actual labour to be decided.

30. *To Mr. Mathews.*—Very ample provision has been made for a continuous supply of water for the Base, even if the population of the rest of the Mornington Peninsula increases considerably during the next few years. Storage is being provided along the route of the main water supply. An 80,000,000-gallon reservoir is being provided within a few miles of the Base. This will serve the Peninsula from Hastings onwards.

31. *To Senator Needham.*—The water supply is of splendid quality for boilers. It has been analyzed specially for that purpose, and has been found to be pure mountain water from a granitic soil. It is similar to the Melbourne supply.

32. *To Mr. Sampson.*—We have been in correspondence with the State Rivers and Water Supply Commission as to the responsibility for the service reservoir. In a letter to Mr. Commissioner Shaw, dated 16th February, 1917, I said, amongst other things—

> As to the cost of the million gallon reservoir, I notice it is included in the estimated cost furnished by you to the Commonwealth Parliamentary Standing Committee on Public Works, in your evidence before them on the 30th May, 1916, under the item, "Service Basin at Naval Base, capacity 1,000,000 gallons, £1,000," as part of the estimated cost of the work, £156,000, to be carried out by you. . . . The Works Committee, in their report, also state in paragraph 34, page 8, "The service reservoir will be constructed as part of the general scheme. From that point responsibility devolves upon the Commonwealth." In view of this, will you be good enough to reconsider your verbal opinion to me the other day that the Commonwealth should do that?

The following reply was sent by Mr. Commissioner Shaw on the 14th August, 1917:—

> In the scheme as originally outlined, the supply to the Naval Base area was to be

drawn from a service basin of 1,000,000 gallons capacity, to be constructed at a cost of £1,000, at a suitable elevation near the north boundary of the Base area. It was then proposed that this service basin will be established by the Commission in the usual way, for the use of the Base and the vicinity. At the present time the Base would probably be the only area supplied from such a basin, but it is possible that in the near future a demand for supply might arise from Crib Point and other places adjoining. During the discussion upon the scheme it was pointed out, that in order to secure the advantage which would arise from a service basin which could be kept quite free from outside demands, the Federal authorities would, probably, prefer to buy for themselves the site and construct their own basin.

No further action has been taken since then. Mr. William Catanach, Chairman, State Rivers and Water Supply Commission, on the 1st June, 1916, gave the following evidence:—

> The idea is to have a large basin which would make the supply for the Naval Base practically safe, and it is, therefore, suggested that there should be a service basin close to the Naval Base, and entirely under the control of the Commonwealth. We are quite prepared to construct this small basin, and it would not cost a great deal of money. We consider that it would be better that the naval authorities should have this small service basin entirely under their own control.

It is extremely difficult, under present conditions, to estimate when the water will be available, or ask the State officers dealing with the matter to give an idea, but I know they are pushing on with the work with all possible speed, and with a desire to give effect to their promise to the Committee that they would give the water supply, if possible, within a year from the commencement of the work, which would approximate about seven or eight months from now. Their difficulties with material, pipes, and labour are very great. The supply of water now being taken to the Base by train is not very costly. Very few men have been employed there for some time past, and the quantity is small, but the rate remains the same as I told the Committee previously. I prepared the plan as to the size of the pipes at the Base on what I thought would be necessary for domestic and fire purposes. I submitted it to the chief officer of the fire brigade, and he made several suggestions, but not altering the conditions much. The population estimate was for 2,000 people at the Base, but in designing the size of the mains I did not consider population so much as the question of getting sufficient water supply at certain points to keep four nozzles of 2½-inch canvas pipes going on any building, and also with the knowledge that that might be necessary in more than one place. It is conceivable, for instance, that more than one of the stores buildings might be on fire at the same time, and provision is being made to be able to bring to bear in that place eight double-headed fire hydrants, each discharging 150 gallons a minute at a pressure of 20 lbs. at the nozzle. If I were laying down a scheme for the requirements of a civil population for the same area, as distinct from naval base requirements, I would not provide pipes of as large a diameter, because there would not be the same fire risks in an ordinary suburban area. The store buildings at the Base are a very vital point for fire attacks. I should say 12-inch pipes would become 9-inch, nines would become sixes, and in some cases sixes would become fours.

33. *To the Chairman.*—Ample provision has been made for water supply on a large scale for shipping. There is a 4-inch pipe going off towards the end of the 9-inch, and fed from two directions. There is also a 6-inch from another direction. In case of fire on a ship, the 9-inch pipes are within less than 300 feet. Salt water could be used for fire-extinguishing purposes if the ship had the necessary pumping plant. Even if a large fleet of warships came in and wanted a water supply quickly, we could water them very rapidly.

34. *To Mr. Sampson.*—In estimating the scheme of water supply and sewerage, we did not take the outside population into consideration. If population grows adjoining the railway station, it will be a matter for the State Rivers and Water Supply Commission to put up an independent reservoir. The proposition is to put it alongside ours and run their own system of reticulation. Our system is to be absolutely for Base purposes only.

35. *To Mr. Mathews.*—In the original proposition as put before the Committee last year, the effluent was to be taken from the septic tank to Westernport Bay, a distance of a little over 2 miles; but objection has been taken by the residents to the point of outlet, and consideration is being given to another wholly within Commonwealth property, and well away from any settlement. That distance will probably be another half-mile. I would not regard regard it possible for any effluent to be as pure as water.

36. *To Mr. Sampson.*—We have placed the septic tank 700 yards away from the Base. That is sufficient. I have seen no reason to alter my previous views on that subject. The proposition is for an anærobic tank only, to be covered over so that there can be no possible annovance. The effluent is not to be treated ærobically, but is to be pumped out to Westernport Bay. There is no question of any possible annoyance arising. The sewage is received in a sealed chamber, partially clarified, and pumped out to the sea. The size permits of the tank being covered over, and as the discharge point of the effluent into the Bay is 3 miles away, I cannot suppose that any possible annoyance can arise.

37. *To the Chairman.*—In my report on the reticulation for this sewerage work, I provide for 1,602 feet of 12-inch cast-iron pipe, and trestling to carry it over the low ground until that is filled up. The proposition is to fill that up to the 15 feet level, and when that is properly settled, which would take some years, the trestling can be done away with; but I still think that in that country, with the chance of contact with salt, it is absolutely essential to have 12-inch cast-iron pipes for a work of that kind at the present time. This would be no more costly than steel. It is not a heavy section pipe. It is not as if it had to stand pressure. It will be as thin as we can cast it, from about half to nine-sixteenths of an inch. At the present time, that is quite as cheap as any steel pipe. I do not think that with sewage running through it, the life of a spiral tube would be longer than a very few years. Even bitumen coating is soon attacked by acids in the sewage. If concrete tubing were used, the trestling would have to be increased to carry the pipe every six feet. In view of the possible filling-up of the ground, and all other conditions, the cast-iron piping is the cheapest proposition. The estimate of cost is: 1,602 feet, 12-inch diameter

cast-iron drain pipe, fixed with light iron straps on cradles in the decking, at 12s. a foot, £961 4s. The total cost, including the trestling, is £1,404. We are providing two pumping stations, one for the residential portion of the Base, and the other near the workshops. In the original proposal it was suggested that there should be a septic tank at the residential quarter, and that the effluent should be run into the sea. I do not think that the change was made on the score of economy. There was no difference in the cost between the two schemes, but the navy officer took objection to the discharge of the effluent into the inner area of Hann's Inlet right in front of the Base. In view of the alternative not being apparently any more costly, and enabling us to dispose of the sewage at a further distance into Westernport Bay, it was agreed to, and thought to be a good suggestion. I have not estimated the annual cost of the two pumping stations, but it will be small. I have not got the figures fro the Navy of the probable cost of current; but in view of the light lifts and the small quantity required for this purpose, practically negligible in comparison with the rest of the load on the Base, it will amount to only a few pounds per annum. It is absolutely essential to have the one pumping station for the workshop and store area, unless the effluent is discharged direct into the Inlet after treatment. I do not think it would be advisable to discharge the flow from there directly into the dock in front of the buildings. There is no danger of offence from the pumping stations, because they will be sealed circular chambers with closed lids, and no gas can escape. The pumps will work automatically with a float. As the sewage rises, the float makes electric contact, and the pump runs until it reduces the level of the sewage in the sump, when the weight is applied, cuts off the current, and stops the pump. The cost of installation of the pumping plants, with motor, pump, pipe, float attachment, chamber, and everything complete, is £200 each. At the residential area, there would be necessary about 1,000 feet of 9-inch pipe and a septic tank, as against 1,500 feet of 9-inch pipe. A pumping station is still required to deal with the guard-room and the single officers' quarters to the north of the parade-ground. The sewage from the officers' quarters could gravitate to the pit at the other end, but it would mean laying a pipe of large diameter, because the grade is flat, in very bad wet ground alongside the Inlet. We were glad to find some means to avoid that proposition. I said that there was an alternative of 1,600 feet of 9-inch pipe as against about 900 feet plus a septic tank; but this plan shows a retaining bank and the water up against it. That is not yet constructed, and it may be many years before it is formed. We should have to discharge the effluent over the mud flats, which are bare at low water for a considerable time. The cost of a small septic tank there would be about £100. The hospital at Stony Point was to be treated separately, and the effluent discharged into Westernport Bay direct. That is, it was to have a system of its own.

38. *To Mr. Laird Smith.*—The view expressed by the Navy Department about the septic tank position has been the subject of a good deal of consideration. It stated that the Home Affairs Department had been asked to put the septic tank further away from the barracks, because in practice it was found that there was a considerable odour from septic tanks. But the propositions so far made have not been found to be practicable, and I think the original proposition is best to be adhered to. It must be remembered that there will be no ærobic tank exposed to the air there. There will be only a closed-in chamber and pump well, about 700 yards from the barracks. There can be no odour from it. I would not concur with an ærobic or filter bed being put 700 yards from the barracks. At Duntroon there is only an anærobic tank, with distribution into the soil. Here we have distribution into the sea instead.

39. *To Mr. Mathews.*—It would be possible to underground any portion of the electric main, including the portion going northward from the power-house to the rear of the barracks, but the cost would be much increased, and we will give you evidence later, with figures, showing the relative cost of overhead and underground work. The underground cable is much more expensive. The cost of poles is only a small proportion of the maintenance. It is preferable, if possible, to have the wires exposed, because if faults occur they are more accessible and more quickly cured. You will see to-morrow that the suggested route with overhead poles is not objectionable. It is not as if they were being brought in front of the barracks, or between the barracks and the parade-ground. The route from the back of the buildings was suggested so that it should not interfere with the main expanse of the Base.

(*Taken at Flinders Naval Base.*)

THURSDAY, 4TH OCTOBER, 1917.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

Joseph Risley Settle, Director of Naval Works, recalled, and further examined.

40. *To the Chairman.*—I placed before the Navy Board alternative schemes for connecting the naval and victualling stores with the barracks and official buildings by tramways, or roads and motor transport. I recommended the roads and motor vehicle service, and the Navy Board has now adopted that scheme. These vehicles, being elastic in their operations, would more quickly serve all the buildings in the Base as well as the official residences on the south edge of the basin. This scheme will entail the metalling of the roads, principally those between and around the stores buildings and the road running at the back of the barracks north and south and turning round to connect up the official residences on the southern side. For this purpose, an amount of £11,000 was placed on the Estimates and approved. That sum does not include any allowance for vehicles; neither did the estimates for the tramway service include any amount for the provision of waggons or trucks. In regard to the railway connexion, a siding will be provided at the north-east corner, and an agreement is being made with the Victorian Railway Department by which the engines of that Department will not pass beyond a certain point. From that point to the power-station and the jetty, all the trucks will require to be either man-handled or horse-handled. The Railway Department insists upon controlling the maintenance of all lines over which its engines pass; but as it is undesirable that a

State Department shall have control of any portion inside the Base, we have arranged that the locomotives shall not pass beyond a certain point, and the remaining portion of the line will be under Commonwealth jurisdiction. The existing railway down to the jetty will require to be modified, for the simple reason that the turn-outs are inoperative as at present laid. I believe that when the Victorian Railway Department put in those points and crossings, it had not access to the jetty in view. As the railways on the jetty are absolutely essential to its working, it is necessary to lay down a separate loop; therefore, part of the line already laid will require to be lifted. No monetary provision has been made for that, but I expect that the alteration will not cost more than about £20 for the labour required to relay. I believe that a system of metalled roads and motor vehicles will give a more efficient and quicker service to the various parts of the Base than would a tramway service. The laying-down of tramways would have involved a large cost, and we should have required motor power for handling the trucks. With good roads, the motor vehicles can deliver to the various stores, and thence distribute to all parts of the ground.

41. *To Senator Needham.*—The sum of £11,000, the expenditure of which has been approved, is the original estimate. It is not additional to any previous vote.

42. *To Mr. Laird Smith.*—The cost of road construction will be about the same as the estimated cost of laying down a tramway system. In connexion with the latter, we assumed that a certain amount of the material already on the ground might be utilized. Speaking from memory, I think there is a difference of £150 in favour of the tramway system, but it would only supply the buildings in the Base, and not the official residences. A motor service will provide a better system of distribution.

43. *To Mr. Mathews.*—The road at the top of the barracks will not be made before the sewerage installation is carried out. We should never think of making a road, and then taking it up again in order to make the sewerage connexion.

44. *To the Chairman.*—I cannot state the estimated cost per chain of the completed roads. The plan which I submitted to the Navy Board contains these particulars—Railways, £1,279; Tramways, £883; Footways, £907; Roadways, £5,861; Gravelling, £1,302. The quantities have been carefully taken out, and these estimates are based on previous prices modified in accordance with later particulars we have been able to obtain. I do not mention this fact because of any fear of exceeding the estimate; but as the cost of material is constantly advancing, it may be necessary to make a percentage allowance on that account. The roads will be of similar construction to the macadamized road already laid down, but they will not be of as heavy a character as I should like them to be. Complete inquiries as to the possibilities of obtaining road-making material in the neighbourhood of the Base have been made, but I have not been able to learn of any likelihood of quarrying stone within a reasonable distance.

45. *To Mr. Mathews.*—In almost every instance, the sewering will be completed before any new road is made.

46-47. *To the Chairman.*—The provision of quarters for the civilian officers is not included in the present reference to the Committee, but I take this opportunity of explaining the general outline of the scheme. We propose to erect the civilian residences on the land lying between the branch railway into the Base and the main railway to Melbourne on the city side of the Crib Point Station, and between the branch railway to the Base and the new road to the official residences. This is merely a tentative proposal, in order to intimate to the Navy Board what we consider the most suitable site for civilian officers' quarters. The plan has been before the Board for some time, and general approval has been given to it. In the area indicated, we shall erect residences for civilian officers, including storekeepers, cashiers, civil secretary, Naval stores clerks, workmen, messengers, and so forth. It is necessary that all these men should be in residence at the Base in case there is an urgent call for naval stores. A vessel may require to put to sea at short notice, and require her full complement of stores and fuel. In that event, the men would have to turn out at a moment's notice in order to supply her. The civilian quarters will be about half-a-mile from the principal official residences. The present scheme provides for eighteen civilian officers' residences. The site is on high ground. On the Base side of the railway, there is some swamp ground that will involve a little earthwork. I do not know of any other more suitable ground, except the site reserved for the hospital; but as that site was not considered available for the executive officers' quarters, I do not think it should be considered in connexion with the provision of quarters for the civilian officers.

48. *To Senator Needham.*—No estimate of the cost of the civilian quarters has yet been made.

49. *To the Chairman.*—I have not made any estimate of the cost of continuing the road and footway past the executive officers' residences. I put before the Board an item of £4,000 for new roads, but it was struck out. When the Board approved of the scheme of motor transport, it considered that the principal roads required for immediate use were sufficiently complete to allow of the Base being brought into operation, and it did not feel justified in approving of the item of £4,000, but they included it in the amount of £11,000 for roads and tramways generally. No money is to be spent on new roads other than those shown on the plan which is now before the Committee. The £11,000 will be expended wholly on roads with the exception of a small tramway from the magazine to the mining school, and from the mining school to the jetty. For excavation work, we have provided £500, but we have no knowledge of what quantity of work will be required.

50. *To Senator Needham.*—I think a motor service will be cheaper than a tramway service. With a tramway service from the stores to the barracks the gradient will be against the load. Generally speaking, I should say that the initial outlay in connexion with the motor service will be less than in connexion with the tramway service, but I have no data to go upon. An advantage in favour of the motor service is that we have roads already made. If a tramway were to be built to serve the executive officers' residences, we should have to lift portion of the road in order to lay the tramway. With the motor transport service, the motors that serve the barracks will serve the residences. The motor transport could handle machinery equally as well as a tramway; but for taking machinery from the workshop to the boats there will be a special railway line.

51. *To Mr. Mathews.*—No duplication of works by the Navy Department and the Works and Railways Department can take place. The Base generally has not been handed over to my Department yet, but as soon as it is actually taken over I shall see that no duplication of work takes place.

(*Taken at Flinders Naval Base.*)

FRIDAY, 5TH OCTOBER, 1917.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

William McKenzie Jeffrey, Resident Engineer, Flinders Naval Base, sworn and examined.

52. *To the Chairman.*—I have been in the service of the Commonwealth for four and a half years, and of that period two and a half years have been spent at Flinders Naval Base. I have been supervising all building construction and storm-water drainage, and other minor works. All the preliminary work in connexion with storm-water drainage and sewerage has been done under my direction. The expenditure in connexion with storm-water drainage has been carried out by the Works and Railways Department. That expenditure to date totals £3,084. We have spent nothing on roads, all that work having been done by the Navy Department. Detailed costs of all work are kept. We keep tally of the cost per rod of all brickwork. None of the buildings is actually completed. For instance, the last coat of paint will be deferred until a few weeks before the buildings are occupied, so that the Navy Department may enter into occupation of them in an absolutely fresh condition. The cost to date of the seamen's barracks has been £37,387. I can work out the cost of the brickwork per rod, and supply the information to the Committee. The cost of the first barrack building is not a fair criterion of the cost of work down here, because, in connexion with it, there were certain delays owing to wet weather and scarcity of material. The average cost throughout all the building at the Base is less than the cost of the first barracks building. I should think that the brickwork in the barracks would be less costly than the brickwork in the private residences, but I have not worked out the details. Every month I send to the head office the total cost of each work, and supply detailed unit costs whenever they are required. I shall prepare for the Committee the cost per rod of brickwork in the three barrack buildings and in the residences. The estimated and actual costs of the major buildings are as follows:—

	Original Estimate.	Cost to Date.	Increase.
	£	£	£
Two blocks of seamen's buildings	30,104	37,387	7,283
Chief Petty Officers' buildings ..	9,852	10,679	827
Warrant Officers' barracks ..	5,674	9,504	3,830
Single Officers' barracks ..	5,674	9,300	3,626
Drill hall	3,250	6,459	3,209

For all buildings, the original estimate was £111,032, and the cost to date has been £141,963. The increase in cost has been brought about by advances in the prices of labour and material. I have prepared statistics showing the increase in labour since the commencement of these works up to September, 1916—

	May, 1915.	June, 1915.		September, 1916.	
	s. d.	s. d.	Increase, per cent.	s. d.	Increase, per cent.
Builders' labourers ...	10 4	11 10	14	14 2	37
Carpenters ...	12 8	14 2	12	15 6	22
Bricklayers ...	13 0	14 6	12	16 2	24
Plumbers ...	12 0	13 6	12	15 6	29
Plasterers ...	12 8	14 2	12	15 10	25
Painters ...	10 4	11 10	14	14 2	37
Cooks ...	9 0	10 6	17	12 2	35
Electrical mechanics	10 6	13 10	31	14 6	38
Average increase ...	—	13	—		28

These averages allow for excess of one class of work more than another owing to unequal numbers performing separate work. In addition to the increased wages, greater privileges have been granted to the men from time to time. When we commenced the works, no cooks were provided, but we were compelled to provide them. A cook's wage of 12s. 2d. per day on seven days is equal to 9d. per workman per day, or an increase of 7 per cent. in the workmen's wages. Water costs 10s. per 1,000 gallons, and that with fuel, sanitary, and camp maintenance provided equals 3½d. per workman per day, representing an increase in wages of 2 per cent., thus bringing the total average increase in the cost of labour up to 37 per cent. The advance in June, 1915, was due to the award of Mr. Justice Higgins, who granted the men a country allowance of 1s. 6d. per working day, to be paid at the rate of hours worked. In June, 1916, His Honour increased the country allowance to 2s. per day for six days per week, and as only five and a half days are worked the 2s. actually becomes 2.18s. per day, because the allowance is granted irrespective of the hours worked. If a man goes to work for one hour in the day, he is granted the full 2s. The consequence is that the country allowance is equivalent to 2s. 2d. per day in a working week of five and a half days. From the particulars I have given it will be seen that since the works were commenced labour increased on a gradual scale to the extent of 28 per cent. up to September, 1916, and taking into account the additional privileges the actual increase is 37 per cent. It is estimated that there has been an average increase of 32 per cent. in wages from the commencement of the work to this date. In regard to material, we reckon that since the commencement of work in May, 1915, the prices of our more important requirements have increased to an average of 37 per cent. That estimate is worked out on this basis: In September, 1916, the market rates showed an increase of 48.1 per cent. in the prices of all building materials. That increase has been gradual since the commencement of the works. I gauge the average increase over the whole period to be 30 per cent. Labour and material together show an average increase of 31 per cent. Further increases in the cost of the buildings were due to heavier foundations being required owing to the soft nature of the ground. In cases we had to deepen the foundations, and in places to reinforce them. There is also to be taken into account holiday pay and loss of time due to wet weather, of which we have had a considerable amount, particularly this year. Up to the present, we have spent in materials £78,600, and in wages £91,000. The increase of 30 per cent. in the cost of material represents £18,138, and an increase of 32 per cent.

in wages represents £22,060, making a total increase of £40,198. Holiday pay represents £2,486; travelling time and railway fares—each man receiving one and a half day's pay plus his railway fare—£585; loss due to wet weather, approximately, £1,000; total increases, £44,269. There have been further increases due to alterations and additions, and, as previously mentioned, to the deepening and reinforcing of the foundations. It was difficult to know what would be the nature of the foundations until the excavations were removed. A number of the buildings are erected on made-up ground, and sometimes after excavating 7 feet through the made-up ground we came upon Mangrove Swamp, and we had to further deepen our foundations and reinforce the concrete.

53. *To Mr. Mathews.*—More care has to be taken in laying the bricks of a building that is not to be plastered than in laying those in walls which are to be plastered. The fact that the barracks are not to be plastered would contribute to an increased cost of the brickwork in them, as compared with the other buildings.

54. *To Mr. Sampson.*—The output of the men as a whole has been fairly well maintained throughout. Nearly 50 per cent. of the men were living on the Base, and the remainder within 6 miles, driving to and from their work. I do not think that the fact of having to travel that distance to work affected their efficiency in any way.

55. *To Mr. Sinclair.*—We measure up a man's work from time to time, and we are able to arrive at the unit cost through our card system. I could not tell you the quantity of work done by every individual on the job; but if we find that a man is slacking off, we measure up his work; and if he does not appear to be doing sufficient, we give him a warning. If the warning is not heeded, he is discharged. I advise the Department in regard to unit costs of a job, and the estimates are prepared accordingly. I understand that the new estimates are increased to meet the altered conditions, but estimating is very difficult because of the uncertain nature of the market. The tendency is for all materials to increase in cost, but I think wages will remain at their present figure.

56. *To Mr. Laird Smith.*—The Arbitration Court is responsible for the increase in wages. The sea air has not materially affected the corrugated iron roofs, and, so far as I am aware, there is no intention of painting them. A certain extent of the storm-water drains for draining the parade-ground was laid by the Navy Department; the only storm-water drainage done by the Department of Works and Railways has been in connexion with the buildings. The lay-out for both present and future buildings makes provision for getting the storm-water away before the buildings are erected.

57. *To Mr. Sampson.*—On solid brickwork, such as foundations, a man will lay from 450 to 500 bricks per day, but on hollow brickwork the daily average is from 280 to 350 bricks. That includes struck joints, face work, and plumbing. I dare say that, by a system of piece-work, we should have got more bricks laid per day, but we should not have had the same quality of work. The bricklayer could lay a lot more bricks, but one cannot watch every brick he lays, and sometimes on piece-work he is inclined to scamp. I do not think that piece-work would have given us any ultimate advantage, when comparing the quality of the work done by day labour against the number of bricks that might have been laid by piece-work.

57A. *To Mr. Laird Smith.*—The nature of the foundations could easily be tested by sinking shafts before the site was fixed.

58. *To the Chairman.*—I cannot say that an average of 400 to 500 bricks per day on foundation work is satisfactory. I know that, in the city, the average is about 600 bricks per day. When operations commenced at the Base in 1915, bricks were costing us 31s. per 1,000 at the kiln. The last lot of bricks we purchased cost us 36s. per 1,000 at the kiln. We have not had to pay any increased price for cement, because we bought in bulk two years ago. Lime has increased very slightly. Baltic timbers have increased by 116 and 124 per cent., and oregon timber 80 per cent. up to end of 1916, and hardwoods have advanced 25 per cent. during the last two years. Tiles are more expensive for roofing than corrugated iron at its pre-war prices, but with iron at £60 per ton tiles are about half as costly. It is very difficult to say whether future buildings could be erected as cheaply and as effectively by day labour as by contract. No doubt a contractor would inflate his tender considerably in the belief that the difficulties in connexion with building down here are much greater than they actually are. As a practical man, I can see no objection to the erection of a temporary hospital at the place proposed, but the question of site is for the Naval authorities to decide. The proposed site for the permanent hospital is suitable in every way from a building point of view.

59. *To Mr. Mathews.*—The number of bricks laid per day greatly depends upon the workmen. Some are better than others. One man will lay 700 and 800 bricks per day, and another only 400. More bricks per day can be laid on a thick foundation wall than on a thin wall.

60. *To Mr. Sinclair.*—The site for the proposed workshop and power-house is on the natural formation. We estimated that the foundations are capable of carrying 3 tons to the square foot, which is much more than will be absolutely necessary. Reinforcing the foundations will increase their carrying capacity. I do not apprehend any danger in connexion with the foundations of the workshop and power-house.

(Taken at Melbourne.)

TUESDAY, 9TH OCTOBER, 1917.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

Henry Alexander Dixon, Assistant Engineer (Mechanical), Department of Works and Railways, sworn and examined.

61. *To the Chairman.*—I have been about five years in the service of the Commonwealth, and am responsible for the designing of the hot-water installation at the Flinders Naval Base. I have had considerable experience in work of this kind. I was responsible for the installation at the Post Office, in Spencer-street, which is the largest heating installation in the Commonwealth; for another at the Victoria Barracks extension, St. Kilda-road;

and for various large installations at the Military College, Duntroon; the Central Telephone Exchange, Melbourne; the Windsor Telephone Exchange; the Adelaide Quarantine Station; and the Quarantine Station at North Head, Sydney. I have also been responsible for a number of smaller installations, which were designed by me and installed with my technical supervision. At the Flinders Naval Base it is proposed to construct a boiler-house, as shown on the plan now exhibited to the Committee. In it will be installed, in the beginning, two boilers, and room will be left for a third. The steam generated in these boilers will be conveyed through pipes to the Chief Petty Officers and Instructors' building, the lavatory blocks, the kitchens, the barrack blocks, the dining-rooms, and bathrooms, and so on. Provision will be made for an extension to the proposed barrack block to the south of the existing blocks. This steam will be used for heating water, which will heat the buildings, for cooking, and to provide hot water in the baths and lavatory basins, and also for laundry purposes. It is thought that one boiler will generate a quantity of steam sufficient for present requirements, the other boiler being kept as a stand-by. Should the Base be increased by the building of four more barrack blocks, and an extension of the Chief Petty Officer's block, a third boiler would have to be added, and then two of the boilers would be in continuous use, the third being a stand-by for use when repairs were being effected to either of the other two, or in the event of a breakdown. The boiler-house will be centrally situated in relation to the buildings that it is intended to serve. No provision has been made in my scheme for the requirements of a hospital, but I think that the margin allowed in our plant would meet the requirements of a temporary hospital. All that would be necessary to supply the hospital would be to lay a steam pipe from the proposed terminus at the south of the seamen's barracks. Heating will be done by means of radiators somewhat similar to that which heats the room in which the Committee is now sitting. The water in these radiators will be heated with steam. It is proposed to install water-tube boilers of the Babcock type, though not necessarily boilers made by the Babcock firm; they could be of local manufacture. I produce, for the information of the Committee, copies of a detailed estimate of the cost of the scheme. It will be seen that the steam supply will cost £12,500, including boiler-house, boilers, economizers, superheaters, pumps, steam pipes, and trenches for the pipes, together with all work necessary to give a service to the three barrack blocks at present constructed. The estimate for the plant and for the heating of the present blocks is £16,720, and the cost of making provision for the proposed hospital as well would probably be about £250. I have not estimated the cost of providing for the four other barracks and the additions to the central barracks, but, roughly, it would cost about £10,000 more, though I should like to go into the matter carefully before committing myself to any definite statement. I have put down as the cost of one boiler £2,250; foundations and freight, £125; brick-setting and erection, £700; or £3,075 in all. In addition, there are steam pipes, valves, and fittings of various kinds. Probably an installation for the Base, when completed, would cost about £27,000. The installation would be an economical one for the purposes for which it is devised. It must be remembered that a large number of persons are to be served. In my opinion, it is necessary to provide both hot and cold water for the lavatory basins, and such provision was designed at the request of the Navy in connexion with the Jervis Bay installation. If hot water were provided for only one or two basins in a row in the lavatory, the saving would be very little. All the basins will be in use at the same time, and every man will want hot water. On board a ship there would, I think, be an ample supply of hot water. The difference between the cost of supplying hot water to each basin in a row and only to the end basins would be merely the cost of the extra taps; the supply pipe would be the same in both cases. Unquestionably, it is more convenient to have hot water laid on to every basin than to have it laid on to only one or two basins. The provision of heating with steam is as efficient as, and more economical than, any electrical system of heating. There is no special laundry at the Base; the men will do their own washing on benches behind the barracks, water being provided for the purpose. Cooking could be done with electricity, but the provision of electricity would be much more costly than the provision of steam. In estimating the cost of working this installation, I have taken as a basis the Melbourne experience that rooms need heating during four months of the year. During those months the cost of working the plant, including coal, attendance, oil, and sundries, would be £3 14s. a day—the cost of water is not included—and during the eight months when rooms would not be heated the cost of working would be £1 18s. 6d. a day, the annual cost of working being £917 8s. To make provision for the replacement of the capital cost of the boilers, steam pipes, and so on, at the end of twenty years, and of the buildings at the end of forty years, sinking-fund charges must be met which would amount to £1,217 15s. a year. That, together with a maintenance cost of £167, makes the total annual cost £2,302. That is the amount that it would cost to provide steam for cooking, heating, and the provision of hot water for 762 men. At per man the cost would be £3.02 per annum, or at an average rate of 1s. 2d. a week.

62. *To Senator Newland.*—Generally, I favour a water-tube boiler, but whether a Babcock boiler should be imported or a locally-manufactured boiler used is a matter of policy to be settled when the installation is determined upon. In dealing with the matter, account must be taken of the fact that it may not be possible to import boilers from Great Britain at the present time. I do not know who will make the final decision, but I presume that my advice on the subject will be asked. There is at the South Australian Quarantine Station a steam reticulation scheme for which a locally-manufactured boiler is used, but it is not a boiler of the type I propose for the Flinders Naval Base. The Duntroon Military College heating scheme is also served with locally-made boilers. I have not gone fully into the cost of locally-made boilers of the type I propose, but I should not think that it would be greatly in excess of the cost of the Babcock boilers, which is now very high; indeed, it would be practically impossible to import one at the present time. The steam pipes would not be all of one size. They would range from a diameter of 3 inches at the boilers to a diameter of 1¼ inches at the end of the line. The steam would be transmitted at the medium pressure of 100 lbs., and the superheaters that are to be installed would make the loss from condensation very low. If an extension to serve the temporary hospital were determined upon, the pressure oculd be

slightly increased to increase the carrying capacity of the pipe, if necessary. The boilers would be capable of generating steam at a pressure of 160 lbs., and we could maintain a higher pressure than we propose to maintain were it necessary to convey the steam through a longer length of piping. The steam pipes would be laid in concrete trenches, which would be drained to the storm-water channels. I produce a plan showing the details of the construction proposed. The pipes would rest on supports at the side of the trench, with which they would not be rigidly connected, and the trench would be covered with a reinforced concrete slab. There would be very little loss of heat in transmission, because the pipes would be efficiently lagged. I am not aware that any special laundry provision is to be made beyond that to which I have referred, the men doing their own washing. As to the items "Heating of seamen's dining-room, £600," and "Hot water to supply seamen's dining-room, £120," the explanation is that food will be taken there in bulk, and the plates and dishes will be washed up and kept in the room, sinks being provided to which hot water will be laid on. That is asked for by the Navy.

63. *To Mr. Sinclair.*—As to the heating, the temperature of the buildings will be kept at 60 deg. Fahr., no matter what may be the temperature outside. In addition to steam for heating the rooms, steam will be used to provide hot water in the lavatory, both in summer and in winter. The heating of the rooms will be done only during four months of the year. My estimate of cost includes the reticulation of the buildings, with the exception of the bathing blocks, where that work has already been done. As regards heating, it includes all interior work. In the boiler-house automatic stokers will be provided. The trenches to which I have referred have not been constructed. No part of the scheme has been carried out yet. The cutting of the trenches would not mean any tearing up of streets. They would be made in what is now open paddock, except for one road crossing. The drainage from them would go into the storm-water system. They would be at a higher level than that of the storm-water drains.

64. *To Mr. Mahony.*—Electricity could be used for heating, but the cost of generating sufficient current would be greatly in excess of the cost of generating the quantity of steam required. The cost of the proposed installation, including buildings, boilers, and the rest of the plant, would be only, as I have already stated, 1s. 2d. per man per week; it would cost much more than that to provide heating with electricity. I have seen the arrangements at the Commonwealth Bank, Sydney, for cooking and providing hot water with electricity. That system is far more expensive than the steam system proposed for the Flinders Naval Base. I have no doubt that the boilers proposed to be used could be manufactured locally. A South Australian firm has begun to manufacture water-tube boilers, and a very fair article is being produced. I have no doubt that it could do the work required.

65. *To Senator Needham.*—The boilers to be used for the heating system under discussion are altogether separate from the boilers in the power plant, or any others. The system is entirely independent. As to the relative cost of electricity and steam for heating purposes, I believe it to be 20 to 1. As to the boilers, I should certainly not recommend against the locally-manufactured article, because I believe that suitable boilers can be made locally. But the determination of the question, Shall the boilers be imported or made locally? is a matter of policy which does not come within my province, though, no doubt, I shall be asked to make a recommendation upon the subject. I should not advise against locally-made boilers because they were locally made. My estimate of the cost of the boilers is based on the price of the Babcock boilers. Locally-made boilers would not be cheaper than the Babcock. It is doubtful, however, that a Babcock can be imported at the present time. I should say that a locally-made boiler might be slightly dearer than a Babcock boiler. Undoubtedly, the making of boilers locally gives employment to Australian workmen. The saving that could be effected by supplying hot water to only two of a row of seventeen basins in the lavatory would be inappreciable. The pipes to supply these basins have already been put into position, and, therefore, the only saving would be in the quantity of hot water used. The consumption of hot water in the lavatory would be small compared with that in the baths and that used for heating and cooking.

66. *To Mr. Laird Smith.*—As regards the relative cost of electricity and steam, you may take it, in my opinion, that it would cost £20 to obtain with electricity the service which under the proposed scheme would be obtained for £1 with steam. The pipes conveying the steam would be carried in trenches underground, but would not be in contact with the ground. They would be well lagged, and the radiation of heat would be less than it would be were the pipes carried above ground. The trenches would be practically sealed, and once they became heated the loss of heat would be very little, but were the pipes carried above ground the loss of heat would be considerable, because so much would be carried away by currents of air moving across their surfaces. The water-tube type of boiler is proposed because it is efficient, and possesses advantages not to be met with in other pipes. It is a sensitive boiler, allowing steam to be raised quickly, and for this particular work is the best that could be employed.

67. *To Mr. Sampson.*—I believe that the only other building at the Base which is to be heated by a hot-water system is the torpedo and mining school. In the officers' residences, hot water is provided from the kitchen range. I do not think that separate installations would be suitable for the buildings to which this scheme would apply. In the officers' quarters, hot water is obtainable only when the kitchen fires are burning, with a small reserve; there is no steam heating system there. It has to be remembered that the hot water for heating purposes is carried through iron pipes and iron radiators, but hot water for baths and cooking is carried through copper pipes, and consequently the two services cannot be combined in one system. It would be more costly to provide a separate heating and hot-water service for every building than to have a general service. The cost of attendance would be greater, and the convenience would be less. One man would be able to attend to the proposed system, whereas separate and scattered systems would each require a man. The saving in fuel in having one system would be considerable. I understand that practically the whole of the cooking is to be done with steam, though some cooking would be done with ordinary fires. I have not made an exact calculation of the saving in fuel that would result from having one general system instead of a number of separate systems, though I can supply such a comparison. I have here detailed plans showing the heating arrangements for the various buildings. The plan which I produce shows half of the seamen's barracks block, the other half being

exactly the same, so far as the installation is concerned. Under the staircase, between the lavatory block and the main barracks block, is an enclosed space in which will be placed two calorifiers, one to provide hot water for the bathing block and the other to provide hot water for heating purposes. Pipes are carried from these round the ceiling of the ground floor and in the roof space, vertical rises connecting them and picking up the radiators as they pass. The radiators will be placed at the side of the doors. They will be of cast iron, somewhat similar in type to that in this room. The torpedo and mining school will not be served by the proposed system. It is at such a distance that the cost of connecting it to the system and the loss of heat would overbalance any advantage gained by the connexion. The proposed temporary hospital would be about a quarter of a mile from the boiler-house. For the torpedo school building a separate system would be more economical than a connexion with the main system. As to the purchase of material, the usual practice is to call for tenders by public advertisement. Sometimes the Department installs the machinery that it needs, and sometimes the installation is done by a contractor; a good deal depends upon whether the day-labour system or the contract system is the policy recommended. In this scheme there will be several classes of work to carry out. For instance, the boiler installation will be different from the heating installation. If one contract were let for the whole work, the successful tenderer would undoubtedly sub-let parts to other contractors. If, for instance, Babcock boilers were provided, the firm from which they were obtained would not carry out the heating installation. At the Spencer-street post-office there was a contract for the supply of the boiler, another for the supply of piping, and another for the radiation, and the installation was carried out by the Department. At Duntroon a contract was let for a section of the heating. The contractor bought his materials at several places, assembled them on the spot, and carried out the work of installation himself. With a scheme of this type a firm of manufacturers would not supply and install all the machinery; but with small installations, with a cast-iron boiler, the contractor who supplied the boiler might also supply the radiators. I have known cases in which a firm has contracted to supply boilers, pipes, and radiators, and complete the installation, but only for a small scheme. This scheme would be on a different basis, and the firm supplying the boilers would not supply the radiation or the piping. As to the carrying of it out by several independent contractors, that would not be a good arrangement. It is not well to have several independent contractors on one job. A work should either be carried out by one responsible contractor, who may, of course, sub-let parts of it, or departmentally, the material being obtained by means of separate contracts.

68. *To Senator Henderson.*—The contractor who carried out work at Duntroon made a small portion of the plant that he supplied.

69. *To Mr. Mathews.*—I understand that there are in Australia firms which, by arrangement, have the right to manufacture the Babcock boiler. I believe that Thompson's, of Castlemaine, have arranged to import certain parts of the Babcock boiler, and make other parts locally. If it were necessary to obtain a Babcock boiler, it could be obtained. The heating of the proposed temporary hospital might reasonably be done by the system that we are discussing, but a permanent hospital should have its own installation. The pipes that are to be used will be of solid drawn steel, though cast-iron clips and bolts will be used to anchor them in the trenches. The arrangements for the supply of hot water to the men were suggested by the Navy Department, I believe. I have worked out the system in conjunction with the architect who designed the buildings, and made provision for baths, basins, and so on.

70. *To Mr. Laird Smith.*—I shall furnish the Committee with a statement comparing the cost of heating with steam, electricity, and ordinary fires.

71. *To Senator Needham.*—There are obvious advantages in having a power-house self-contained, with a constant demand. That makes for more economical running than a varying demand.

72. *To Senator Newland.*—The building in which the boilers will be placed was designed to suit the arrangement that I suggested, but I am not responsible for its details. It is not intended to supply by this system hot water for cooking or other purposes to the non-commissioned officers' quarters at each end of the parade. I have not estimated the cost of connecting those buildings with this system, but I think that they are too far to be connected with it, and the number of men to be served is very few. Those buildings are not heated with steam, though hot water is supplied for domestic purposes from the kitchen range. There are fire-places in their recreation and social rooms, but the bedrooms are not heated. The seamen's dormitories, on the other hand, are heated, because they are used both as sleeping apartments and as recreation rooms. Furthermore, the seamen must have some place in which to dry their clothes, and this drying is done in the dormitories. That is one of the chief reasons for placing radiators there. There will be shelves alongside them.

73. *To the Chairman.*—The increase in the cost of materials due to the war varies with the different items, but the piping that would be used for the conveyance of steam costs about four times as much now as it did before the war, its price having doubled during the last twelve months. All round, I should think that the war is responsible for an increase of 33 per cent. in the cost of the proposed installation. It seems essential to carry out this system at an early date, because no other provision has been made for the supply of heat for cooking or other purposes at the barracks. The torpedo school could be supplied with heat from the power-house near by, but I think that the Navy Department would prefer not to use that power-house for the purpose. The school building will contain large class-rooms, in which men will have to sit for lengthy periods. I believe that there is provision for fire-places in the administrative block.

74. *To Mr. Mathews.*—I would not recommend cast-iron pipes for the conveyance of steam, because they could not be guaranteed to withstand the pressure.

75. *To Mr. Sinclair.*—The consumption of coal during the winter months would be 1½ tons a day, and during the summer months .62 tons a day. The coal might be brought from the railway station on a motor lorry, or the narrow-gauge track could be extended. No building is to be erected for the storage of coal; the coal will be dumped outside the boiler-house, and the daily requirements taken from the stack.

76. *To the Chairman.*—In making my calculations I have put down 30s. a ton as the price of

coal. Newcastle coal would be used. Wonthaggi coal costs less, but contains so much ash, and is of so low a calorific value, that Newcastle coal is to be preferred.

77. *To Mr. Mathews.*—The quantity of ash in Wonthaggi coal is so great that Newcastle coal would be preferable under any circumstances.

(Taken at Melbourne.)

WEDNESDAY, 10TH OCTOBER, 1917.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Newland,	Mr. Sampson,
Senator Needham,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

Harold Whitmore Smith, Assistant Engineer (Electrical), Department of Works and Railways, sworn and examined.

78. *To the Chairman.*—I report directly to Mr. Hill. I have prepared estimates for the electrical mains, telephones, and electrical clocks and fire-alarms for presentation to the Committee. As to my experience, in 1906 I graduated from the University of Adelaide with first class honours as electrical engineer, and, being awarded a travelling scholarship, I went to America, where I remained until 1913 doing electrical work. I graduated, in 1908, from the Cornell University with the degree of M.E., and then spent four years and a half in electrical work, two and a half of which were with the Westinghouse Electrical Company in Pittsburg. I have had experience in the manufacture of electrical apparatus in electrical railways, and the design and preparation of transmission schemes covering 1,000 square miles of territory. I have been with the Commonwealth Department four years and four months, during which time I have carried out all the electrical work connected with the Naval College—with the exception of the power-house. These works were carried out by contract according to my plans and specifications; with the Woollen Mills, at North Geelong; Duntroon Military College; the Canberra electrical supply; the North Head Quarantine Station; the Aviation School; extensions to the Cordite Factory and the Small Arms Factory; the electrical work in several of the forts; at the Caulfield Military Hospital, and, generally, all the electric lighting and lifts in Commonwealth buildings, such as the new General Post Office, Melbourne, and the Sydney Customs House. I have had full control of the installation of services for the Commonwealth—all the work carried out by the Department of Home Affairs, and now by the Department of Works and Railways. When I first entered the Department the work was carried out by contract, but during the last three and a half years all the work has practically been carried out by day labour. So far as electrical work is concerned, I think that day labour is very satisfactory, so far as efficiency goes. As to the expense, I think we have got good work at a lower price than under the contract system. It is my opinion that the day-labour system has proved more effective and more economical than the contract system. As to the electrical systems proposed for Flinders Base, I, first of all, would like to say, as regards the power-house, that the Department of Works and Railways has not been consulted in any way. We have simply been advised by the Navy Department that they would supply all the power-house machinery; the Works Department simply erecting the building. The Navy Department advised us that the system of supply would be direct current at 460 or 230 volts. The work that I have estimated on is simply that of installing all the necessary mains to supply current to the various buildings. The internal works in the buildings is estimated in the cost of the buildings themselves; and the estimate I now have to place before the Committee includes, generally, the mains for the necessary street lighting. In February I submitted to the Engineer three estimates. One estimate was for putting all the cables overhead on poles throughout the whole of the Base. A second estimate was for putting all the cables in the main portion of the Base underground; that is, using lead-covered cables and putting them in wood troughs filled with bitumen, which is the ordinary system of underground work adopted in Australia. The mains outside the Base proper, including the married quarters and the hospital, the detention barracks, and a branch to a sewage pump, were to be left overhead. The third estimate was for all the works in the Base proper being underground, but on what is called the draw-in system; that is, laying, in the road or pathway, tile ducts with manholes at intervals, and drawing the cables into those ducts. That is a very costly system, but it has the advantage that you can lay extra ducts to provide for expansion, and if there is any trouble with the cables they can be removed without tearing up the surface of the roads or pathways. In this third scheme it was necessary, of course, to put down more ducts in view of future needs; and I also allow sufficient ducts so that all subsidiary cables, such, for instance, as cables for telephones, fire-alarms, electric clocks, and so forth, can be put underground at the same time. The costs for the first estimate were in the neighbourhood of £15,000; for the second estimate, £18,000; and for the third, £28,000. These were sent on to the Navy Department in March, asking for directions in the matter, and stating that if we were advised as to which system was preferred we could proceed with detailed plans and estimates. On 18th May, having received no reply, we again asked the Navy Department for a decision. The dates I am giving all refer to this year. On the 24th July no reply had been received, beyond a note from the Navy Department asking, in view of the tremendous cost of the work, that it be deferred as long as possible, and pointing out that the power-house would not be ready until the middle of 1918. The Navy Department has not yet stated which scheme is desired. Mr. Hill instructed me to prepare an amended estimate embodying what we considered a satisfactory scheme at a minimum cost. I have, therefore, prepared this overhead scheme. It is based purely on overhead work throughout the whole Base. The estimated cost of this scheme is £16,200. The difference in the estimates is occasioned by the fact that in the interval various changes have been made. For instance, in the first scheme the hospital was located near Stony Point. My first scheme included really more work than the present scheme, but, in the meantime, the price of copper has increased from 2s. to 2s. 9d. per lb. for cables; so that really the present estimate, though for less work, represents more money. The following is the scheme on which I have estimated. In the first place, I should say that we have had a difficulty in deciding on the loads which each building will require. As regards lighting, we had detailed plans of the buildings, so that the lighting could be accurately deter-

mined; but, as regards the power requirements, we have written several times to the Navy Department. We wrote on 8th January, 1917, asking for their estimate of the amount of power required for the various buildings, but, so far, we have received no reply, beyond an intimation that they are getting the information ready. It will be seen, therefore, that in regard to power I have to estimate the probable requirements. The scheme covers altogether ten three-wire feeders, of which only nine will be installed at present, one being for the future, and also one two-wire feeder. On the plans before you the black dots represent the probable location of the poles, and the red dots indicate the position of the street lights. Each line represents, except in one case, a three-wire feeder, this plan being diagrammatic. One feeder, represented by a heavy black line, is to supply the street lighting in the Base proper. The reason for having one feeder for street lighting is to enable all lights to be switched on simultaneously from the power house. This feeder has three branches, one running westerly, then northerly, along the road at the rear of the seamen's barracks to the end of the barracks; the second running northerly along the road between the Drill Hall and the Naval Stores until it meets the road running from Crib Point Railway Station, along which road it turns westerly to a point near the future barrack. The third branch supplies the wharf. On this feeder there is provision for 38 street lights, and it is intended that the lights shall be simple brackets attached to the poles carrying the cable. The second feeder supplies street lighting for the portion outside the Base proper. It runs from the power house northerly along the road between the naval stores and the drill hall until it meets the road running to Crib Point, and then turns along that road to Crib Point Railway Station. It has one branch passing along the road in front of the senior and junior officers' houses; and 25 street lights in all are on this feeder. The third feeder, marked in yellow on the plan, supplies the latrines, painters' shop, boat builders' shop, wireless and signal school, the sewage pump, and the detention barracks. It leads from the power house in a westerly direction, and then north along the road at the rear of the seamen's barracks, with two branches, one to a sewage pump, and the other to the detention barracks. The former will be at 460 volts. No. 4 feeder, marked in red, is proposed to supply three of the four future barracks. It is not intended to erect this at present, but simply to make provision with cross arms, so that it can be installed at a future date. This feeder will run right out to the terminus, though it may stop at the rear of the end barracks. Feeder No. 5, shown in purple, will supply two seamen's barracks, the chief petty officers' barracks, and one of the future seamen's barracks. As one of the seamen's barracks will not be built for the present, I have arranged to tap the temporary hospital from this feeder, No. 5. The reason that the cables are placed along the rear road is to, as far as possible, minimize the unsightliness of the overhead construction. Feeder No. 6 is a two-wire circuit. It runs from the power house to the wireless station, and will be used purely for wireless purposes. I understand that it is the intention of the Navy Department to instal a special generator in the power house for wireless purposes, and, therefore, it will be necessary to run a circuit from the power house to the wireless school. For that I have made provision. Feeder No. 7, which is shown in green, supplies the magazine, warrant officers' quarters, lighting of wireless station, shooting battery, drill and stripping battery, armourers' shop, drill hall, lecture room, gymnasium, single officers' quarters, guard room, and a small sewage pump located to the east of the guard room. Feeder No. 8 will supply the stokers' school, the boatswains' stores, and a torpedo and mining school. Feeder No. 9, which is shown as a dotted red line, will supply the naval stores, the receiving shed, the inflammable store, the administrative buildings, and the victualling store. This feeder runs northerly along the road between the drill-hall and the naval stores. Feeder No. 10, shown in dotted green lines, supplies the married officers' quarters. It proceeds northerly along the road between the naval stores and the drill hall until it reaches the road leading to Crib Point Railway Station, which road it follows until it reaches the station, with a branch passing in front of the senior and junior officers' quarters. This main will serve all the married quarters and the captain's house. Feeder No. 11 is for the wharf light and power. I have no details at all, but I presume that the lighting, and probably power, will be at some date required here by the Navy, and this is a circuit designed to supply it. It is proposed that the poles shall be of Australian hardwood, though I am getting out a design for concrete poles with a view to going into the question of the relative cost and advantages. The cables will be hard-drawn bare copper cables, and the size of the cable is given as from 37-12 to 7-16. In calculating the size of the feeders I have assumed that the maximum load on any feeder will be 60 per cent. of the total load, and the maximum drop that I have allowed does not exceed 20 volts except on feeder No. 10 supplying the married officers, on which the drop is 26 volts. I have also in my estimate allowed for the poles being high enough to carry underneath them any wires required for telephones, fire alarms, and electric clocks. I have allowed a minimum distance of 2 ft. 6 in. between each parallel circuit of wire on account of the high winds which prevail at Flinders, with a view to insuring that, under no conditions, will one circuit be blown into contact with another. In all, under this estimate, 142,200 ft. of copper cables, weighing about 33 tons, will be required, and the cost of the cable, at the present quoted price of 2s. 9d. per lb., will represent £9,900. I have prepared a detailed estimate with quantities which I hand in. The magazine will be lighted by light thrown from screens between the windows, so that there will be no internal lights. The poles vary from 30 feet to 35 feet and 40 feet in length. I have had no personal experience of concrete poles, but I know that a number have been built and erected in various places, principally in America. Up to the present, however, they have not been used to any considerable extent. The great trouble is their excessive weight, which, for the same service, is about double that of wood poles. At present the price of concrete and reinforcing makes it doubtful whether such poles would prove economical. Of course, if you are making a great number of poles the final cost is much cheaper than making a few, the cost of the forms being fairly high for a small number. As to the absence of details of the requirements of the Navy Department, it naturally makes it impossible to prepare a proper detailed estimate. Of course, it is quite possible that there are facts beyond our knowledge, which would make us change our plans in some respects. It is self-evident that the fullest information should be made available. If the hospital were to be placed at Crib Point I should have to re-design the cable

to provide for the additional load; the size of the copper would have to be increased. If the present hospital is merely of a temporary nature, and the main hospital is to be built beyond Crib Point Station, we should have to run an additional circuit on the same poles or increase the size of the copper of the original circuit. If it were intended to erect a large number of civilian quarters just to the west of the present officers' quarters, it would mean that the main would have to be changed. In my calculations I have assumed nothing but what you can see on the plans. If the Naval Board last week approved of a design for a large number of quarters at the site the fact has not yet come to my knowledge. It would make the scheme which I prepared much more suitable if I knew the exact requirements of the Navy Department. For instance, in calculating the feeder supplying the seamen's barracks, I have allowed simply for the barracks shown on the plan. If it were proposed to install buildings to the westward it would not be possible to supply those buildings from that same feeder, and, therefore, there would have to be additional cables or additional circuit. It is most advisable that both the present and future requirements be known as accurately as possible, and thus possibly save needless expense. So far as I can see, the scheme I have suggested would adequately meet the requirements of the plans before me. The scheme has not been approved by the Naval Board. As I said before, it has been prepared since 24th July under the instructions of Mr. Hill; but I understand that nothing has been done in the way of seeking approval beyond forwarding a copy of the plans to the Director of Naval Works. It is quite likely that we shall have grave difficulty in obtaining material. If we were to go ahead with the overhead works at the present time, we should have to indent the copper cables. Copper cables are not being made in Australia, though I understand that a company is constructing works at Port Kembla, New South Wales, with a view to their manufacture. I understand that this company hopes to be ready to start work shortly after the new year; but that depends on the getting of machinery from England. Certain necessary machinery has been received by the company, but other necessary machinery has gone down with torpedoed vessels. Until this is replaced, the company is unable to say definitely whether it will start; but with the machinery available the company say they will be prepared to make cables up to the size needed for this scheme. If, on the other hand, an underground system were decided upon, I understand that the company has no idea at present of making underground cables; and our requirements in this respect would have to be met from England, America, or Japan. At any rate, there is not in stock at the present time a sufficient quantity of copper cable to do this work. As to the proportion of material, generally, that can be obtained locally, I may say that out of the total estimate of £16,200, the copper cables alone represent £9,900; and these could only be obtained locally from the company of which I have spoken. A portion of the insulators can be made locally, but that represents only a few hundred pounds. The poles, of course, will be obtained locally, and the balance of the work consists of what we call services—insulated wire running from the bare copper cables to the buildings. These will have to be indented or obtained from stock. Then there is, of course, labour.

79. *To Mr. Sinclair.*—I do not know anything about the Government having a contract with the Port Kembla company for ten years. My prices of material are based on quotations from manufacturers—English manufacturers principally—who indent cable. I do not know what price the local company would be able to turn out cables at, but I presume that it would be largely fixed by the price of similar material that could be imported. The present price of cable, as I have said, is 2s. 9d. per lb.; and I do not think it has changed materialiy since I prepared my estimate. The price of all copper goods has consideraby increased. In pre-war days copper goods were as low as 10d. per lb., though I should say that a fair average price would be 1s.; this means that the price has practically increased three times. If there is a ten-years' contract with the Port Kembla company, it would seem that I ought to be acquainted with the fact, in order to correctly form my estimate. I shall endeavour to obtain for the Committee information whether there is such a contract in existence.

80. *To Mr. Mahony.*—The present estimate that I have given the Committee has not been submitted to the Navy Department; and, as a matter of fact, we have received no reply as to the alternative estimates previously submitted. My first three preliminary estimates were based on the hospital being located at Stony Point. When, at the end of July, I prepared an amended estimate, it was proposed to have the hospital as located on the plan, and if that location is changed the estimate, of course, will be affected. I do not think it is practicable to supply heating electrically at the Base, the main reason being the great cost as compared with the scheme put forward by Mr. Dixon. A comparison between electricity and fuel of any kind depends entirely on the cost of electricity and the cost of fuel. At Flinders Base there is, of course, no possibility of water power; all the power would have to be obtained from the power-house, which, I understand, will contain three steam-generating sets. I understand that Mr. Dixon, under his scheme, anticipates an efficiency of 60 per cent.; that is, of the coal which is burned under the boilers in the boiler-house, 60 per cent. of the energy will be let free in the building for heating purposes. If you compare that with the power-house, you will see the reason for the great cost of electrical heating. First of all, in the power-house proper, coal is burned underneath the boiler. With modern boilers, you get an efficiency of about 80 per cent.; and it may seem strange to you, but it is absolutely correct, that the efficiency of a steam engine of the size proposed for the power-house is only about 8½ per cent.; that is, of the energy in the steam, only 8½ per cent. comes out in the form of mechanical power. In an electrical generator, about 90 per cent. of the energy comes out as electrical energy; so that the over-all efficiency of the power-house is practically 80 per cent. by 8.5 per cent. by 90 per cent., which comes out about 6.12 per cent. Of the energy in the coal, there is only about 6 per cent. in electrical energy. Assuming that with electrical heaters the efficiency is 100 per cent., then for the same heat you would have to burn ten times as much coal in the power-house as would support a system of heating with steam or hot water. At Flinders Base the fuel cost alone would be ten times more for electrical heating than with the other system. There is another point. Under Mr. Dixon's scheme, if his boilers were of a certain size, you would have to install boilers of ten times the size in the power-house. You would have to install engines and generators, and you would have to run heavy copper cables to the various buildings. An electrical scheme would entail more first cost in the way of a plant, and

the ratio would be increased with your fixed charges, and so forth, from 10 to 1 to probably 15 or 20 to 1. I have not had time to work out the detailed figures, so the ratio is only approximate. Then, as I stated at the beginning, the Navy Department has done all the work in connexion with the power-house. I do not know the basis of their calculations, but I assume that the size of the power-house they have fixed on will be just sufficient to meet their power and lighting requirements for the workshops, and so forth. If there be any electrical heating or cooking, it is very probable that you would have to install additional plant, as I have said. I think that the system that Mr. Dixon has put forward would be far cheaper than the cost of electrical heating. The amount of current required for heating and cooking is really astounding. The figures are only approximate, but it would seem that for cooking alone we should have to install a plant requiring 170 kilowatts. That figure was given to me by the contractor who put in the Commonwealth Bank installation. Taking the same amount for heating as that taken by Mr. Dixon, it would mean 335 kilowatts, and for hot water about 300 kilowatts, making a total of about 800 kilowatts for hot water, cooking and heating. As I say, I do not know whether the Navy Department has figured on this plant as being only sufficient for their requirements. If I am correct in thinking that the power is only capable of supplying their workshop load and lighting, you would have to install additional plant of 800 kilowatts, or practically double the existing power-house. The voltage is 460, and to transmit 800 kilowatts to the barracks would mean very heavy cables, representing, at present prices, roughly, £5,500 for copper alone. I think that the detailed estimate I am preparing will show that there is a decided saving in the hot water and steam system. I think that Mr. Dixon mentioned 1s. 2d. per man per week for hot water, heating, and cooking. I understand that the result at the Commonwealth Bank for cooking gave a cost of .65d. per meal per person. Taking two meals per day, the cost would be 1.3d. per day, or 9.1d. per week. That is based on current at 1½d. per unit, which I think the power-house at Flinders will not go under. Assuming that to be the cost, it would mean, at Flinders, 9d. per week for cooking alone, on the basis of two meals, or one full meal and two light meals.

81. *To Senator Needham.*—I am satisfied in my own mind that in electrical installation day labour has proved satisfactory and effective, and has been as cheap as contract labour. Of course, this work has not involved any huge number of men, and, with the size of the staff, I am of the opinion that day labour has proved very satisfactory. We bought the best material at as low a price as any one could buy it, and we have had no labour troubles. I am convinced that we have got very satisfactory work from the men employed. The Navy Department has not consulted our branch in regard to the power-house; and, personally, I think it would tend to improve things if we were more in touch with the Navy in this regard. We were simply informed that the power-house would be built by the Construction Branch, and were informed as to the current—practically, we were told that we started at the switch-board. The same thing happened in connexion with the Naval College. The Navy Department installed the power plant, and our Department carried out the work of wiring all the buildings and putting in the street lights. I think it would be better if there were some consultation between the Departments. Personally, I have no explanation at all as to why there should have been such a delay in reply to our communication of 8th January, 1917. I do not think there is any feasible scheme of water-power for the generation of electricity at Flinders. I have not given the matter any consideration, but to my knowledge there is no water supply within a suitable radius of Westernport to serve the purpose. I have allowed for comparatively small lights in the street, with a maximum of 200 candle-power, spaced by 200 feet on the more important roads, and 250 feet on the less important roads. To my mind, there are only two disadvantages in the overhead system. In the first place, it is to many people unsightly; and, secondly, there is more risk to life. There is always the possibility of a severe storm breaking the poles, and of people coming into contact with the fallen wire. But with a well-constructed system, the risk, in my opinion, is very small, and the overhead system has the advantage of a lower first cost. Then, again, it is easy to effect repairs, because the wires are in sight all the time. If there is any trouble, it can easily be got at. With underground cables it is very difficult to locate the breaks, and repairs take a long time. The overhead system is easier to extend, as being more flexible. It is a very simple matter to take down a cable and put up a heavier one; but, with the underground system, it is a matter of digging up the streets. As to reliability, the two systems, if well constructed, are about equal. I would recommend to the Committee the overhead system as perfectly satisfactory, and as involving the minimum cost. An underground system on the solid plan would cost about 50 per cent. more; and the question is simply whether you are prepared to pay that 50 per cent. to have the wires put out of sight. I have no figures as to the relative cost of concrete and wood poles, but I shall get them later on. I should say that, with an overhead system, and with telephone and fire alarm wires placed on the same poles, safe working conditions can be guaranteed, with ordinary care on the part of the workmen themselves. As to which system the Navy Department desire, you will see by my evidence that we are still in the dark as to whether they prefer an overhead or an underground system.

82. *To Mr. Laird Smith.*—We were not consulted at all about the internal installation of the power-house; we were simply told that certain lighting and power were required, and that the machinery for supplying it was already available. If I were asked to design the whole scheme for the Naval Base, I would certainly consider a high-pressure alternating current system preferable to a low potential current, regarding the matter from the point of view of a general electrical supply. Whether there are any peculiar requirements in the Navy demanding a direct current plant, such as is used on board ship, I do not know; but from the supply point of view there is no doubt that a high-pressure alternating current system is the better and cheaper. If a high-pressure system were used to supply the buildings, as outlined in my estimate, the total estimate of the installation would be cut down to £10,000. As to whether it is necessary to install three distinct engines and dynamos for the purpose of supplying the small power that will be necessary at Flinders for many years, I can only say that the more sets the more reliable the system. If one machine out of three breaks down, there are two left, and we assume that each of these machines is capable of carrying 50 per cent. of the load on the station. If there are two machines only installed, then each has to be large

enough to carry the total load, so that it is possible there may be advantages in having three sets. It would mean that slightly less capacity would be installed, but, since the machines are small, I should say that the cost per kilowatt would be higher. The total cost would probably be practically the same as that of two machines; and there is the advantage that if one machine breaks down, only one-third of the plant is lost, whereas in the case of two machines one-half is lost. There is another point. One of these sets would, presumably, have to run all night in order to supply the small amount of lighting during the morning hours, unless they are going to run the workshops. It is difficult to say, off-hand, whether a storage battery would be the better arrangement. Each case has to be worked out on its own basis; but, speaking generally, I should say that, for a system of this size, it would probably pay better to run all the time. So far as I know, there is no provision made in the building for any extra storage battery. I have no information as to the power requirements, and as to the variation of the load during day and night; each individual case has to be considered. If you shut down, you save in attendance to a certain extent, but against that you have the fixed costs—it really depends on the costs in each individual case. Personally, I think that a three-phase plant would cost less than a direct current plant. You can get pressure, of course, at the most distant station by putting in heavy enough cables; but if, in the neighbourhood of Stony Point, extensive works were later on erected, some change would have to be made. A hospital, which is purely a lighting load, could be supplied at the low pressure of 460 volts, but it would not be economical to supply a workshop requiring 500 or 600 horse-power with that voltage. I have made no provision for arc lighting. To my mind the modern metal filament lamp is replacing the arc lamps for street purposes, as has become evident since the war has raised a difficulty in getting carbon. My proposal for Flinders Base are fairly small lights, equal to those required in a suburb or a small country town. As to whether 460 is the correct voltage for internal lighting, I may say that that voltage will not be put on the lamps. It is a three-wire system, and each feeder consists of three wires. We tap each lamp off the neutral wire and one of the outer wires. The voltage will be 230 for lighting, and 460 for power. I believe that the separate machinery for wireless is some that is being transferred from Williamstown. There is really no way of protecting ourselves against malicious attempts to connect wires together. Of course, telephone lines at the exchange are protected with fuses, which will blow in case of contact with the electric lighting wires. I am quite satisfied there will be sufficient protection for the telephone services with two systems of wires on one pole. I am satisfied that we can get insulators made here. At the Woollen Mills we generate a three-phase alternating current of 415 volts, 50-cycle, and supply about 800 horse-power. In the case of the Caulfield Military Hospital, we buy power from the Melbourne Electrical Supply at 4,000 volts, and transform it to 400 and 200 volts. At Canberra, we generate three-phase current of 5,000 volts, 50-cycle, and supply about 30 miles of 5,000 and 10,000-volt lines. The largest cable we use for the wires is 7-7 aluminium. We have not inspected the country from which we get our poles, but have accepted suitable tenders, and inspected on delivery. We shall require, approximately, 104 poles 30 feet long, 26 poles 35 feet long, and 59 poles 40 feet long, or a total of 189. It would certainly be advantageous to inspect poles before they are cut; but it is, of course, simply a matter of balancing the cost of such inspection against the possible gain of securing better poles. Personally, I think that the natural round poles are satisfactory, so long as they can be obtained fairly symmetrical; there is a great difference in the cost between round and square poles. My estimate of £16,000 is based on the prices which ruled on the 1st September, 1917; and I am satisfied that the work can be done for that price on that basis. The wire leading from the feeder to the lamp will have to be insulated, and it will have to be imported. I would prefer it to be insulated with rubber, though, in some cases, it might be advisable to give it an additional protection by a wrapping of tape, in view of the strong sea air. Rubber covered with wrapping, similar to so-called waterproof cables, would probably prove satisfactory.

83. *To Mr. Sampson.*—As to the difference between an alternating current and a direct current, what we call current might be taken as analogous to the flow of water, and what we call voltage, to the pressure of water. A direct current is one in which the pressure is absolutely constant at all times, like water flowing through a pipe at constant pressure; an alternating current is one in which the pressure varies according to a wave form. It starts from zero, rises to a maximum, goes to zero again, then goes to negative values, and back to zero again; and that is repeated about 50 times a second for what we call a 50-cycle current. The great advantage of the alternating current is that you can generate it at a high pressure, and transmit it economically, and then with an apparatus we call a transformer bring it down to a low voltage for utilization. The size of the cable or the amount of the copper required is the square of the voltage. For instance, if you can use a voltage ten times, theoretically you need only 1-100th of copper; and it has the great advantage of transmission over distances. A direct current can economically supply only a certain distance. In Melbourne, the City Council supply direct current within the city area, bounded by Spencer, Spring, Flinders, and Lonsdale streets, and alternating current outside. There is one other advantage connected with the alternating current. All direct current machinery, in order to give constant pressure, has to have a device which we call a commutator, composed of segments of copper, insulated with mica. It has to be designed in such a way that it is the weakest part of the machinery from a mechanical point of view. With alternating current, motors can be used which have no commutator at all, and are much cheaper and less liable to trouble. A fundamental disadvantage of the direct current is that there is no means at present known of generating it at high voltage and reducing it to a low voltage without using rotating machinery, whereas with the alternating current we have a device called a transformer, which is about 98 per cent. efficient. It has no moving parts, and, consequently, it is cheap and needs no attendance. From the point of view of electrical supply, if I were laying down this scheme at Flinders, I would adopt the alternating current system to do the work I require there. It would be cheaper. As I said before, the first cost would be £6,000 less, and the motors would be cheaper and less liable to give trouble. The Navy Department decided,

on 7th July, 1916, that there shall be direct current —460 volts. All I know is that there are going to be workshops; I know nothing of the detailed requirements. As to the power-house, I understand that the idea with the Navy Department has been to imitate sea conditions. For instance, in the boiler house there are no automatic stokers or coal-handling appliances; and it may be that, since most ships are equipped with direct current, the same plan is being adopted at Flinders with a view to training men—the advantages of the alternating current giving way to that object. However, I have not been in touch with the Navy Department, and I do not know their reasons. It is quite possible that the Navy Department may have machinery of such a type that it requires to be run at various speeds; and a very efficient way of doing that is to have a variable speed motor. With direct current it is possible to get motors which run at various speeds, but with the alternating current it is rather difficult. For instance, if the Navy Department has a workshop containing a lot of machine tools that have to be run at varying speeds, they may prefer direct current for that reason. Similarly, for electrical cranes of certain types they may prefer direct current, the characteristics of which are, in some respects, better than those of alternating current. But, of course, if alternating current were generated, and a small amount of direct current was required, the alternating current could be converted into direct current by machines which we call converters. If I were considering the problem, I would balance the amount of direct current required with the amount of the alternating current required, and arrange the plant to meet the larger requirement. Taking the feeders in their order, the first two are purely for street lighting, the third will supply lighting, and will also supply power to the sewage pump at the septic tank. In the boatbuilders' shop there will be machinery to be driven, and workshops in the wireless school will also require a small amount of power. I have simply had to make my own estimates as to the amount of power that will be required, and I have allowed for a load of 20 kilowatts for lighting and 43 kilowatts for power, or 63 kilowatts in all. For the seamen's barracks only lighting will be required. Feeder No. 7 will supply the armourers' workshop, and will also supply power to a sewage pump near the guardroom. What will be the exact power required, I cannot say, but I estimate it at 20 kilowatts. I have allowed for a load of 60 kilowatts for lighting and 20 kilowatts for power on that feeder. Feeder No. 8 supplies the torpedo mining school, where, again, provision must be made for power. There are electrically driven compressors used in connexion with the torpedo workshops, and I have estimated 17 kilowatts for power at that point. Coming to feeder No. 9, I may say that in one of the victualling stores there is to be a refrigerating plant for meat and perishable products. Of the power required in that instance I have a better knowledge, and have allowed 17 kilowatts for the purpose. The total lighting load of the whole of the feeders is a little under 300 kilowatts. That is the total connected load. Under normal conditions I do not anticipate that more than one-half of that lighting load would be on at the one time, thus leaving a load of 150 kilowatts for the power-house. I have allowed for about 97 kilowatts for power. There, again, a factor should be taken, because all machines will not nearly be running at the same time. The exact amount, of course, will vary, and it is very hard to say what it will be. But, again, taking one-half of that total power load of 97 kilowatts, which is a fairly good basis for an estimate, the maximum load for lighting and power at any one time should not be more than 200 kilowatts. So far as I know, there are no provisions to be made, other than those for which I have allowed. The sets of engines that the Navy are installing are each capable of supplying 250 kilowatts, and they can, of course, supply anything less than that. On a basis of 200 kilowatts an engine will be supplying about 80 per cent. of its rated load. In addition to what I have estimated there must be a certain amount of load in the workshops. I have not estimated on that at all. The Navy Department do not anticipate using more than 400 kilowatts for some time, and that would mean the running of only two of their engines. Two hundred kilowatts will be used under my scheme, and 200 kilowatts under their own. You ask whether it would be advisable to have the alternating current, or whether it would be possible to detach my portion of the whole scheme from that of the Navy scheme, and to use an alternating current in the one case, and the direct current, which the Navy Department proposes, for the remainder of the works. I think it would be better to have the same system throughout rather than to have a mixed system of direct and alternating currents. The mixed system would introduce complications, and would increase the cost of spares. It would be far preferable to have the one system. If one-half of the current is used in the Navy workshops, and the remaining half outside, then I think that, unless there are special reasons for the use of the direct current, I would prefer the alternating current on account of its flexibility and the way in which it would lend itself to expansion if other workshops were established at a considerable distance from the existing workshops. As to the desirableness of using one of the engines for the alternating current and another for the direct current required by the Navy works, I would point out that it would be necessary to instal spares for both classes of current, so that the quantity of plant to be installed would thus be increased. Taking the system of mains as laid out by me, there is a saving of £6,000 on the use of the three-phase alternating current, and there will also, I think, be a saving in the power-house machinery. It is quite practicable to have one of the engines driving an alternating current generator and the others driving direct current generators. There is no physical reason against such a course, and all could be under the same supervision. I am prepared to give you an estimate of the cost of having a separate engine for each system. I understand, however, that an order has been placed by the Navy Department for a direct current plant—for three generators and all the other necessary equipment. I will supply you with a comparison of the costs. The alternating current generator would be fundamentally different in construction and design from the direct current generator. The alternating current would be cheaper. I will supply the Committee with an estimate of the cost of the two classes of generators. In regard to power-house work our aim is, of course, to make available, in the form of electrical energy, as much of the energy which exists in the coal as we possibly can. There is a 20 per cent. loss in the boiler plant, but the great loss is in the engine. We are able to convert into mechanical work only about 8½ per cent. of the energy in the steam which we supply to the engine. The engine drives the generator, and of the mechanical energy which is put into the generator we get about 90 per cent.

in the form of electrical energy. The indicated loss is inherent in the process we use in steam-engines. It is not possible with the use of steam-engines to exceed very much the performance we are getting from them. We need to use other methods of generating electric current if we want to improve more than we are doing in the matter of heat. If we could do without steam altogether—if there were some way of getting the heat in the coal directly in the form of electrical energy—we should be able to cut down very much the cost of electric current. For electrical heating purposes we change the energy in the coal into heat. We then take it back to mechanical energy; we next change it to electrical energy, and transmit it to the building; and then transmit the heat energy. The great loss is made in converting from heat energy to mechanical energy. If we could get electrical current from water-power at a very low rate, there would be, of course, a basis for considering electrical current for heating purposes, particularly where coal is very costly.

84. *To Mr. Mathews.*—There is no provision in this scheme for lighting the street in front of the warrant officers' quarters, nor for lighting the road leading north from the torpedo mining school. These matters were discussed with Mr. Hill. In my first estimate I had split up these feeders, and had one-half running along the street between the naval stores and the drill hall, and one-half running along the road north from the torpedo mining school. I also had a system of lighting around the drill grounds. The system consisted of an underground cable laid round the drill ground and supplying a number of concrete standards. When beginning to prepare this amended scheme I discussed the whole matter with Mr. Hill. He considered that it would be sufficient to light only one of these roads and to put all the cables on the road between the drill hall and the naval stores, thus eliminating a number of poles and cutting down the quantity of overhead work. Mr. Hill also thought that the lighting round the drill ground would not be required for the present—that sufficient lighting would be thrown from the barracks or that, if necessary, standards could be placed outside the barracks, connecting with a short underground cable with the barrack blocks. On his instructions I modified the scheme accordingly. There is no provision for street lighting beyond the points marked in red on the plan and showing the suggested positions of street lights. If it were thought necessary, the scheme could be readily modified. Additional lighting could be put along the drill ground, or carried to any other point required. Now is the time to determine what is required, and to make preparations accordingly. You will observe that in my estimate this scheme is put forward as supplying the minimum requirements of the Department. We consider that it is down to bedrock. Many things for which no provision is made could be added. It might, for instance, be thought that the street lights should be put closer together, or put along roads for the lighting of which we do not at present provide. As to the three estimates of cost, the increase from £15,000 to £16,200 is due to the increased cost of material. In connexion with both the second and third systems, the only undergrounding is at the main base. The lines to the married officers' quarters, and to the original site of the hospital, are still left overhead. Taking the estimate of £16,200 as it stands, I think that the whole of the work, including the greater proportion of the extensions, could be put underground for about an increased cost of 50 per cent., or, say, in round figures, £25,000. That would be the cost of putting everything underground on the solid system. No doubt the underground system is far more sightly than the overhead system, and is necessarily adopted in all crowded areas and in cities. The tendency is to do more and more underground work, but it is considered to be more costly than overhead work. In America, more particularly, there is proportionately more overhead work than we have in Australia. There they have the practice of running high-voltage cables overhead through the streets of big cities, whereas in Melbourne, for instance, and in all the suburbs, the high-tension cables are always put underground, and only low-tension wires are placed overhead. In connexion with the Jervis Bay College, we provided for a mixed system. We have one main line of poles running from the power-house at the rear of the cadet block, but all the branches from it, as well as all other cables, are led underground. From the parade-ground, and around the academic block, there are no overhead cables. It is only on the outskirts, and on the one main road I have mentioned, that there are overhead cables at Jervis Bay. Our object in adopting that mixed system was to keep down the cost and at the same time not to mar the appearance of the place. From an electrical point of view, the systems are on a par as regards reliability. The only question is whether we should be warranted in spending 50 per cent. more in order to eliminate the more or less unsightly construction by putting everything underground. There are many considerations to be taken into account, but if I had the spending of the money I think that I would hesitate to expend the additional 50 per cent. involved in putting everything underground. Shortly put, it is a matter of pounds, shillings, and pence. There may be fewer faults with the underground system, but they are harder to locate, and take longer to correct, than do any faults in connexion with the overhead system. The price of the copper wire largely contributes to these costs. I roughly estimate that if this system had been put in under pre-war conditions, instead of costing £16,500 it would not have cost much more than £7,500. While the price of copper wire has increased, the price of iron has also gone up. In estimating the relative cost of copper and iron wire for telephone lines or the electrical clock lines, you should take, first of all, copper wire of the size required, figure out the corresponding size of iron wire necessary to give the same conductivity, and then compare the market prices of the two. In respect of the same sizes there could be no comparison between copper and iron wire; the copper is very much superior. I will ascertain for you what would be the difference in cost between copper and iron wire for the telephone and fire-alarm lines. I hold that this overhead system is just as good as an underground system would be from the point of view of efficiency and upkeep.

85. *To the Chairman.*—This system of lighting could easily be so extended as to light the front of the barracks and other buildings. We have, for instance a street-lighting feeder going along the road at the rear of the barracks, and, if desired, we could make an extension at comparatively small cost to light up the front of the barracks.

86. *To Mr. Mathews.*—We could also continue a line to the front of the warrant officers' quarters.

87. *To the Chairman.*—The wiring inside the barracks—the internal wiring—could be used in making an extension to light the front of the barracks. We provided for bringing the lines along the road of the barracks

instead of in the front of them, in order to eliminate poles from the main street. There is no reason why the poles should not be brought along the main street other than the question of sightliness. The cost would be practically the same. As an engineer, I could see no objection to it other than the fact that we should have the poles and wires in front of the reserve. Our desire has been to have the poles and wires in the least conspicuous places. If we had the lines running along the main street, the lighting of the reserve would be very considerably increased. I think we should thus provide a lighting that would be quite sufficient for the parade ground.

88. *To Mr. Sinclair.*—In converting coal energy into electrical heat, there is a total loss of about 94 per cent. There is only about 6 per cent. of the available energy in the coal available as electrical heat.

89. *To Senator Newland.*—I am not aware of the considerations that influenced the Navy Department in selecting the direct current system. The Naval authorities may have very good reasons for wanting a direct current—reasons of which I am absolutely unaware—but we were not asked to confer with them on the subject. The fact that the direct current system is used on warships is one possible reason for the decision of the Naval authorities to use a direct current system at the Base. To the best of my knowledge, most of the vessels of the British Navy are fitted with the direct current system. The main reason for this is that the distributing distances on board ship are not very great. When the equipment of ships of the British Navy with electricity was commenced, the direct current was used practically wholly, and the authorities have more or less followed along those lines. If electric propulsion is used to any extent on battleships, the alternating current will have to be employed. On several of the largest ships of the United States Navy electrical propulsion is being employed. Steam turbines are used, and transmit to large alternating current motors. There is a tendency in America to use the alternating current on board such vessels as oil carriers, where the pumps for moving the oil are alternating current motors without any commutators. These do not permit of any risk of sparks, which might cause an explosion. The loss of power in transmitting electrical current overhead and underground is about the same. I have no knowledge of the load we may be asked to carry for the workshops. I know nothing of their demands. I have allowed for a heavy cable of 37-12 capable of supplying the wharf, but I know absolutely nothing of the Navy Department's requirements in that regard. The cable which I have included in my estimate would supply quite a number of cranes on the wharf. As for the workshops, they are so close to the power-house that any reasonable load could be readily carried from the power-house. My estimate does not include any work in the workshops, because I do not know the requirements. The workshops being attached to the power-house, most of the work would be of an internal character, and probably would not be carried out on poles. A fresh cable could be run.

90. *To Mr. Laird Smith.*—To make a good job, if the poles were brought to the front of the buildings, to which reference has been made, it would be necessary to carry the current from the feeders into the buildings by an underground cable. I am proposing to bring the cables overhead to the seamen's barracks, and then to branch underground from the pole into the main seamen's barracks so that we may not have any wires that might possibly be touched. It is rather difficult to get into that building, as it is a three-storied structure, and it is very difficult to fix the wires in such a way that it may not be possible for some one to come in contact with them. That being so, to make absolutely sure of avoiding that danger, and to secure a better looking job, I am proposing to bring the wires underground from the poles into the main distributing board, which is located on the verandah on the ground floor. Our main object in running the lines behind the barracks was that the poles should be as inconspicuous as possible. If the poles are brought to the front of the building, it would to some extent increase the cost of installation. We shall need to have runs underneath the building, and that will involve additional cost. We admit that overhead construction is not a pretty job, and the desire is, as far as possible, to restrict the overhead system to what are more or less alley-ways or rights-of-way that are not largely used. That was the fundamental idea which influenced us in bringing the line along at the rear of the barracks. If there should be a development to the west, we could easily have the same line of poles and run other cables.

91. *To the Chairman.*—I have prepared an estimate for telephone installation, which is in addition to the estimate for electric-lighting mains. I present to the Committee copies of that estimate. Our Department asked the Navy to state what provision they desired in respect of telephones. The Navy replied that they required an automatic telephone system, and the Director of Naval Works furnished us with two drawings showing the positions of the telephones required. In all, 72 telephones were asked for, and possibly three additional telephones will be wanted for sentry-boxes. This estimate covers telephones for purely internal work; that is to say, it does not cover cost of telephones for outside services. The telephones covered by it will simply be used to enable the various offices and depôts at the Base to communicate one with the other. They will have no connexion with any outside service. I have not estimated the cost of an outside telephone service, because such work is generally done by the Postmaster-General's Department, and the practice is for the Department concerned to make direct arrangements with the Postal Department. The Naval authorities' plan indicated that the telephone exchange would probably be located in the main guard-room. The estimated cost of the installation is £2,700. That includes the complete equipment at the exchange—switchboard, main distributing plant, battery, motor-generating set for charging battery, and the necessary switchboards, as well as the 75 telephones, their erection, and all the necessary wiring, assuming that the wiring is run overhead on the poles. Should it be desired to have an underground system, these wires would have to be undergrounded at an increased cost, which I have not yet estimated. I propose installing a 100-line equipment, but with equipment for only the 75 lines. Later on the additional equipment can be put on to supply the hundred lines, and there will be room also to add another 100-line equipment should the Base expand. The equipment on which I base my estimate is similar to that of the automatic telephones already in use at Perth, in Western Australia; Geelong and Brighton, in Victoria; and a number of Sydney suburban exchanges, such as those at Balmain and Newtown. This, then, is a general outline of the system, and the detailed estimated cost of the various items is based upon present

prices. We have not yet selected any special system. There are, I understand, three systems of automatic telephones in use. Two are American systems. One of these—manufactured by the Automatic Electric Telephone Company—is the system mostly used so far in Australia; the other system is manufactured by the Western Electric Company of America. I understand that the Postmaster-General's Department is installing one or two of the Western Electric Company's systems in South Australia. There is also a third system, made by Siemens Brothers, of England, which in many respects is very similar to that of the Automatic Electric Telephone Company. It has already been installed, I believe, at Port Adelaide, and we have a 25-line equipment, made by Siemens Brothers, at the Naval College, Jervis Bay. The firm of Siemens Brothers, however, has been declared an enemy company, and is practically doing nothing in Australia at the present time. The Western Electric Company have intimated to me that, at present, they cannot supply automatic telephones. My estimate is based on prices furnished by the Automatic Electric Telephone Company. So far as I know, the three systems cost about the same. If this work is proceeded with, we shall prepare specifications and invite tenders. Each system must be judged on its merits, and tenders for the material required will be called. My only experience of the automatic system relates to the 25-line equipment which we have installed at the Naval College at Jervis Bay. In that case we utilized the services of the Postmaster-General's Department, taking its advice as to which system we should adopt. We also employed the Postmaster-General's men in installing the system. The electrical work at the College was done by contract, and it was thought that the more economical course to pursue would be to secure the services of officers in the Postmaster-General's Department, Sydney, to install the telephones, rather than to send men from Melbourne to do so. The system, so far as I know, has proved satisfactory at the Naval College. Speaking of automatic telephones generally, although troubles arose in the initial stages, they seem to be giving satisfactory results, particularly where they are employed without any connexion with outside exchanges using the manual system. The Commonwealth dockyard at Cockatoo Island is, I am informed, installing the system manufactured by the Automatic Electric Telephone Company. That system is also in use in a number of the larger business houses of Sydney, such as Farmer's, the Sydney Gas Company's offices, and other large establishments. The first cost of installing the automatic system is considerably greater than the cost of installing the manual system; the chief saving is in respect of attendance. I understand that, according to evidence given by the late Mr. John Hesketh, the automatic telephone is considered the better proposition for general exchange use. You ask whether, admitting that, it would also be a better proposition in a case like this, where only 75 telephones are to be used at the present time, or in respect of a 25-telephone installation, as at Jervis Bay. If an operator had to be assigned to this work continuously, the cost of the manual system, even in those cases, would be greater than that of the automatic system. The Automatic Telephone people state that their system needs very little attention, and, so far as I can ascertain, the experience of the Postmaster-General's Department seems to bear out the contention that the apparatus is very reliable, and, on the whole, gives little trouble. The switchboard has various warning signals, so that any fault arising in any particular part is immediately indicated. It is thus not difficult to ascertain the cause of any trouble. The automatic people are quite willing to guarantee that the service will be satisfactory. I have not made a comparative estimate of what would be the cost of the automatic and the manual system at Flinders, nor have I made a detailed estimate of the comparative cost of working the two systems. I have worked upon the direction of the Naval authorities that they desired the automatic system, and have estimated accordingly. I think the automatic would prove to be more economical than the manual system, even in the case of a small service such as we are proposing to install at the Base. I do not consider that at the present there would be any great difficulty, other than that presented by the shortage of shipping, in obtaining the necessary automatic telephone supplies. Within the last month or two the Automatic Telephone Company has been taking orders from the Postmaster-General's Department for a considerable quantity of equipment. I should, therefore, think they would have no difficulty in supplying a 75-line equipment. The Committee could obtain information from an officer in the Postmaster-General's Department as to whether the automatic or the manual is the more economic system, or, if you desired it, I could prepare for you a comparative statement of the working cost. I certainly think it would be possible to obtain information from an officer in the Postal Department who has had more experience of the working of the automatic system than I have had. The work of our Department, as a rule, involves very few telephone installations, except where connexion with outside exchanges is required. The automatic system at Jervis Bay is the only one that we have put in, so far as I am aware, and it has been in operation for about three years. I have no special information in relation to it.

92. *To Mr. Laird Smith.*—There will not be much exposed wire in respect of our overhead system. We are using cables as far as possible, and breaking down to aerial wires near each group. I understand that the Automatic Telephone Company would supply the complete exchange equipment, including telephones, and that, if desired, they would supply us with the services of men to erect it at a certain cost per week. They would also be prepared, I think, to contract for the whole work. I think that a naval electrical engineer will be detailed for constant duty at the Base, and that he could be educated to effect repairs to the automatic telephone system there. It would not be necessary to employ down there a man whose special duty it would be to effect telephone repairs. There must be an electrical engineer attached to the Base to attend to general repairs, and there would be no difficulty in instructing him to attend to telephone repairs. That would reduce the cost of the upkeep of the automatic system. The automatic system is wholly independent of the operator, and, on the whole, the experience is that connexions are made in one-half of the time taken under the manual system, and are also made more surely. It is a fact that improvements are constantly being made in the automatic system, and that the initial faults are being quickly corrected. Its efficiency is being steadily increased. I have visited a number of the automatic exchanges in the suburbs of Sydney, and have found them working satisfactorily. I was favorably impressed with them. I

have also seen in the Sydney *Daily Telegraph* office a private installation of the automatic system, which was put in to permit of quicker connexion between the several Departments. It is superior to the common battery system, and is certainly beyond the experimental stage. The Perth automatic system is the largest in Australia. Most of the difficulties that have arisen in connexion with the automatic system have been where, as in Melbourne and Sydney, a number of exchanges are on the automatic principle, and a number are on the manual system. The delay that sometimes takes place is in speaking from a suburb where there is an automatic system to a suburb where there is only a manual system. I was recently in Sydney, and noticed that the automatic equipment is protected from dust, being absolutely enclosed. I have had experience of the use of aluminium wire for general work. We have a large number of aluminium cables in connexion with the electric supply at the Federal Capital. So far as straight-out transmission is concerned, I think the aluminium cable has no objection; but in the case of distributing mains, we have experienced difficulty in the jointing of the service wires from a building to an aluminium main. We have some aluminium cables at the Cordite Factory, and our experience has been that the joints last for only about a year. At the end of that time, we get oxidization, and very often only an intermittent contact, with the result that we have to re-make the joint. The jointing question is a difficult one. At the time the cables were secured for the Federal Capital, there was a saving of about 15 per cent. made by employing aluminium instead of copper wire. During the last two years, however, no aluminium cables have been imported. Their export from England has been prohibited, and there is none in the country at present. The use of aluminium and copper wires should be considered from the stand-point of relative costs. If a saving of more than 5 per cent. could be made by using aluminium cables, I would favour them as against copper; but if very little saving is to be effected, I should prefer the copper, because of the greater ease in making the joints. I do not anticipate any serious effects on induction by running the telephone service wires on the electric light poles at the Base. Being direct current, I anticipate very little induction trouble. If it were an alternating current, we might have to transpose the wires; with direct current there should be no trouble at all. As to the batteries to be employed, my estimate is based upon the use of the storage battery, and includes provision for a motor generating set for charging it by means of their own local system.

93. *To Mr. Sinclair.*—Although this is to be an internal system, it could if necessary be connected up with the local exchange. If desired at any time, the exchange at the Base could be connected up with a trunk line. The Naval authorities indicated to us that they wanted provision made for a direct line from the Navy Office in Melbourne to the captain's house at the Base, and also to the administrative building. My estimate does not cover that work, since it would be done by the Postmaster-General's Department. The estimate is for an entirely local system; but if desired that system could be connected with a commercial exchange, so that from the respective telephones one could get through to trunk lines running to Melbourne, or perhaps to Bittern, which is the nearest local exchange. The Postal Department, I presume, will make any arrangement desired by the Naval authorities for trunk lines going direct from the Navy Office in Melbourne to the Base without passing through any commercial exchanges. I presume that the Naval authorities would want direct lines to the Naval Base from the Navy Office for the purpose of greater secrecy.

94. *To the Chairman.*—The Navy Department were asked what provision they wanted in the way of electric clocks, and replied that they desired a system of electric clocks throughout the Base. They asked for an estimate. We have not obtained from them a statement as to where the clocks will be located. I have prepared an estimate for installing in the chief petty officers' quarters a turret clock with one 5-ft. dial and a 2-cwt. bell, with striking mechanism for striking ship's time—naval time, and dog watches included. I have also provided for installing eighteen electric clocks in other buildings, as follows:—Single officers' quarters, chief petty officers' barracks, two seamen's barracks, warrant officers' quarters, wireless station, wireless school, boatbuilders' shop, power-house, workshops, torpedo and mining school, receiving shed, administrative buildings, drill-hall, lecture rooms, depôt surgery, gymnasium, and main guard room. In making up this estimate, I assumed that the wiring could be run on the electric light poles, and I allowed for fifteen clocks with a 12-inch dial, and three clocks with a 24-inch dial. The cost of this work is estimated at £725. Some months ago this estimate was forwarded to the Navy Department, which acknowledged its receipt and asked for details of the clocks proposed, but did not intimate whether my estimate for the installation of eighteen clocks was satisfactory to it or otherwise. I am therefore unable to say whether they want more or fewer clocks.

95. *To the Chairman.*—I have prepared an estimate of the cost of installing fire-alarms, but it is only a preliminary one, owing to the fact that the general question of fire protection has not yet been thoroughly settled. In consultation with Mr. Hill, I fixed upon the positions for twelve fire-alarms, as indicated on the plan produced. In consultation with Mr. Lee, Chief Officer of the Metropolitan Fire Brigade, I went into the question of the type of fire-alarm to be adopted. Mr. Lee considered that the Base was deserving of a system somewhat similar to that in use in the streets of Melbourne. This estimate, therefore, is based upon twelve fire-alarm pillars of exactly the type used in the streets of Melbourne and suburbs. We provide for nine in the Base proper, which are joined up in one closed circuit that is brought to the main guard-room. The main guard-room is the most central place for the exchange. We also provide for three alarms in the married officers' settlement near Crib Point. These, likewise, are brought back in a closed circuit to the same exchange. We have arranged, so far as the wiring is concerned, that a very small current shall be flowing all the time, so that if a line breaks an alarm will be given, and the necessary repairs can at once be made. This will be an advantage over the open system, since a break in the wiring can be at once detected and repaired. There is thus no chance of an alarm not being transmitted because of a broken line. The equipment of each pillar will be similar to the Melbourne equipment, and the fire-alarm will be given by breaking the glass and pressing the button. As soon as the button is pressed, the mechanism in the pillar interrupts the current a number of times and transmits the signal by which the alarm is located to a particular box. I have made provision in my

estimate for recording alarms on a punching register of the Gamewell type—originally made by the Gamewell Fire Telegraph Company of America. The total cost for the pillars and wiring, and of the exchange equipment, is £700. That will include all line-testing equipment, relays, and gongs. The estimate, as I have said, however, is preliminary in the sense that it has not been dealt with by the Navy, and the question of the exact location of the pillars, &c., has not been determined. I see no objection to the wires for the fire-alarms and electric clocks being strung on the electric-light poles. By so stringing them we do away with miscellaneous pole lines round the Base. I have tried, as far as possible, to restrict the pole lines within certain defined areas. We have, for instance, a main pole line running along the road west from the power-house and then north to the rear of the seamen's barracks. We have also the main line of poles running along the road between the drill hall and the stores, and a small line of poles from the power-house to the torpedo school, and then to the wharf. If it were decided to install the telephone, clock, and fire-alarm wires on separate poles, then probably on those streets two sets of poles would be required. I would not recommend separate poles for the systems. It would mean, not only increased cost, but an increased disfigurement of the Base. We have not had any statement from the Navy Department, so far, with regard to the estimate for fire-alarms. As a matter of fact, it was prepared only recently and forwarded to them within the last few days, so that their wishes in this matter are not known to us. We have had the advice of Mr. Lee as to the type of fire-alarm to be employed, and I understand that the questions of the apparatus, its location, and the methods of fighting any outbreak of fire at the Base have been discussed with him. As to the large stores containing big stocks of goods, and the necessity for more fire-alarms at that point, I would remind the Committee that the plan provides for practically four alarms being provided near the stores block—one opposite the drill hall, one opposite the inflammable store, one at the corner of the road passing the warrant officers' quarters, and one at the corner of the torpedo and mining school. The question of whether that number is sufficient should be discussed, I think, with Mr. Lee. In Melbourne, the practice is, I understand, to have fire-alarms at the intersection of all streets, or, in other words, about 220 yards apart. This estimate does not cover any alarms within the buildings, but the system can be easily extended to provide for fire-alarms and watchmen's clocks in any particular building. We could have, for instance, such a system as we have now in the Commonwealth offices.

96. *To Mr. Laird Smith.*—We could connect up this proposed system with an automatic system inside any of the buildings at the Base. In large buildings in Melbourne the practice is to install at various points fire-alarms and watchmen's clocks. The arrangement is such that if the watchman does not press the button at the particular time required of him a call is transmitted to the Fire Brigade, so that the Fire Brigade authorities learn at once that the watchman is either not on duty or is delinquent, and immediately some one is sent out to ascertain what the trouble is. Such a system could be easily incorporated with that now under consideration. The watchman's clocks and the equipment in use in Melbourne are very largly made by the Fire Brigade authorities in Melbourne. They are turning out a very satisfactory clock and general apparatus. As to the wiring on the poles outside, we are keeping as much as possible out of the main street. Everything is being done to minimize the risk of unsightliness by reason of overhead construction.

97. *To Mr. Sinclair.*—You ask whether, having regard to the number of automatic telephones at the Base, I think a fire-alarm system is necessary. That is a question to be considered by a fire expert rather than by an electrical engineer. An American firm has put on the market a system under which an alarm is used in connexion with telephone wiring. Fire-alarm points are attached to the telephone wiring, so that as soon as the glass is broken and the button pressed, the apparatus in the fire-box automatically cuts out the telephone and transmits an alarm to the fire exchange. I discussed that system with Mr. Lee. So far as I am aware, it is not in use in Australia, but it was brought under my notice by the Automatic Telephone Company, and it is used chiefly in connexion with automatic telephones. Mr. Lee was very much opposed to anything but a separate system of wires for the fire-alarms. He instanced the fact that in connexion with the firm-alarm pillars which are now being erected in Melbourne, the Cable Tramway Board desired to have an attachment so that a tramway official could send a signal to head-quarters if a tram cable broke at any time. He was averse, however, to permission being given for any such attachment. The result is that you now see in Melbourne two different types of pillars, in many cases standing side by side. Mr. Lee is emphatically of opinion that there should be separate fire-alarm pillars, and, that being so, I have not pushed the matter further. My only desire was, as far as possible, to reduce the number of overhead wires.

With the consent of the Committee, the following memorandum from Mr. Harold W. Smith, Assistant Engineer (Electrical), Department of Works and Railways, dated Melbourne, 31st October, 1917, is added to his evidence :—

With reference to the various points raised during my examination, and on which I was to furnish further information, I desire to advise as follows :—

1. *Contract with Metals Manufacturers Ltd., of Port Kembla, New South Wales.*—This Department has no intimation of any contract between the Commonwealth Government and the Metals Manufacturers Ltd.

2. *Concrete* versus *Wood Poles.*—I estimate that at present prices of cement and steel reinforcement the cost of concrete poles is at least double that of wood poles. The concrete poles have a greater weight than the wood poles, hence their erection cost will be higher. As there are no white ants at Flinders Base, the life of wood poles should be long.

3. *Cost of Alternating Current* versus *Direct Current Plant.*—I estimate the cost of alternating current generating plant at about 85 per cent. of cost of direct current plant of same size.

4. *Cost of Extending the Mains to the Original Site of the Hospital.*—To extend the mains to supply a hospital the size of present temporary hospital located on original site for hospital near Stony Point would cost £2,000. If a large hospital, say, three times the size of the temporary hospital, were located there, the cost of extending the mains would be increased to £5,200. The reason for the large values of the above estimate are that the load is increased on the end of a long feeder, and the economical distance to which direct current can be transmitted is exceeded.

5. *Manual* versus *Automatic Telephone System.*—Omitting all outside wiring and subscribers' internal wiring, which are similar in both cases, the costs of a 75 line equipment (exchange and subscribers' equipment) are :—Automatic, £1,434; manual, £450. The increased first cost of automatic system is £984. Allowing 10 per cent. depreciation, the increased yearly cost is £98 8s. for the automatic system, but against this is the cost of the operator for the manual system, which would be about £110 per shift, making a net saving of £11 12s. per year for the automatic system.

6. *Copper* versus *Iron Wire for Telephone Wiring, &c.*—The best wire for telephone lines is hard drawn copper. This has a great conductivity, high tensile strength, and does not deteriorate when exposed to the weather. The

scrap value of copper wire is high compared to that of iron wire. Iron wire may be used on telephone lines of short length, but owing to the poorer talking qualities of a circuit composed of iron wire, and comparatively rapid deterioration of iron wire exposed to the weather, the best practice is to use copper. Iron wire has about 1-7th of conductivity of copper wire. On basis of present prices for equal conductivity, iron costs about 1.3 times copper. It might be possible, however, to use No. 10 gauge iron wire on short lines such as at Flinders Base, and this would save about £190 compared with copper.

7. *Estimate of Cost of Supplying Electrical Current for Heating Seamen's and C.P.O.s' Barracks, for Supplying Hot Water for Baths, and for Cooking Purposes.* —To enable this to be done, it would be necessary to install a 1,000 K.W. plant additional to present plant. Owing to the large amount of power and distance, it would be more economical to generate current at 3-phase 50 cycle 2,300 volts. Transformers would be installed at points near barracks to step down to voltage of 415 and 240. The capital cost of equipment would be as follows :—

1,000 K.W. power-house complete ...	£42,000
Transmission lines	1,140
Transformers	2,000
Sub-station buildings and equipment	1,800
Services	500
Heating equipment	2,070
Hot-water equipment	4,860
	£54,370

The running costs will be as follows, based on similar service to that assumed by Mr. H. A. Dixon, Mechanical Engineer :—

Yearly cost—2,115,280 units at 1.4d. per unit (say) ...	£12,450
Fixed charges on equipment exclusive of power-house ...	805
	£13,255

Cost per week, £255.
Cost per week per man, 6s. 8d.

The fixed charges on power-house are included in the cost of 1.4 pence per unit which I calculate to be the cost per unit of a power plant of this size, including fuel, labour, repairs, supplies, and fixed charges.

Taken at Melbourne.)

THURSDAY, 11TH OCTOBER, 1917.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

John Smith Murdoch, Architect, Department of Works and Railways, recalled and further examined.

98. *To the Chairman.*—I do not think the plans of the buildings for senior and junior officers have been submitted to the Naval Board, with the estimated cost. The Naval Board, in intimating their building programme for this year, said they wanted one further senior officers' house, one further junior officers' house, and ten warrant officers' houses, the senior and junior officers' houses to be similar to the accommodation already provided in those already erected for those ranks, and the warrant officers' houses to be in accordance with the sketches of accommodation approved in correspondence. This Committee sanctioned the erection of two of the warrant officers' houses two years ago, on a scale of accommodation which at that time was put forward by the Navy Department, but which since then has been modified. That is, the Navy Department asked for a larger scale of accommodation, and the Works Department held back progress regarding the warrant officers' houses until the Committee had a further opportunity of considering the new scale of accommodation put forward. The estimated cost of the warrant officers' houses originally put before the Committee in 1915 was £680 each, but that estimate, as explained at the time, was given merely on an outlined sketch supplied by the Navy Department, and before drawings had actually been made. That estimate would be fairly approximate at the time, but there has been a serious rise in the cost, and a material addition to the accommodation asked for by the Navy Department, and the consequent effect on this building proposition is that the houses are estimated to cost £1,465 each for one type, and £1,415 each for another type. The Department propose to go in for two types of houses for the sake of architectural variation. Both types embrace the same accommodation, and the Navy Department have approved of both. The senior officers' residence was estimated a little more than two years ago to cost £1,750. To-day it is estimated at £2,475. The accommodation is similar, seeing that we have not added any more rooms, but a good many unforeseen matters arose. When the plans were originally before the Committee, no site had been selected. No one knew where the houses were to go. The site which I had in my mind was not agreed to, and the sites eventually selected required a considerable amount of foundation that we had not anticipated. What with that fact, and the rise of cost on all buildings, the difference in the estimate is accounted for. The increase in the estimated cost of the warrant officers' houses is over 100 per cent. I have not the plans here on which the original estimate was based, but my recollection is that we have enlarged the rooms, and added an extra room. The houses are to be made with brick walls, tiled roofs, concrete foundations, timber floors, and one coat of cement plaster for the interior. The site proposed faces the road which runs parallel with the railway, starting from the left-hand side of the main entrance to the Base opposite the railway station. We have avoided putting these houses in low or damp ground. Provision is made for extending them further eastward when necessary. The most eastward of them would be half-a-mile from the hospital site. They will face the railway station. The cost of handling building material for them from the railway to the depôt will be very small. It would not pay to run in a siding, but it might pay to put in a 2-foot tramway. We have rails there already. In any case, the handling charges from the railway to the ground for these houses will be the smallest we have to meet. I cannot express an opinion as to whether the accommodation we propose is beyond what is warranted by the position of the officers who are to occupy the houses. The Navy Department are emphatic in the matter, after consultation with the married warrant officers affected. Their opinion is that they should not be given less accommodation. On No. 2 plan, the house consists of open verandah 10 feet wide by 28 feet long, at the front; from the centre of the verandah an entrance hall 7 feet wide by 13 feet long; at the right-hand side of the entrance hall, a sitting room 13 feet by 13 feet; on the left a bedroom 13 feet by 13 feet; behind these a living room 15 ft. 4½ in. by 13 feet, and a bedroom 16 feet by 13 feet. Behind that again is another bedroom 13 feet by 13 feet, with a passage intervening, and a kitchen 12 ft. 6 in. by 13 feet. There are numerous conveniences in the way of cupboards in the various rooms; a bathroom and lavatory with basin, linen closet, pantry, sanitary convenience, fuel store, a washhouse with troughs and boiler, and a back verandah 7 feet by 12 feet

The estimate includes all the internal electric lighting and water fittings and piping, but does not include the cost of bringing these services up to the house. Fencing is not included in the estimate, but the fence I have in my mind for all these houses at the Base is a wire fence, with cypress hedge. I would allow the wire fence to do duty for five or six years until the hedge grows high enough. Those hedges and the trees proposed to be planted along the roads will eventually give the Base the nice appearance of a good class suburb. For a few years, of course, these places will look very bare. The estimate does not include footpaths or outdoor work. The type of fence is to be put before the Committee. I do not think anything is likely to increase the cost above the present estimate. Wages are as high as we are likely to have them there, and it is hard to imagine material getting much higher. Our estimate is based on our knowledge of what the buildings down there have cost. The height of the walls from the floor to the ceiling is 10 feet. I consider that the buildings have been brought down to the lowest degree of economy consistent with decent construction. Even under the floor joists, I do not propose to increase the thickness of the walls. We will allow the 11-inch and 4-inch walls to go right down to the concrete, and support the timber work on a brick course. This system is quite good enough for a small cottage of that sort. The alternative of wooden buildings was considered, as £1,400 odd seemed an alarmingly large cost for a small dwelling house, but the engineer there concluded that, although wood might mean a small saving in the first cost, the change was not advisable having regard to the question of upkeep. No. 1 plan differs from No. 2 simply in that the entrance to the house is obtained at the side instead of at the front. It is the dearer estimate by £50. The roofs in each plan are as simple as I could make them. The roof of No. 1 is gable. That of No. 2 is hipped. Neither house has any projection except the verandah. Bricks have gone up only about 5s. to 10s. per 1,000. Tiles have gone up in the last nine months. A tile roof now would be considerably dearer than an iron roof at pre-war prices, but at present prices tiles would be as cheap as iron. I prefer a tile roof at the same cost. The 1915 estimate was based on galvanized-iron roofing. It was not adequate, having regard to the sites that were afterwards selected, and in the working out of the detailed plans a good many things were discovered that were not fully realized on the original estimate, which, on the whole, was too keenly cut. Cost of material and cost of labour have also risen very much. Those are the causes to which I attribute the greatly increased estimate over that of 1915. My personal opinion is that a Government does not obtain the same amount of work from the workmen that a private employer does, but the contractor's profits are probably enough to outweigh that difference. I would not be prepared to say that the methods of work at the Base have been the means of increasing the cost, but I will go so far as to say that the quantity of work per unit under the method down there probably has not been up to what an energetic contractor might get out of the men. There would be about 3,800 bricks in a rod of brickwork. In ordering you might regard it as about 4,000 bricks, and it would include hollow walls. If Mr. Jeffrey estimates that it cost £15 6s. 11d. per rod for labour for brickwork at the seamen's barracks, I should say that was about correct. Four pounds per thousand for labour only seems a high price.

99. *To Mr. Laird Smith.*—I think our Department was responsible for the selection of the sites for the officers' houses already erected. The whole selection of sites for the groups of houses was arranged between our Department and the Navy Department. Our officers were very anxious to get the houses placed on the promontory to the south of the group, but the Navy Department thought it would be a mistake to get so far away from the railway. We, on the other hand, thought the houses would be too near the railway on the present sites, but these were selected at the instigation of the Navy Department. The captain's house would be at the main entrance to the group, and on each side of it would be the senior officers' houses. Then, on the road running south-east, towards the hospital, the junior officers' houses would be placed, and on the road running parallel with the railway would be the warrant officers' houses. The land enclosed by these different groups of houses would be given up for a recreation ground for the children belonging to the officers of the group. That meant that the houses, being arranged in groups, had to be put on the sites which have been selected. According to the lay-out, each group has to have a relationship to the other, and in any scheme of that sort it must happen, where a comprehensive plan is laid down, on land which varies in quality for building purposes, that you strike some sites less suitable than others for building on. Two junior officers' houses have been built, and one of them is on, perhaps, the worst allotment of the whole group. It must be regarded as suffering from its necessary proximity to the others. If we could go over the whole area and pick out sites without a given plan, we could find sites on which we could escape earthworks and deep foundations, but where the whole plan has to bear a relationship with other groups we are forced in some cases into undesirable building spots. One might say that the system of town planning is responsible. The question of suitability of building site is considered now up to a point. For instance, among the warrant officers' houses it would be obviously not economical to build from the east side of the seventh house to the west side of the eighth house, and that land is left as a reserve simply because it is undesirable building land. Between the senior officers' and the junior officers' groups another unsuitable area for building has been avoided. But the particular house to which you refer really comes into the middle of the junior officers' group, and it was unavoidable to place it there. One difficulty was that the road running south-east, fronting the junior officers' houses, was kept rather high. If it had been lower, it would have enabled us to keep the floor of the houses lower. To some extent that applies to the sites for the warrant officers' houses, because the road, being rather high, obliges us to keep the floors higher than otherwise would have been the case, and increases slightly the cost of each house. To have the floors of the houses below the level of the road always has an unsightly effect. If the road had been kept lower, we could have reduced the height of the foundation of these houses by a foot or so all round. However, the road is made now, and, after all, the difference is not very great. Wooden houses cost a good deal more to maintain. In this case brick buildings will be better. It is hard to furnish an estimate of the difference. I would recommend brick under present conditions. With the present prices of wood, the saving would not be commensurate with the expense of upkeep. Slate is just as dear as tiles or galvanized iron for

roofing. Tiles would be cheaper, even with slates at £12 a thousand. I have no objection to a slate roof. In a great many places I would prefer the effect of slate, but now that we have started here on tiles it will be a good thing to complete the group with tiles, to avoid variety of colour.

100. *To Mr. Sampson.*—You can safely assign a life of 66 years to a brick building erected for commercial purposes, and 44 years for wooden buildings. On that you calculate the amount of sinking fund to be set aside to liquidate the cost of the building within its life, and similarly with the fund to be set aside to keep it in repair. Our departmental experiences vary considerably according to climate and other causes, but I always think that with an ordinary brick house about 1 per cent. keeps it in repair, and, in the case of wood, from 1½ to 1¾ per cent. Thus a £1,000 brick house would cost, on an all-round average, about £10 per year to meet the requirements of tenants. That is, every five years or so you would have to spend about £50 on it for repapering, painting, and doing up the fences and footpaths. We could build the ten warrant officers' houses in six months. I do not think we could build them under five months, and it would probably be cheaper if we took from six to eight months. If we put on too many men on a small work of that sort, they would overlap one another. It does not pay to rush your building too much. The system of supervision at the Base is to have a resident engineer and a clerk of works under him. We have a leading bricklayer on each job. We have a leading carpenter and a leading plumber for the whole work. The leading hand has responsibility to the clerk of works, and the clerk of works is responsible to the supervising engineer. The clerk of works cannot be on one building all the time, so that the leading bricklayer is responsible for the output of the men. The leading bricklayer is a member of the same trade union as the other bricklayers, but the clerks of works have an association of their own. It would be inexpedient to occupy any of the buildings at the Base until the water supply is there. Having regard to what has occurred, the residences already erected were probably started somewhat prematurely, but, before the programme of residential buildings now contemplated can be all carried out, about eighteen months will have elapsed, by which time the permanent water supply will probably be there. It will be necessary to allow ten months to put up the residential part of the Base, including the senior and junior officers' houses. They could all be constructed at the same time, but one is a fairly big one, to cost over £2,000. Perhaps the most economical time to allow for the whole group would be ten months. It would suit the convenience of the workmen better, giving them a little longer job. If the work is done quicker you bring a lot of men to the Base and dispense with them in a very short time. I think a contractor would ask for ten months to do these buildings, considering the local conditions.

101. *To Senator Henderson.*—I think 10-ft. walls are quite high enough even for a hot summer. The prevalent desire in Australia for high houses is rather based on a myth. Ten feet is just as good as 15 feet from the point of view of coolness. It really becomes a question of taste. Ten feet is a good medium. An Englishman would make the height about 9 feet, and an American about 8 ft. 6 in.; but, in view of the prevailing taste in Australia, we thought 10 feet would be a good medium. Twenty years ago in Australia a man would not be content unless he had the walls 12 feet or 13 feet high, and often rooms were made really higher than they were wide or long. That does not give a nicely balanced effect. I heard Mr. Jeffrey say at the Base the other day that, in his opinion, the output of work was not affected by the day-labour system. If there is the slightly diminished output that I imagine on Government work, the reason is that the men in charge have not the keen incentive that the contractor has. If the contractor is not always on the job, he has a pretty keen man in his place.

102. *To Mr. Mathews.*—The brickwork at the seamen's barracks and at the junior officers' quarters is just about the same, so far as regards windows, angles, &c., so that would not account for the difference of £3 per rod in the cost of labour, as estimated by Mr. Jeffrey. What might account for it is that the barracks are higher, and the lift is consequently greater. There is also the other reason, given by Mr. Jeffrey, that the bulk of the work at the barracks was done in the winter, when there is generally more lost time. The warrant officers' house on No. 1 plan would cost, erected, say at Malvern, by the Government, on a good building site, about £1,250. The rate at which we would build the group of warrant officers' houses would depend largely on our capacity for turning out the joinery at our small joinery works at the Base. Unless there is any reason for rushing, I prefer to have a limited number of men and keep them on a good length of time.

103. *To Senator Newland.*—We intend to erect one more two-storied building for the senior officers, and one more for junior officers, than the Committee have already seen at the Base. On a good building site the difference in the cost of construction between a two-storied place and a single-story place is not very material. But if it is a bad building site, requiring deep and wide foundations, obviously the less foundations you require the more economical the project. A two-storied house wants much less foundation and much less roof than a single story. On a bad site, such as that occupied by the junior officers' house, referred to by Mr. Laird Smith, a single story would have been rather a poor proposition, because in places the foundations had to go down about 5 feet below the floor. On any kind of site the difference in cost would be slightly in favour of the two-storied house, because you have only half the roof and half the foundation. On the other hand, the material has to be lifted to a greater height. I can supply the Committee with an estimate of the quantity of bricks and other material required for a warrant officers' house, and a statement showing the increased cost caused by the increases in the prices of bricks and other material over pre-war times. It is the policy of the Department to use Australian timbers everywhere, but lately the market has been so uncertain that we have been using a good deal of imported pine for door frames and other small work. We use nearly all Tasmanian hardwood for flooring. Oregon makes good door frames that keep very true, which is rather a good quality for light buildings, where you have thin walls. Australian timbers are absolutely suitable for all the work we have to do if we can get them. For all our works, the material used may be put down as Australian, even to the paint. Except for glass and ironmongery, every building we make is Australian. We cannot get Australian glass or door handles, but a man in Launceston makes very good locks, and we use them largely.

For the warrant officers' houses the foundations may be an average depth of 3 ft. 6 in. below the floor line, and will be of ordinary concrete. In other works we have used a great deal of reinforced concrete, but that would not be a payable proposition in these buildings in preference to brick. It might have been a good proposition if we had the material on the site, but on that site the brick proposal is more economical. For the house mentioned by Mr. Laird Smith the site was slightly levelled, but there will not be very much levelling to do for the other buildings. Generally speaking, we are rather in the unfortunate position of being too low with most of our sites. Probably the ground rises towards the point, but the road rises with it. The main factor affecting propositions of this sort is the level of the crown of the road. I do not know what arrangement the Navy Department makes with the men who occupy the cottages. I believe they get them free of rent, and pay 7 per cent. on the value of the furniture allowed them.

104. *To Mr. Sinclair.*—I do not know what we are paying per 1,000 gallons for the present water supply for building purposes. No doubt that cost has been included by the quantity surveyor in his estimate. All the water we have used so far is brought down by rail. We should have shown a considerable saving if we had had the permanent water scheme, because we should have been getting water at 1s. per 1,000 gallons. We are paying a good deal more than that now. Our concrete is estimated to cost us 45s. per cubic yard. It consists of six parts bluestone (2-in. gauge), three parts sand, and one part Portland cement, giving a consistency of nine to one. That is quite strong enough for light buildings like these. Brick foundations would be cheaper, but would not present the same homogeneous mass to the resistance of the ground. Ten-to-one concrete is pretty strong in a position of that sort. Millions of pounds have been unnecessarily sunk in foundations in Australia. With concrete at 45s. a yard I would use it in preference to brick for foundations. Brickwork would work out at just about the same price. The estimate of 45s. per yard is based on what works have cost down there. All our sand has to be brought there.

105. *To Mr. Mahony.*—The same conditions with regard to the leading hands operate on our works as operate with private employers. We adopt the most up-to-date methods known amongst contractors for supervision. Our men in charge of the works are really contractors' foremen. We got them from the employ of contractors. It is very difficult to say whether a contractor could erect the warrant officers' houses, as planned, for less than our estimate. The only way to tell would be to have a practical test. Contractors' tenders might vary as much as 50 per cent. I have always said that the Government method of day labour and contractors' methods do not vary very much in their effect. Any leakage that occurs through the Government doing their own work, and I admit that there may be some, is compensated for by the contractors' profit.

Charles Edward Montgomery Whyte, Engineer Constructor, Department of the Navy, sworn and examined.

106. *To the Chairman.*—Since I gave evidence before the Committee in February of this year nothing further has been done in regard to the workshop and the power-house. Three generators and auxiliary machinery have been ordered, but the remainder of the proposed works are in abeyance. In the depôt at Williamstown we are building a launch for the Customs Department, and are carrying out repairs to H.M.A.S. *Protector.* The work at Williamstown is of a similar character to what will be done at Flinders on a much larger scale. I do not think that the Committee would derive any benefit from an inspection of the Base at Williamstown. There is only one 25 horse-power engine there, and if any further power is required it is borrowed from the municipal council. At Flinders Naval Base we shall generate steam and make electrical current for our power; all the lathes and machines will be supplied with motors. The current for lighting will come from the main power plant. I am not an electrical engineer, and I have not consulted with any electrical engineer as to the class of plant to be installed at the Base. The matter was arranged before I was appointed to my present position. Admiral Clarkson seemed to be quite clear as to what he required. I did mention to him the matter of having an alternating current instead of direct current, but he would not listen to any such proposal. I understand that he was convinced that the direct current was more suitable for machinery, and he told me definitely that he wanted direct current machines driven by compound steam-engines. I have made several inquiries on my own account, and have no reason to question the decision that was arrived at. I do not think that the direct current will be the most efficient for lighting purposes, but the machinery requirements are more important. The plan prepared by the Works and Railways Department passed through my hands, but was dealt with by the Navy Board, and I do not know what decision was given. I think the electrical engineer of the Works Department mentioned three systems, but I was not asked to express an opinion on them. I mentioned the matter to Admiral Clarkson, who said that the question was one to be determined by the Navy Board, and I have heard no more of it. Both the dynamos and the steam-engines are already ordered, and if an alternating current is required for lighting purposes the only course possible now is to order additional plant for lighting. Whether or not it would pay to do that would depend on the prices of the machinery, which nowadays are difficult to estimate. At present, no lathes or machines are on order, owing to the fact that the proposals for the construction of the workshops have been cancelled for the time being. At the present time I am waiting to know what we are to do with the power plant we have already arranged to install. We have ordered three generators of 250 horse-power each, and so far we have no use for the power they will provide. I put forward a proposal for ordering machinery, but the Navy Board said that we could not buy machinery until we have buildings in which to place it. The boilers and engines are being made at Cockatoo Island dockyard, but I cannot say when they will be available. Very little work is being done at the dockyard at present, but I should say that the boilers and engines could be delivered in six months if the work were expedited. The dynamos have been ordered from Holmes, of Newcastle, England, and tenders have been called for the auxiliary machinery, including the pumps.

107. *To Mr. Sinclair.*—Different types of generators are required for alternating current and direct current. I am not sufficiently conversant with the prices of electrical machinery to say whether the generator for alternating current is more expensive than that for the direct current.

108. *To Mr. Laird Smith.*—My predecessor, Mr. Woolnough, originated the first designs for this plant, after consultation with Admiral Clarkson. I think that later he modified his design. When I succeeded Mr. Woolnough the matter was in abeyance, but some time later it was decided to proceed with the installation, but on a reduced scale, owing to the cost. When I assumed office, the first matter to be decided was the power, but I was practically instructed that a compound steam engine and direct current were required. I think we provided for a compound dynamo. I do not claim to be an electrical engineer, but I have an electrical man in my Department who carries out all electrical work under my direction. The dynamo ordered from Holmes, of Newcastle, was of Admiralty standard design. As to whether there is a particular necessity for a low-voltage direct-working current I cannot say. Admiral Clarkson considered that the direct current was better than the alternating current for driving machinery. I understood that the power was required almost entirely for machinery, and I was told to make a provision of 100 kilowatts, possibly extending to 200 kilowatts, for lighting. I have no idea of what the load curve will be throughout the day. That will depend on what machines are working and how the shops are lighted. We may have large shafting lathes, using as much as 50 to 100 kilowatts, and they will make a tremendous difference to the load. The provision of storage in addition to the dynamos was considered, but no decision was arrived at. I am unable to say at what hour of the day or night the plant would have the heaviest load. I should be perfectly willing to work in co-operation with an electrical engineer in order to decide upon the most efficient plant.

109. *To Mr. Sinclair.*—We have made no provision in the power-house for storing patterns. Very often patterns are left in the open. The small articles can be stored in comparatively little space, but large patterns take a lot of space.

110. *To the Chairman.*—The original design of the power-house did not provide for a second story. It was suggested that patterns should be stored above the coal bunkers and boilers. Our plan provided for a building 46 feet high. The space above the boilers was to be left open. The matter of having that space above the boilers was discussed, and I understand that Admiral Clarkson had reasons for having it as designed. The Babcock and Wilcox boilers will extend to a height of 14 feet from the ground. I do not see any justification for having the power-house 46 feet high. I raised that point as to the height of the workshops with Admiral Clarkson, who told me that it was the policy of the Navy Board to have a high building. I have never been informed of the reasons for having the building 46 feet high. I am unable to suggest at this moment any means of temporarily housing the plant already ordered for the workshops, and that which will be transferred from Williamstown. The original intention was that the building should be of galvanized iron, but I understand that the cost of iron to-day is almost prohibitive. I think Admiral Clarkson is agreeable to practically any kind of building that will afford the necessary accommodation. I spoke to him in regard to the workshops and boiler house, but he could give me no information, because he did not know whether or not they were to be proceeded with. I do not think that the developments and changes which have taken place in naval warfare and construction during the war will affect our design for workshops and plant. The same machinery as has already been designed will be required. So far as I know the position in regard to the workshops and the boiler house is the same as when I gave evidence formerly. I have no further suggestion to make. I understood that Admiral Clarkson would be content with a brick building for the workshops and boiler house. The tenders for the power plant passed through my hands, and the order was placed about June. Trouble in regard to an alteration in the prices delayed the order for some time.

111. *To Mr. Laird Smith.*—No steel-working machinery has been ordered yet.

(Taken at Melbourne.)

FRIDAY, 12TH OCTOBER, 1917.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Sampson,
Senator Needham,	Mr. Sinclair,
Senator Newland,	Mr. Laird Smith.
Mr. Mahony,	

John Smith Murdoch, Architect, Department of Works and Railways, recalled and further examined.

112. *To the Chairman.*—The plastering for the warrant-officers' quarters is estimated to cost 2s. 3d. per yard. We propose to eliminate lime plaster at the Flinders Base, because a thin coat of cement rendering gives a fairly smooth surface, and stands wear and tear better, obviating the needs for repairs, and it can be coloured right off with Indura, or some other brand of distemper. For an expenditure of an additional 7d. per yard or so, we can thus obtain coloured wall surfaces at the beginning. No specifications have been written up for these works. If tenders were to called for, specifications would have to be written and quantities would have to be taken out by private quantity surveyors. Quantities could not be taken out merely from the plans themselves; specifications would be necessary for the guidance of tenderers in estimating quantities. The Department is able to estimate the cost of these works, because it knows exactly what is intended, but specifications would be needed to impart this knowledge to some one else. We have allowed about 1s. 1d. per yard for labour in connexion with the plastering. I cannot say now what the plastering already done has cost for labour, though the returns kept on the spot will show it. Generally these estimates are based on our experience. We estimate the cost of labour for a rod of brickwork at £13 15s. for laying, and £1 2s. 2d. for mixing the mortar, or £14 17s. 2d. altogether. I am not aware that the bricklayers have agreed to do ordinary work for £4 7s. 6d. a rod, though the Secretary to the Bricklayers' Union once told me that they would carry out work at standard prices. There is no novelty about the brickwork in connexion with the cottages that we are discussing. In the Commanders' quarters, there are courses of bricks set on end, and slight variations from ordinary laying that cost a little bit more, but there is nothing difficult about any of the brickwork. I do not think it would be possible to get brickwork done at Flinders for anything like £5 per rod. I have known brickwork to be done for

about £8 per rod, that is, labour only, but I do not think that it has been done below that price. Our estimate of £14 17s. 2d. is based on what we are actually paying. Our estimates are based on our actual experience of cost. I am willing to take a good deal of responsibility for the difference between the estimates made before the war and the present estimates. The original estimates, as I explained at the time, were made before adequate drawings had been prepared, and I had not a full realization of what the work would entail. I did not anticipate having such bad sites for certain of the houses, nor did I think that the buildings would be so elaborate. After the Committee had inquired into the original estimates a good deal of correspondence took place between our Department and the Navy Department regarding the details of these houses. Sketch drawings and designs passed backwards and forwards between the two Departments, and, in the end, the original plans were considerably modified. The Committee had been led to believe that these houses would cost a certain amount, but the result of the modifications to which I refer was to make it necessary to increase the estimates considerably, and therefore we are submitting for consideration, not only the proposals relating to these houses, but also those relating to the armourers' workshops and the torpedo and mining school. I think that the present estimates are on the safe side, and will not be exceeded. I should be glad to have the houses done for £150 less, but I would not guarantee that they could be done for less. The Commonwealth will get value for the money it spends. I cannot discover any way of economizing if the Navy is to get the accommodation for which it asks. The houses will be well built, there being no incentive to scamp work; but there will be no extravagant construction, and no elaborate ornamentation. Our estimate of cost includes all overhead charges, though nothing on account of the office in Melbourne. According to a calculation made by Mr. Jeffery, the general charges to 30th June, 1917, came to 20.286 per cent. That is a statement made to the Minister. These general charges comprise actual running expenses, which include all wages for staff—excepting the cooks' wages—store-keeping, maintenance of camp, office, horses, water, fuel, sanitary, and hospital, which amount to 11 per cent.; cooks' wages, which come to about 4 per cent.; working plant, temporary buildings, &c., about 1½ per cent.; works actually pertaining to permanent works, 4 per cent. What is meant by the last item is, I think, permanent works such as electrical works, with which it has been necessary to proceed before approval to permit of other works being gone on with. We credit ourselves at the end of a work with the remaining value of the plant. The Government pays the wages of the cooks who prepare food for the workmen, and at a place like the Flinders Naval Base the kitchen staff is expensive. The cooks' wages for two years amount to £4,800. The cooks prepare meals for the carpenters, bricklayers, labourers, and other persons employed on the place. The men themselves pay for their food, having a Committee which runs a mess; but the Government provides accommodation for the mess, together with all utensils, and pays for the preparation of the meals. This is one of our heaviest general charges. The estimates that I am now putting before you include all these charges, those given two years ago did not. If the work were done by a contractor, the chances are that he would have to make similar arrangements for the feeding of his men, though his expenditure might not be quite so lavish. Probably it is the comforts that the men enjoy in Government employment that makes them so much in favour of the day-labour system; it is probably the desire to enjoy these comforts rather than the desire to do less work that makes the men favour the day-labour system.

113. *To Senator Henderson.*—I do not think that the provision of these comforts is an inducement to the men to do less work.

114. *To Mr. Mahony.*—Probably we get better men by making this provision. Mr. Jeffrey, when giving evidence on 5th October last, stated the rates of wages paid to various classes of labourers. He showed that whereas ordinary labourers were getting 10s. 4d. a day in May, 1915, by September, 1916, their pay had been increased by various awards by 37 per cent. We pay only the award rates. I have not heard it suggested that many of our men live at a distance from the Base in order that they may draw an extra 2s. per day. There would be no difficulty in preparing specifications for one of the proposed buildings, should the Committee desire it. The New South Wales system of calling publicly for tenders for any large work, and asking the Department of Works to tender too, the lowest tender being generally accepted, has this objection, that it necessitates considerable expenditure on the preparation of drawings, specifications, and so forth. I should have no objection to my Department tendering as against outside firms, but I do not think that any saving would be effected by adopting the New South Wales system. I think it would be better either to call for tenders straight out, or to work on the day-labour system. Full consideration should be given to all the conditions surrounding any proposal, and a decision come to regarding the method of its construction. I cannot say whether the Commonwealth would have gained or lost by having these buildings constructed by contract. During the last two years the conditions have been quite abnormal; it has been impossible to see ahead. I should very much like the introduction of the butty-gang system. It could be applied to excavation work, drainage, brickwork, to a large part of the carpentering work, to plastering, and to painting. I am not sure that it could be applied to plumbing; I would prefer to have that work done by the Department. The plumber is the man who may get round you. The adoption of the butty-gang system would put an end to the perpetual contrasting of the day labour and contract system. It must be remembered that the Department, not because of any particular smartness in its officers so much as because of the fact that its purchases are large, and its payments certain, can buy as well as any purchaser on the market. I think that it would be an excellent thing for the Government to purchase its own materials, and let the construction be done by piece-work. I would welcome that arrangement. I shall supply the Committee with a specification of one of these buildings. The one specification would apply pretty well to both. The additional information that would be obtained from a specification would relate to qualities of material and sizes.

115. *To Mr. Sampson.*—The practice of paying cooks to provide meals for workmen on Government jobs has had Ministerial approval for the last seven or eight years. It obtained at Canberra, at Duntroon in connexion with the construction of the Military College, and at the Naval College works. I shall ascertain for the Com

mittee the date on which the practice was approved, and the recommendations on which that approval was given.

116. *To Senator Henderson.*—The main reason for employing cooks to provide food for workmen is the isolation of the places in which the work is being done. Where work is being carried on in or close to a town, the men employed on it have to "find" themselves.

117. *To Mr. Sinclair.*—The increase in the estimates is not due to any great extent to the increase in the price of bricks. I stated yesterday that the increase in the price of bricks has been only 5s. or 6s. per 1,000. Between 25 and 30 per cent. of the cost of the buildings is represented by the brick work. Hollow walls cost a little more than solid walls, and to estimate the cost of brick work it is necessary to know how much is to be hollow and how much solid.

118. *To Mr. Mahony.*—I do not know that it is the practice of the British Admiralty to pay cooks to provide meals for men engaged on the construction of new works: but I know that it has been the practice of the Navy Department here to provide meals for the men employed on the works that they have been carrying out.

119. *To Senator Needham.*—I do not think that the piece-work or butty-gang system can be regarded as a method of sweating workmen so long as care is taken to see that work is not let at prices which will not give fair wages. I have not considered the matter in its sociological or political aspect; indeed, I have not given it much consideration at all. Personally, I should like to see an end to the continuous contrasting of the day-labour and contract systems. Possibly the butty-gang system might create a tendency to do poorer work, because it would be to the interest of the workmen to make high wages by getting as much as possible done per day. They would have to be properly watched by those in charge. There is, too, this consideration, that the system might affect cruelly the mediocre workers. If tenders were made by coteries of workmen, I take it that these coteries would include only fast workers. I do not know what would become of the slow workers.

120. *To the Chairman.*—The Navy Department has approved of the building of the power-house to a height of 33 feet. This Committee, in March last, recommended that the height of the walls of that building be reduced to 33 feet, and the Department of Works thereupon prepared entirely new drawings to carry out the Committee's recommendation. On the 19th June, the secretary to the Department sent these drawings to the secretary to the Navy Department, stating that they had been prepared in accordance with the recommendations of the Works Committee, and asking whether the work could be proceeded with as modified. On the 11th September, the reply was received that, with certain additional minor alterations, the plans would have the approval of the Navy Department. These alterations affected chiefly engineering matters, and it was suggested that the roof should be tiled instead of covered with iron. The construction of the power-house is not now before the Committee: the power-house wing of the block has been settled. It is the machine shop and the boiler shop that are comprised in the present reference to the Committee. Admiral Clarkson asks for steel stanchions, steel roof and galvanized iron walls on wood framing. I dare say that if the galvanized iron for the walls were particularly desired, the Government regulations respecting its employment would be waived. Regarding the use of steel, the position is pretty much the same now as it was last year. If steel is used, it will have to be made locally, though I understand that the British Government would be glad to have our locally-made steel for war purposes. I do not think that anything but steel can be employed to support the building, if it is to be 46 feet high, though it is not material whether the space between the supports be filled in with brickwork or with iron and wood. At present prices the difference between the cost of the two constructions would not be much, but brickwork would give a better job, and would match the power-house construction. The only substitute I could suggest for steel supports would be a composite arrangement of hardwood and brickwork, and I do not think that that would be cheaper than steel. I have not had any conversation with Admiral Clarkson on this matter. The Navy Department asked for a building with steel stanchions 46 feet high. When the Committee considered the matter before, it was pointed out that, could the buildings be lower, it might be economical to use brick supports; but for a building 46 feet high the supports should be steel. I do not quite understand Admiral Clarkson's suggestion regarding temporary shelter. The steel necessary for a building 46 feet high could be obtained, though, of course, at a high price. We could get it rolled at Newcastle by the Broken Hill Company. It is for the Navy Department to say whether the work must be gone on with.

121. *To Mr. Sampson.*—Iron and timber are now so dear that brickwork would be nearly as cheap for the spaces between the supports. Speaking from memory, I gave evidence on a former occasion that the difference for the whole of the buildings would be about £1,700. Some years ago a galvanized iron building on this site would have been much cheaper than a brick building, but conditions have altered entirely. An iron building might cost a little less than a brick building now; but, in view of the advantages gained by using bricks, I prefer bricks. I am familiar with the evidence given by Admiral Clarkson. An iron building can, of course, be easily extended, and all over the world workshops such as this have been constructed with iron; but I think that if the economic conditions were explained to him, Admiral Clarkson would have no objection to the adoption of brickwork in the way I propose—that is, brickwork between the steel supports. The sectional area of brick piers necessary to support a building 46 feet high would be too great to be economical.

122. *To Senator Newland.*—The site, the size, and the accommodation to be provided in these buildings were determined by the Navy Department. The only point at issue between our Department and the Navy Department is in regard to the construction of the walls. We have simply carried out the demands of the Navy. If the site, or any of the arrangements, is not suitable it must be because the Works Branch of the Navy Department is not in touch with Admiral Clarkson. The space between the supports is 18 ft. 6 in. from centre to centre. Between these piers the brickwork is 11 inches thick, the walls being hollow, to keep the building dry; but most of the space is occupied with windows. The window-sills of the bottom floor are 6 feet above the ground level, and there is 11 ft. 6 in. of brickwork between the bottom and top sets of windows. I have not used

reinforced concrete slabs, though I know something about them. My opinion is that brickwork would be quite as cheap. If concrete slabs were to be used, I would prefer to make them on the spot. I do not think that that would increase their cost, because all the material would have to be brought to the place. Thin slabs could not be used without a supporting frame-work, and I do not think that a wooden frame-work would be sufficient; concrete or steel studs would be needed. While the construction suggested might not be dearer than brickwork, it would not be cheaper. I do not think that we can count on getting very much iron for these buildings on the removal of the works from Williamstown. Probably most of the iron there is used in the fences, and I think they would remain the property of the Victorian Government. I have no opinion to offer as to the advisability of having the building 46 feet high. That is a matter entirely for the Navy Department.

123. *To Mr. Sinclair.*—I do not know what the lay-out of the proposed shops will be, though we have drawn our plans in strict accordance with the requirements of the Navy Department. The stability of the building has been calculated to meet the weight of the roof and the weight of the travelling cranes. The ground seems fairly good for foundation purposes. That is shown by the formation disclosed by the sinking of a pit for the condensers. We take care to be on the safe side regarding foundations. Each of the stanchions would have an area of resistance of about 50 super. feet, and I should say that the ground could be depended on to carry a weight of from 2½ to 3 tons per foot. The crane rails in the fitting shop would be 32 feet above the floor level. I do not know what kind of cranes will be used. The Navy Department asked that the crane rails should be at that height from the ground. Were the building only 32 feet high, brick supports would be satisfactory, and cheaper than steel. Of course, a building 46 feet high could be supported with brick piers, but it would not be economical to use such piers. In accordance with a recommendation of the Committee, we are using a wooden truss instead of a steel truss in the power-house. In giving evidence before, I said that by substituting a composite roof truss of timber and steel for a steel roof truss, the height of the walls might be reduced from 46 feet to 42 feet without reducing the clearance alongside the walls for the travelling crane. I said, too, that that would mean a saving of about £1,378 for the whole building, including the power-house. The steel truss is arched, and springs from a point about 4 feet below the top of the wall, whereas a composite truss would rise from a tie beam going right across the building on the top of the wall. I do not know that that arrangement would suit the requirements of the Navy Department, which may desire the greater clearance which the arched steel truss will give in the middle of the building. An arched wooden truss would not be practicable. It would have to be constructed in sections, and the blacksmiths' work necessary to strengthen the joints would make the construction dearer than a steel truss. Mr. Whyte has told me that he has no authority for departing in any way from the demands of his Department, and Admiral Clarkson's evidence is that the Department requires a building 46 feet high.

124. *To Mr. Mahony.*—The Navy Department did not inform me of the class of work to be done in these workshops. It will provide its own machinery, and the dimensions of the building are, I presume, those which will suit that machinery. Had the Works Department been consulted, its engineers, who are, I consider, competent men, might have been able to give some assistance in determining the height of the proposed building. Were the walls reduced to a height of 33 feet, the crane rails would have to be lowered correspondingly. As I am not a mechanical engineer, I cannot offer any opinion as to the best position for the crane rails.

(Taken at Melbourne.)

TUESDAY, 16TH OCTOBER, 1917.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Sampson,
Senator Needham,	Mr. Sinclair.
Mr. Mathews,	

Rear-Admiral Sir William Rooke Creswell, K.C.M.G., First Naval Member, Naval Board, sworn and examined.

125. *To the Chairman.*—I have on previous occasions given evidence in relation to Flinders Naval Base. I have not had the advantage of seeing the present reference to the Committee, but I understand that it is in addition to previous references. You are right in assuming that the scheme submitted to the Committee has met with the approval of the Naval Board; not in minute details, but as to the general scheme and the order in which the work shall be undertaken. I do not see how it can very well have occurred that on many occasions, when references have been submitted to the Committee, the Department of Works has submitted plans which at the time of their submission had not met with the approval of the Naval Board. It might happen in the case of buildings in regard to which we had given the Department a general idea as to our requirements; possibly plans have been brought up here before they have come to the Naval Board for final approval. I cannot think, however, that the Works Department would proceed with large work on their own account. I certainly think it would be advisable that plans for all naval works should be submitted for approval by the Naval Board before being submitted to this Committee, and that the Board should be primarily and wholly responsible for all the work carried out at the various stations. The approval of the Board should be obtained before works are started. Of course, it goes without saying that all works for the naval service should have our approval in every detail. The procedure has lately been rather changed. Our Works Branch has, so to say, been wrenched from us and placed under the Department of Works and Railways. I was in fairly close touch with the works; and I have endeavoured to maintain those conditions, which are good for the furtherance of the service. Now, however, we are under a different Minister, and the very close association between ourselves and naval works has ceased. It is possible that works designed by the Works Department may have been submitted to the Minister for Works before coming to us. I should say, in any case, that it is a sound principle that the Naval Department should be the judge of what it requires, and should have the carrying out of what they require —that the Navy should be made responsible for any mistakes or any excesses, or any fault in the

work which they carry out. As to whether the placing of the whole of the work under one Minister means economy, I may point out that the Navy has always been a self-contained, self-supporting, self-sufficing Department. On a ship a man cannot look overboard and obtain any other person to do anything for him; he has to do all for himself; and that is the whole spirit of the Navy, as shown in the administration of the Admiralty. At home, the Admiralty asks for nothing from the nation but so many millions of money and a draft of so many men and boys per annum; all the rest is evolved in the Navy. So it has come that the Navy has always carried out its own works, built its own dockyards, and possessed its own engineers; it has never done any work except through its own people. Of course, there have been contractors to carry out works designed by the Naval people, but all these works have been absolutely supervised in the Department. Here, even in our own small way, we find ourselves to be very heavily handicapped in getting what we wish to be done. An instance is afforded in the matter of the barracks at Flinders Naval Base. It will be remembered that our idea was a one-story building of the bungalow type, with large verandahs, and everything close to the ground. We were, however, overruled. There was a very long dispute, but we gave way in the end in order to prevent delay, otherwise heaven knows when the work would have been done. If Mr. Murdoch states that the plans submitted by the Naval Board to the Works Department were for a two-storied building, he is wrong; there may be some misconception. The Naval Board accepts responsibility for everything carried out by the Naval Department. The Chief Officer of Works is appointed by the Naval Board, and, as to subordinate appointments, we have to go largely by what the Chief Officer recommends. As to whether I am satisfied with the work done by the Department during the past three years, I can only say that I am not a professional engineer. In these matters I have to be guided very largely—in fact, almost entirely—by officers appointed by the Department. There were one or two matters disputed down there. The principal one was regarding excavation as against the driving of piles for the wharf. I should have liked to have the papers here showing what action I took in that matter. I called for an explanation, and the explanation was not satisfactory to me. The reason given to me for excavation, instead of driving piles, was that the piles would not stand driving. There was also, I think, the point raised that, in any case, the removal of the stuff would be necessary. There was another case with reference to strengthening up the face of the walls. That, of course, is a professional matter, and I was guided entirely by the professional officer. However, I afterwards understood that the correction would not amount to any great waste in the particular place. Of course, the enormous cost is a pity, and such expensive mistakes are really a crime. I agree with Admiral Clarkson that it would be better to have a temporary building for the workshop in view of the present difficulty in obtaining steel and galvanized iron. We desire to get from Williamstown to the Naval Base as soon as possible, but we cannot move before the water supply and the sewerage system are completed. I should agree to a recommendation to the Minister that the water supply and sewerage work be carried out at once. I should think that if these works were completed within six months, we should be able to go there. It is bad and costly to be only temporarily in a place where all the work is more or less makeshift, and does not represent any real progress. We are being, I shall not say forced, but called upon by the State Government to move from Williamstown. They want the place in view of the revived idea about State shipbuilding; and a good deal of persuasion and influence is being used to get us away as soon as possible. We are told that we have already overstayed our time by one year. If we got down to Flinders we should be able to start straight ahead with our own work and training, knowing that whatever we did represented progress made. I think we have about 400 men at Williamstown at the present time. As to the requirements in the way of workshops I should prefer to leave that to Admiral Clarkson, who is the technical member of the Board. I know what the intentions of the Naval Board are regarding works to be carried out. We propose to have works there for the repair of destroyers and submarines. I should not think there will be any manufacturing in a large way, though we might be able to supply small castings. So far as the war is concerned, I think it will alter our policy very little, indeed, at the Base, but I should give a great deal to know. How our rate of progress will be affected, or what will be the position of the world after the war, is difficult to conjecture. However, in view of the original idea of the establishment of Flinders Naval Base, I do not see that the war will have any great effect. Under Admiral Henderson's scheme, it was to be a Base for destroyers and submarines, but, owing to circumstances, a good deal has been added to that. In the first place, Admiral Henderson's idea was that, if the Fleet were to go on increasing in regular increments, as laid down in his report, we should be completed in the east long before they were completed in the west with bases—that the whole two divisions of the Fleet would be completed in the east before they were completed in the west—and that the point of junction and exercise would be at Westernport. If, as in the case of Portland, in the Old Country, you have a port of exercise, such as I have indicated, it is economical and useful to have a good workshop inside for any repairs that are not of a large nature. Further, at the present time, Williamstown is the only depôt for *personnel*, for naval ratings, and providing spare men for the ships—a place of training and schooling. It will be seen, therefore, that, in addition to providing for men to fill vacancies we require accommodation for training them while waiting for ships. We have concentrated this work at Williamstown, but we are being "levered" out; and the best thing is to move and concentrate all our naval work in one place, particularly as Westernport is what I might call providentially the most perfectly suitable place for the purpose. There we could combine our training schools for men—not boys—training schools for torpedo, gunnery, stoking, wireless work, and for mechanicians. I think, further, we may have a very material addition in our naval flying school. One great advantage of the Flinders Naval Base is the climate. Of course, we get willing work anywhere, but I have in the course of my work experienced every climate in Australia, from Brisbane, and Townsville, to Adelaide, and I think that there is no place where you can stand so much drill without fatigue as in a bracing climate like that down here. We are dredging at Flinders, and I think our depth is 10 ft. 6 in. at low water. I think that the dredging will be completed in a very short

time—long before the men get there. I do not speak of all the dredging, but we shall have a completed channel sufficient for launches, torpedo boats, exercise, and so forth. There is only a bucket dredge at work now, but we hope to have our pumping dredge before long; it ought to have been there before this. The dredging work ought to be completed before our men go down. My impression is that there is only a very small amount to do to meet the requirements I have indicated, and that the work should be done within three or four months from now. I hope that every year money will be placed on the Estimates for this work, so that it may be properly and systematically carried out. As to the expenditure at the Base, I should like to say that it is very much less than Admiral Henderson estimated, but, of course, the whole of our plans have suffered dislocation through the war. The water supply will not only be wanted for the Base, but probably for the watering of warships, and there is a proposition, though we have not actually plans and estimates, to carry the mains to deep water. I should say that those who have drawn up this scheme for the Base water supply had the knowledge that water would be required in large quantities for big ships. I do not think that the Department received instructions that it would be necessary in the future to carry the main to Stony Point for the purpose of supplying large ships, but the matter was considered as a demand that would be made on the water supply. I certainly think it will be necessary to provide a water supply for large warships; and I should say that Stony Point would be the best place to carry the main to. We have considered the matter of a jetty at Stony Point for taking in oil fuel, and the same jetty would serve both purposes. That is a point you might refer to the engineer. I could not say whether an outside electrician was consulted in regard to the electrification of the Base. Admiral Clarkson could tell you that. He, though not a professional, is a very clever electrician, with an extensive knowledge of the theory. I can only say that if it were possible for a different system to result in considerable saving in the cost of lighting, Admiral Clarkson would be the first to go for it. We would probably accept, at the time, whatever principle was most forward in Home establishments, such as Denny's, the Naval dockyard, or Armstrong, Whitworth and Company's. Of course, in electrical science the progress is very rapid, and it is quite possible that even in the last two or three years there has been considerable advance.

126. *To Senator Henderson.*—I indorse Admiral Clarkson's idea of a temporary building, because I feel that we must get on; we must not be stopped because iron and steel are dear. We must have something to cover ourselves with, and cannot allow the machinery to remain under nothing at all. It goes without saying that if other approved material could be obtained to meet our requirements, it might be better to proceed with a permanent erection at once. Iron and steel are not the only materials in the world, but the other materials would have to be approved as meeting our requirements. As to whether brick would not be equally suitable for the workshops, I can only give a layman's answer. I have an assurance that there is no danger of an earth slide depriving the piles of their foundation.

127. *To Mr. Mathews.*—I have suggested that the Navy should be self-contained. I know that the Army and the Navy both come in for severe criticism. I do not suggest that the Navy should go into a corner, and do things by itself, telling others that it is no business of theirs. Our only desire is to do the work. When we have to act through somebody else, there is uncommon delay owing to the fact that we have to imprint things on another's brain, and that very frequently we are not successful, and we do not get what we desire. As to whether this attitude may not result in votes of money not being given to the Navy, I can only say that money is very hard to get in any case, and that we have not been able to adhere to our principle. It is suggested to me by you that the Navy is rather prone to have shore work carried out on a ship system, although the circumstances are altogether different. I can only say that the Navy is a pretty old service, and there has come down with it, in parallel lines, all the system of dockyard service and work. The experience goes back, perhaps, 200 years, and every endeavour has been made to eliminate all the unessential. The Navy people at Home are about the most experienced, and we are only following them after obtaining their ideas and advice. The Admiralty has been most generous in the way of telling us anything we wish to know that can help us. It is not as if we were using ship methods for shore work; we are using engineering knowledge and dockyard knowledge, and what have been naval shore methods, as I say, for, perhaps, 200 years. The Rosyth Naval Base, in Scotland, is an example of the perfection to which this system has been carried. I am not an electrician, but I feel certain that at the Base we would not go in for any system that was not the best approved in the very largest Home establishment. Any system adopted by us would be no old-fashioned system—and yet, on the other hand, would be no experimental system—but one that had been reported on as the most successful in similar establishments at Home. The A. and I. Staff will not be transferred to Westernport. If water, sewerage, and lighting were provided, we could at once go to Westernport. I do not know how long we shall have to wait for power, but we must have it for lighting. Workshops will always be wanted at Flinders Naval Base. As to the accommodation of large vessels like the *Brisbane*, and so forth, we can get any depth we like, at Stony Point. At Sandy Point, a little further along, I think we could put the *Medic* alongside. But Flinders Base is not intended as one for big ships. If, however, one should have a mishap, while undergoing exercise, it might be possible to do the work there instead of losing time by sending her to Sydney. Speaking from memory, I think our proposal was to have a big reservoir, and my view is that a 9-in. pipe will be quite big enough. I am the person guilty in reference to the loss on the growing of cereals at the Base. The land was rough scrub and bush, and, as we were going to have a lot of women and children there, I had an idea of having it placed under pasture land. I should have had a magnificent crop last year, and entered into an arrangement with the Army for the supply of hay at a valuation, but the tremendous rain ruined everything. I am in hopes, however, that we shall be able to pay for the whole lot this year.

128. *To Mr. Sinclair.*—Our Department has a well-defined scheme for the completion of all the Naval Bases. In the case of a building like the power-house, the Board decides that certain work is required, and the instructions go to the Third Naval member, who is the engineer. He then estimates that for the work required so much room,

and so many lathes and so forth will be required, and that so much space will be necessary for the building itself. He will have to estimate as to the lifting power, and, to that end, the height of the building, so that one boiler may be lifted over another if necessary. All this the Third Naval member arranges after being told by the Naval Board the kind of work the shop is required to do. It would be very hard to estimate the maximum number of boilers in the shop at any one time, but I should say that if we had three it would take up considerable room. I should say that a couple of destroyers refitting would be as much as would ordinarily be met with. The dock has been eliminated there, so that if any docking is required a vessel must come to Melbourne. Boiler repairs will be the largest work done. The re-feathering of a turbine would be rather a large work, though, perhaps, we should be in a position to do it if required. A 42-ft. clearance in the workshop is a good height, but it is a matter for the engineer member of the Board. It is that I had in mind when I was speaking of lifting one boiler over another; and the matter was discussed very closely by myself and others. That the piles "would not stand it" was quite an incorrect statement made to me by one of the officers. I was told afterwards that the piles would drive, and, as a fact, they did. The man who made the statement to me is not in the service now. I should think that the more work that was done in the way of a storm-water scheme, when the streets are being dug up for sewage and water reticulation, the more economical it will be. Storm-water does terrible damage to work already done, and I think to make the proper provision now would save cost in future repairs.

129. *To Senator Needham.*—The water supply is guaranteed to us. When I gave evidence in February last, I anticipated that the dredging work would be completed in about twelve months from then, and I think that it will be completed in about four months from now. I think we shall get all we want by means of a suction dredge if it can be kept pretty well constantly at work. In February last I also said that some pressure was being placed upon us to bring about our removal from Williamstown, and that, consequently, I thought there was some necessity for an early completion of the Flinders Naval Base. I have not changed my mind in that regard. The State Government was strongly urging us to get out in order to leave room for the project of shipbuilding. However, that urging ceased to some extent, and has only now been renewed with a similar object in view. We therefore wish to get to Flinders Naval Base as early as possible. I also suggested to forego the construction of the hospital building, and to use one section of the present buildings instead, rather than go to the cost of erecting another building. That idea, however, was not accepted, and the building of a temporary hospital was suggested. That, I think, would be good, and it could be built in such a way that the material might be utilized later for the permanent building. As to the possibility of transferring the detention barracks and gymnasium from Williamstown so as to avoid the cost of new erections, I should say that it affords the best example of the difficulty I have spoken of in regard to working with other Departments. I assented to the gymnasium being put up on the condition that it was so built that it would be transferred with us. I am not sure that I made the same condition in regard to the detention barracks. We ought to be able to transfer the gymnasium, but the Home Affairs Department seems to be completely unconscious that its transfer was ever made a stipulation. There should be no difficulty whatever about the matter; it means merely taking the building, wheeling it to the water edge, placing it on board, and towing it round to the other place. I cannot say what the amount of saving would be, but since the building was put up with a view of transportation, it ought to be very considerable. The iron, for instance, ought to represent a considerable sum nowadays. I think that an electrical clock installation is necessary, for the whole routine work of the place depends on the exact time. I have no idea as to cost, but I know that I thought the cost at the Naval College for a similar installation was excessive. I think that proper arrangements are being made for a wireless installation to meet our requirements. In the workshops it is the intention to repair only destroyers and submarines. Water-tube boilers will be those repaired. We have no idea of going beyond Admiral Henderson's scheme in the way of the accommodation of shipping; all I say is that we ought to continue dredging there year after year, having small annual amounts on the Estimates for the purpose. I do not contemplate continuing dredging until we are able to accommodate the *Australia*. If some day we get 20 feet at low water, and can bring in light cruisers, that will be all, for the place is really intended for smaller craft. I may be very narrow in my view, but my idea is that the Navy should have the sole control of the spending of the money on Naval work. The Navy alone should get the money, and be told that they are responsible for the spending of it, and for every economy. The work should be done solely and only with Naval approval. I mean everything in connexion with Naval work—buildings on the shore, work afloat, and everything else. I mean every item connected with Naval expenditure. Of course, I do not say that the captain is going to come on shore and say that he wants a window in a certain place in a certain building. The captain will tell us what his requirements are, and it will be the engineer's part to provide the necessary building. The captain knows what he wants in a building, and it is the engineer's place to meet his requirements. I want absolutely no interference by any other Department; the Navy should carry out the whole.

130. *To Mr. Sampson.*—I think it would be quite possible for a competent staff to carry out Naval works under another Minister if the competent staff would carry out the Naval orders. However, what we have is somebody who takes it for granted that we know nothing—that we do not know what we want, and that they know better than we do as to our requirements. Our ideas are not given effect to. In 1915, I said that I would prefer single-story buildings for the seamen, with conditions approximating as nearly as possible to shipboard; but I accepted the other plan, while not approving of it, in order that the work might be proceeded with. These buildings have been completed for some considerable time, but nobody is yet occupying them. We wish the work proceeded with, so that we may get into occupation; and the reason they are not occupied is that there is no water or sewerage. If the whole place were completed we could walk in there to-morrow, but if large buildings are there without certain other essential work, we could not go into occupation. As the Admiral responsible, my recommendation is to proceed with the whole of the referred works, and to complete them as early as possible.

If all these works are completed, we shall certainly go into occupation at once, but we could not go down if there were no sewerage or water, or some other essential were absent. If any purpose could be served by proceeding with the buildings in a sort of handicapped style, so that they might all be completed by the same date, there would be no objection. I should like to consult my colleagues as to what works are to be considered absolutely essential before any reasonable occupancy. The idea for this Naval Base was originated by the desire of the State Government to hurry us away from Williamstown, and that desire is active now. Of course, nothing cataclysmic would happen if it were possible for us to continue at Williamstown. But we have to remember that an Aviation Corps is contemplated, and is daily becoming more important. For such work as this there are no facilities at Williamstown, whereas there are excellent facilities at Westernport.

(Taken at Melbourne.)

WEDNESDAY, 17TH OCTOBER, 1917.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Sampson,
Senator Needham,	Mr. Sinclair.
Mr. Mathews,	

Frederick Golding, Acting Chief Electrical Engineer, Postmaster-General's Department, sworn and examined.

131. *To the Chairman.*—The Works Department has not made any reference to my Department in regard to the proposed installation of a local telephone service at Flinders Naval Base, and I have no information as to the class of telephones which they propose to install there. I have inspected the plan of the Base as exhibited in the Committee's rooms. The permission of the Postal Department would not have to be obtained for a service within the Base itself. I should need some further information as to what power would be available before I could say whether it would be a profitable undertaking to provide an automatic system for a service of from 75 to 100 telephones. I should say that for a Naval Base the automatic system would be preferable, and now that you inform me that they will have ample electrical current available I would suggest the installation of the automatic system for the reasons that it would be more self-contained, would give a continuous service, and would be more reliable, inasmuch as the human factor would not enter into it. It would also give a more rapid service. While it would be more expensive to install, it would be cheaper to maintain. The annual costs would be less, but the capital costs in the first instance would be greater than those of a manually operated magneto system. Anticipating that the Committee would desire some information under this heading, I have prepared some figures for its use. I have taken a hundred number system, which is generally the smallest unit adopted in the case of an establishment of this kind. The capital cost of a manual switchboard, one hundred line magneto, would be about £365. The annual costs for a continuous service—and I am giving these figures in order to provide a proper comparison between the automatic and the manual system—would be in the vicinity of £470. For an automatic service the capital costs would be from £890 to £1,000, and the annual costs would be about £150. These figures allow for the rates of pay obtaining in the Postal Service, and in framing my annual cost for a manual system I assumed that there would be a continuous service. If it were unnecessary to maintain a continuous service, then, of course, the annual salary allowed in respect of one or two attendants might be eliminated. You tell me that a continuous service would be required. That being so, I may say that I have allowed for the salaries of three attendants, and have taken the minimum rate of pay for an adult in the Postal service, which is £126 per annum. The time which a mechanic would have to give to either an automatic or a manually operated service would, I estimate, be one-fourth of that of a mechanic on the ordinary telephone service. I presume that the Naval authorities would have at the Base mechanics capable of maintaining their own system. After a little tuition any mechanic with a knowledge of electrical engineering would be able to maintain the automatic system. I have allowed that one-fourth of a mechanic's time would be taken up in attending to either system. The proportion might be a little more in the case of the automatic, but I do not think that the expenditure involved in respect of that additional proportion of time need be considered. The Navy Department might be able to reduce the figures as regards attendants, but I have allowed for a continuous service day and night, or, in other words, for three shifts. These costs are necessarily only approximate in the absence of data regarding the probable traffic. I should need to know what would be the calling rates. I have estimated a fairly high, but not an extreme, calling rate, and I have provided in my estimate of the costs of the automatic system for two master switches, which should take care of the traffic. Should the traffic be abnormal, then slightly additional costs would need to be added to the automatic—say, £20 or £30—for additional switching apparatus. Personally, I do not think it would be necessary, and I believe the figures I have given may be accepted as correct. I have assumed that the cost of electrical power will be approximately the same as that obtaining in Melbourne. Here we procure it at ¾d. per unit; I have no doubt that the necessary power would be obtained at the Naval Base for approximately the same cost. It would be a very small fraction of what I understand is likely to be the power produced for other purposes at the Naval Base. I have also assumed that the installing facilities will be similar to those obtaining in Melbourne. The cost of the construction of the lines inside the Base I have assumed to be the same in the case of the automatic or the manual system, and I have therefore neglected that item. My figures are therefore not complete as regards the total cost of installing the telephone system; they are comparative as showing the cost of the manual *versus* the automatic system. I am not in a position to say what line construction will be required. The automatic system would not require the continuous attention of a mechanic, and I have therefore allowed one-fourth of the time occupied by mechanics in maintaining apparatus at substations, or subscribers' premises, and the switchboard inside as in connexion with an ordinary city exchange. It would not be necessary to have a mechanic constantly in attendance to deal with any faults or crossing of lines. Under the automatic system we

should have an apparatus which would cause a bell to ring, and so to announce a fault on any line. We have quite a number of unattended automatic exchanges such as this would be. There is one in the General Post Office, Sydney, which is generally unattended. The mechanic calls in, sees that the switches are in proper adjustment, and makes any slight adjustment necessary. On the average, that does not occupy him for more than one or two hours a day. The switchboard in Sydney is the nearest approach to the one now under consideration that I can call to mind on the spur of the moment. The Sydney Gas Company has just installed a somewhat similar plant. Farmer and Co., of Sydney, have likewise a similar plant, which is for the most part wholly within their own building. The Hotel Australia and Usher's Hotel, Sydney, have similar plants, but not extending outside their buildings. Such systems can obtain connexion with our central exchange, where we have the necessary apparatus. There would be no difficulty in regard to all of the connexions at the switchboard in the Naval Base connecting directly with the Navy Office, Melbourne, but they could not get through the Navy Office in Melbourne to the metropolitan network without the intervention of an operator at the Naval Base. To secure that connexion, nothing more would be necessary than the switching in of two plugs. Any of the connexions at the Naval Base could get direct communication with the Navy Office here. I understand that there would be no objection on the part of the Postmaster-General's Department to direct connexion between the Base and the Navy Office. I have gone into the figures as to the cost of building the line. There are poles already existing between Melbourne and the Naval Base at Flinders. It would be necessary to erect two wires between the two points, and I would suggest the use of 200-lb. copper wire. A 150-lb. galvanized-iron wire would give a satisfactory service between the two points, but it would not permit of the Naval Base speaking, say, to Sydney or Adelaide, and, as they would probably desire to do later on, to Brisbane. I take it that the Naval Base would require at times to speak through to Sydney or Adelaide; hence my suggestion that 200-lb. copper wire—that is to say, 200 lbs. to the mile—should be used. Having regard to the high price of copper at the present time, a 200-lb. copper wire line from the Base to Melbourne would cost about £1,500. If 150-lb. galvanized-iron wire were used, the cost would be about £900. I repeat, however, that a galvanized-iron wire would not give a satisfactory service between the Base and distant places, such as Sydney and Adelaide, or even Ballarat or Bendigo. The difference between the copper and the iron wire is in regard to the speaking properties, apart altogether from the additional conductivity which the copper wire gives. In speaking over a galvanized-iron wire line there is a magnetic effect that is absent when speaking over copper wire. Then, again, copper has about six times the conductivity of iron. With a copper wire line it would be possible to speak over great distances, but with an iron wire the speaking capabilities of the line would be limited practically to between the Base and Melbourne. Coming to the question of the annual charges for such a line, I may say that we have no regulation at present providing for a service of this kind, but it would be a matter for negotiation between the Navy authorities and the Postmaster-General. Without expressing an authoritative opinion on the matter, I think the annual costs for the supply and maintenance of a copper wire line between the Base and the Navy Office, Melbourne, would be about £180. We have a regulation under which the Naval authorities could erect their own wire on our poles, paying for the use of our poles about 10s. per mile, which would mean £21 for the whole line. Under that regulation they would have to erect the wire and maintain it. Taking a broad view of the matter, however, I think it would be more in the interests of the Commonwealth if the Postal Department supplied and maintained the service. We are in a better position to do that than the Naval authorities would be. A somewhat similar condition arose in connexion with the provision of a telephone service between Queenscliff and Melbourne for the Military authorities. That service was provided by the Postal Department, which charged the Military authorities something like £220 per annum for supplying and maintaining the line. The length of that line is about 71 miles, as against 42 miles in this case, but at the time of its erection the price of copper wire was about £87 per ton, whereas it is now costing between £140 and £150 per ton. There is a difficulty in obtaining such wire, but, so far as this Naval proposal is concerned, we are in the fortunate position of having in Melbourne a sufficient stock of 200-lb. copper wire for the purpose. The use of such wire on any outside unimportant work would not be allowed; but I view this as a work of national importance, and that is why I suggest that our Department would probably be in a position to supply the copper wire necessary for the line. There is a great difficulty nowadays in obtaining copper wire, and it is hard to say when the position will be relieved. I have no knowledge of copper wire yet being manufactured within Australia, and, until it is, it will be extremely difficult to secure here. We might be able to obtain it from America, but we cannot obtain any from England, the Minister for Munitions not being prepared to grant priority certificates allowing for extensions in the manufacture of copper wire. If the line were properly constructed, and the power wire required for electric lighting at the Base were placed above the telephone wires and the fire-alarm wires, there would be no danger attending the erection of all those wires on the one set of poles. I suggest that the power wire be placed on top because it is heavier and stronger wire, and therefore not so liable to come down during a gale as the lighter telephone wires would be. If the telephone wires were placed over the power wires, there would be a danger of their breaking in a gale, and coming into contact with the power wires. There could be no objection to using the one set of poles if the telephone wires were placed 5 feet below the power wires. It might be necessary to put in cross-overs, that would depend upon whether the alternating or direct current were used on the power wires. You tell me that there will be a direct current and a voltage of 460. In that case there will be no trouble. So far as I am aware, no application has been made to the Postal Department for information in regard to this branch of the works at the Base. We installed the automatic system in Farmer and Company's premises and elsewhere. If a private firm or outside body wishes to connect up a service with our Department we must install it. We do not seek control over any system to be kept within the owner's own property, but if it crosses any public ways, or is to be connected with our system, we must have control. If a firm installed a telephone system within its

own premises, and wished subsequently to connect it with our system, we should have practically to purchase it, and to charge them a rental, that being necessary to prevent the purchase-line system again coming into operation in connexion with the telephone service. As you are aware, there has been a lot of trouble in that respect. We desire to have control of any system that connects with our own, because we wish to make sure that it will be properly maintained. The latest experience of the automatic system is very satisfactory to subscribers. Under that system the transmission is, if anything, superior to the transmission of the common battery system. That has been particularly noticeable in connexion with our larger networks, such as those of Sydney and Melbourne. I think that eventually the introduction of the automatic will result in a reduction of cost. The prediction of a witness before this Committee some time ago—that the introduction of the automatic would result in a saving of over £1 per subscriber—has, speaking generally, been borne out. The automatic system is comparatively new. So far as we can judge, it is wearing well, and its life will be as great as, if not greater than, that of the old system; that, however, remains to be proven a few years hence.

132. *To Mr. Mathews.*—The automatic system is a complete success. For use within the Base itself, a 150-lb. galvanized-iron wire would give sufficient conductivity and insure a sufficient continuity of service. It would be cheaper than 150-lb. copper wire, but one vital factor which cannot be overlooked is that iron wire at such a place as the Naval Base would be valueless at the end of from five to ten years, owing to the rusting that would be caused by the salt in the atmosphere. I certainly would not recommend the Committee to use iron wire for either telephone or telegraph lines at the Base. In connexion with our own system, we have had, particularly about Sydney, to renew our galvanized-iron wire, in some districts, within five or six years. For instance, at Manly and along the coast at Randwick and Waverley our galvanized iron wire lines cannot be relied upon for more than from five to six years. I would not suggest the use of iron wire for any of the lines at the Naval Base. Rather than use iron wire I would suggest the use of a lighter wire of phosphor-bronze, or a 100-lb. copper wire, although, as I have already mentioned, the conductivity of the iron wire would be quite satisfactory as within the Naval Base itself. In pre-war times iron wire cost us about £15 per ton, and copper wire about £80 per ton. Thus in those days an iron wire would cost about £1 per 1 mile, whereas a 200-lb. copper wire would cost a little more than five times as much. I do not think it would be advisable to use less than 150-lb. iron wire—assuming that iron wire was to be used at all—in the Base itself. The point which must not be overlooked is that, if the Base wished to ring up Sydney, the effect of the use of copper wire between Melbourne and the Base would, to a certain extent, be lost as the result of using a couple of miles of iron wire within the Base itself. The strength of the wire is also a consideration. A 100-lb. copper wire would give all that was required from the point of view of conductivity, but it would be likely to carry away in a gale, and I think that, whether copper or iron be employed, it would be better to use nothing less than a 150-lb. wire. A very long time since, the price of No. 6 and No. 8 galvanized-iron wire was £12 per ton, but £15 per ton for the lighter wire is the nearer approximation. It is most difficult to say what would be the price of galvanized-iron wire for some years after the war, but I anticipate that, unless it is made in Australia, prices will remain high for many years. That statement applies to both iron and copper wire.

133. *To Mr. Sinclair.*—Coming to the question of whether there is any material difference between the alternating and the direct current for the telephone service, I may say that the alternating current produces on the telephone wires an inductive effect. In other words, it produces a peculiar hum—a musical note—which interferes with the speech or the hearing. That can be eliminated by putting in cross-overs in the middle of the lengths. The putting in of cross-overs, of course, would raise the cost of installing the telephone system. Even if the power wires and the telephone wires were carried on separate poles, the question of the production of this inductive effect would depend entirely on how far the power wires and the telephone wires were apart from each other. It is a question, not of their being carried on the same poles, but as to the distance between the wires of the two systems. I do not think there is sufficient in the objection to the alternating current to say that it would necessitate the use of the direct current throughout the Naval Base. If what we know as the single-phase alternating current were employed, serious troubles might arise; but with the alternating current of the three-phase system, which is usually adopted on works of this kind, and is similar to the system adopted in Melbourne City Council, no trouble would arise. It may be that the Navy Department have asked for a direct-current electric supply because they consider it better suited to the running of their machinery. There is a direct current employed in Melbourne, and in the suburbs there is an alternating current. If they had a direct-current supply for the workshops at the Naval Base, and an alternating current outside, they would need two separate plants or a converting system, which I would not recommend in this comparatively small area. I do not care to express any opinion on the question of the power to be introduced, because I have no knowledge of the machinery to be used, or what power the Navy authorities require. It is true that in the city area the converter is used more in connexion with converting the alternating current back to a direct current than otherwise. They have a rotary converter—that is, the machinery in which the armature is rotated by the alternating current—and from the other side of the armature is drawn the direct current. In that conversion there is a loss of, at the most, 20 per cent. I have no definite information as to any contract having been entered into between the Commonwealth Government and the Port Kembla Electrolytic Company. Our primary object in buying out private lines was to insure a better system—to enable us to have proper control of their maintenance. It was found that many of the subscribers to private lines connected with our telephone systems had old-time apparatus, and were unwilling to incur the expense of installing an up-to-date telephone. The consequence was that both they, as well as our other subscribers when speaking to them, got an indifferent service. It was opposed to the efficiency of our service to permit these purchase lines to continue. I suggest that in the interests of the Navy Department itself the Postmaster-General's Department should erect this line. We should not insist upon that, but we

should insist upon the line being properly constructed, so as not to interfere with our trunk lines extending to Flinders and other places. It would be entirely for the Navy Department to say whether they wished us to erect the line or would erect it for themselves. My only object in suggesting that we should be allowed to erect it is to secure efficiency; it is not any question of securing revenue for our Department. We already allow people outside the Department to use our poles on the payment of a certain rental, and that privilege is largely availed of throughout the Commonwealth.

134. *To the Chairman.*—The estimate I gave you as to the cost of the installation of the automatic and manual systems at the Naval Base included the cost of telephone instruments for 100 stations. I see no necessity for placing the wires underground in the case of a small scheme of this kind, unless the overhead wires would interfere with cranes or machinery that the Naval authorities propose to establish at the Base. If there were no such considerations, I do not think undergrounding would be necessary, but I am speaking, of course, without any knowledge of the proposals of the Navy Department. The undergrounding of the wires would add security to their system, but I do not know that the additional expense involved would warrant it. That would be a matter for the Navy Department to consider. The relative cost of the underground and overhead system depends entirely upon the question of locality—whether the country to be worked is rocky, clayey, or sandy, or whether, in the case of the overhead system, the poles could be obtained at a low price. I am well aware that in many Naval establishments they consider the security of more vital importance than cost, so that I would give some consideration to an undergrounding proposal; but, so far as the Postal Department is concerned, I would not be prepared in a case of this kind to suggest the undergrounding of the wires. There are three principal automatic systems on the market. They are the Strowger—which is known also as the American automatic; the Western electric system; and the Siemens systems. Any one of these would be satisfactory. The firm of Siemens Brothers, in England, I understand, has been declared not to be an enemy firm. The Postal Department installed the automatic service at the College at Jervis Bay. The Navy Department purchased the plant, and we sent men there to install it and set it in operation. At first, there was not at the College a mechanic possessing the necessary knowledge, and I think they neglected their battery; but subsequently, so far as I am aware, there has been no trouble. Firms supplying the material for an automatic system sometimes contract to carry out the whole work, but where such a system was to be connected with that of the Postmaster-General's Department, we should object to the work being done by contract not under our control. We require the installation of certain apparatus which a private contractor might not consider necessary, and which might not be necessary in the case of a self-contained system; but where there is any likelihood of the work being connected up with our system, we have to take care that it is properly carried out. The difficulty in that regard could not be overcome by requiring that the specifications should first be approved by our Department; we should have to see that the work was carried out in accordance with the specification. It would be advisable to recommend a consultation between the Navy authorities and the Postmaster-General's Department before this particular work is put in hand. In the interests of the Naval authorities themselves, I think it would be advisable for our Department to put in the installation.

135. *To Mr. Mathews.*—For all practical purposes, the sagging and contraction is the same in respect of both copper and iron wire. Scientifically, there would be greater induction on an iron wire of equal conductivity, but for all practical purposes in an installation of this kind that phase might be allowed to pass unconsidered.

Rear-Admiral Sir William Rooke Creswell, K.C.M.G., First Naval Member, recalled and further examined.

136. *To the Chairman.*—Fourteen hundred pounds odd seems a very large cost for the warrant officer's house, but I am not a judge of the price of a building. I have lived all my married life in a house worth not much over £1,200. I cannot see why the warrant officers' houses should be so enormously costly. We went into the question of the accommodation, and added to what was proposed in the first instance, because the warrant officer is nearly always a married man. He is usually an excellent officer who has come forward on his merits. One of the desires that urge him forward is the wish to get married. By the time warrant officers become senior men, as the men who will have these quarters will be, they probably have three, four, or five children. No single men will have these houses. We may get more married warrant officers than we have provided for, or we may get less. We cannot exactly estimate. In an isolated place like the Base it is advisable that men should have their wives and families with them. We hope to have a little society there, so that everything will go happily. The plan generally meets with my approval. Brick houses are better; wooden houses are inclined to be cold. I should not like to cut down the accommodation provided for the warrant officers. I can supply later a statement showing the number of warrant officers that we anticipate having with the first contingent of men at the Base. These buildings will suffice for our requirements for five years. The Henderson scheme is drafted on the principle of five-year advancements. We propose to ask for authority later to erect five or six cottages for civilian officers, somewhat similar in design to these; but a storeman, for instance, would have a smaller house. There would be no difficulty in locating single civilian officers in the barracks, but I should not like to lay down any rule about it. As a rule, the civilian officers would be married. We preferred the one-story idea right through the whole establishment for barracks and everything else. Our first plan was drawn up on that basis and forwarded to the Department for Home Affairs, who were to get to work on it, but they never did so, and we have never had that plan returned. I specified more than anything else a large verandah all round the seamen's barracks. In the present building the Department have given us a verandah, but it is only on the west side, where it catches the greatest amount of wind in the winter and the afternoon sun in the summer. There was no proposal for two-storied buildings until we asked to have the buildings we planned carried out by the Works Department.

137. *To Mr. Sinclair.*—Naval officers do not pay rent. Civilian officers pay rent to the extent

of 10 per cent. of their salary unless the terms of their appointments specify otherwise. I brought forward a proposal to use some of the barrack building as a temporary hospital, but the medical officers thought it would be better to have a separate hospital. I have since recognised that if a ship had to be suddenly paid off, we might require all the available empty space, and it would lessen the efficiency of the place if we could not do so except by turning sick people out. Part of the temporary hospital will be used afterwards as a permanent surgery. The manufacture of Whitehead torpedoes is a very advanced process. We did not propose in the first place to make them at the Base. All we intended to do was to adjust and repair torpedoes. We also thought, when the original plan was drawn up, that we should be able to establish a torpedo range there. We thought that in making our first dredging cut it would give us a straight cut right out, but a torpedo range has to be such a long one now that we should not have had the run. It must be as free as possible from tide influence, and have a certain depth of water. There are several places in Australia where we can establish a torpedo range. We hope still to be able to repair and adjust torpedoes and get them ready for service at the Base. We intend to have a torpedo school there.

138. *To Senator Needham.*—The warrant officers' houses, considering the style and accommodation provided, seem to me very costly. The isolated position of the Base might add to the cost of material, but not so much as to account for these prices. I think I could get a house of this kind erected for less than £1,465, but I am not a builder. We are trying to get down there a men's club, outside the ordinary buildings. It is to be self-supporting. It will be really a sort of hotel on the Derby system, the proprietor getting no interest in any liquor sold. It is an idealized canteen. At present, if a man's friends want to go down to the Base to see him, there is no place except the open prairie where he can take them, free from service conditions. Mr. Hudson, our padre at the depôt, is interesting himself in this matter, and I should be glad if the Committee could hear him one afternoon on their return from the West. The reasons advanced in argument against our idea of one-story buildings were that two-story buildings would be more economical, that they would give the men more room than we had designed, and that men ought to have separate rooms for sleeping and meals. We are there to prepare men for life in the Navy. If on board ship, we could give them separate rooms. I should say give them all the room and all the comforts possible, but we have to prepare men to live in a confined space, and teach them to do so in the most wholesome way, so as not to cause any inconvenience or unpleasantness to their fellows. If we have to send a draft of 50 men on board ship, we like to have men who can settle down at once to ship conditions. We have certain rules which, if observed, remove all the unpleasantness of eating and sleeping in the same room. The first thing the men have to do is to lash up their hammocks and bedding and remove them. Every possible port is then opened, and a clean draught of air goes through the place, making it a fresh room. There are not a lot of fusty bunks with blankets all round the eating table. All vestige of the previous night is removed before the food is brought in. That is the system I wanted to introduce at the barracks at the Base, and I wanted a large verandah all round, which would be practically a sitting-room for the men in anything like fine weather. I do not think that the provision now made at the Base will militate against the efficiency and adaptability to ship life of drafts sent forward, but they will not drop into ship conditions so readily. Our first design was based on the lines I have indicated, and was also the most economical; but now that the men have been given a good withdrawing-room and larger rooms and larger space, I would not be so Spartan as to say that it should be taken away from them. I am not apprehensive of any serious results from the system provided. I have no doubt the men will be able to adapt themselves to the conditions on board ship.

139. *To Senator Henderson.*—Rent is not charged to Naval officers in any establishment at Home. My suggestion to use part of the barracks for hospital accommodation was only a temporary expedient. We were pressed to find some means to save the very large proposed expenditure on the hospital on the promontory. The Medical Director considered that it would be better to have the hospital separate from the barracks.

140. *To the Chairman.*—The Works Department originally proposed to put the septic tank dead to windward of the barracks and only ½ mile off. In Sydney, the Mosman drainage comes down into the septic tank, which is to windward of the Middle Head fort. Theoretically, a septic tank is perfection, but in practice at Middle Head it was horrible. I have asked that the septic tank at Flinders be put further away, and should not be to windward. I quite understand that the Department say this tank will be practically a sealed sump. I spoke to Mr. Settle, the Director of Naval Works, who is an expert on drainage matters. If anything goes wrong with the tank, the offensive smell will come directly to the barracks. With the whole of the vast horizon to choose from, there is no necessity for that sort of thing.

William Morphett Cerutty, contractor, sworn and examined.

141. *To the Chairman.*—I have been accustomed to sewerage and engineering works generally. I have seen the price schedule of quantities for the water supply, storm-water drainage, and sewerage at the Base. I have not been to the Base, but I take it to be average country, and have assumed that it is not full of stone. Included in the quantities is a great amount of cast iron and galvanized cast iron. On the departmental estimate a lot of this will run out at £13 a ton, which is absurd at present prices, seeing that the raw material to make cast-iron pipes is £12 10s. per ton to-day in Melbourne. Metal prices may be anything now. Evidently this estimate was made some time ago. About a year ago, these metal prices would have been fairly right. Cast-iron piping could not be got to-day for less than £16 or £17 a ton delivered on the job. The 1,602 feet of 12-in. cast-iron drain pipe for the sewerage work would have to be a fairly heavy pipe if it had to act as its own girder between the cradles. The estimate for all the metal work in the sewerage details and fittings is very low indeed. Apart from that, so far as regards excavations and other work, it can be done much cheaper than these prices. I have had experience as a contractor with my own day labour. Under the contract system the contractor has more pull over his men. It would result in economy if tenders were

called for these jobs. Compared with these prices, tenders would range from about 12½ per cent. to 15 per cent. lower if they were called for to-day, that is, of course, leaving out the metal work. The prices for metals to-day are about 33 per cent. higher than those in these schedules. I would do the work detailed in the schedule for storm-water drainage at 12½ per cent. cheaper than these prices. I think I could guarantee that. The water supply details consist mostly of the supplying of cast-iron pipes. Outside of the supply of pipes and fittings, the same estimate would apply. The prices given here for pipes, &c., are very little above the present-day cost of the raw material. If tenders were called for the work generally, including the laying and joining of pipes, but excluding the actual supply of the material, I still say that there would be a reduction of from 12½ per cent. to 15 per cent. The Melbourne and Metropolitan Board of Works do this sort of work, as a rule, by contract. At intervals of about two years they do a job by day labour, and then drop it. I have done about 40 contracts of this sort, and am conversant with all the details.

142. *To Senator Needham.*—I do not think that the Government can buy metals cheaper than a contractor. The only advantage the Government could have would be to buy in much larger quantities, covering several contracts, but under present-day conditions that would be a disadvantage so far as cast-iron pipes are concerned, because the bigger the contract the bigger the price, owing to the shortage of supplies of the raw material. The isolated position of the Base is no disadvantage. I have allowed for that. I would give the workmen fair conditions. They would be under a Wages Board. I am not conversant with the conditions under which the men are working for the Commonwealth Government at present at the Base. I suppose they are treated fairly. I do not know that I would provide cooks for them. I suppose they would provide their own cooks. If a contractor provides cooks and that sort of thing, he runs up against the truck system, which is always barred. I do not know what other special conditions the workmen receive at the Base. I did not know that they were given a travelling allowance of 2s. a day if living outside of their work. I should say they should live inside the work. Generally, when men do this sort of work away from their home they camp on the place. According to the prices in this schedule, I think my estimate of 12½ per cent. less would cover the conditions you have mentioned. If the men travelled backward and forward, they would not want cooks on the job. There is not a job going where hot water is not provided for the men. It is a bad thing for men doing heavy work to have a hot meal in the middle of the day. I would not take it myself if I were working hard all day. It would not do a man any good, and it would affect his work. If a man has his principal meal in the middle of the day, he does not want to work afterwards. That is my experience, and everybody else's. I would give the conditions which you mention as obtaining at the Base—providing cooks and allowing 2s. a day for travelling—and still be prepared to construct the work 12½ per cent. cheaper. I would like to have a look at the conditions obtaining down there. I do not know what you might be "ringing in" on me. After I have seen the list of the conditions I will give the Committee a definite reply. When a contractor quotes a price, he quotes on the open labour market.

143. *To Mr. Sinclair.*—The prices of metals vary from hour to hour, so that a contractor cannot fix that part of the tender unless he gets a firm quotation. I suppose I would expect to make a profit on the purchase of metals if I contracted to find all metals and labour. The Department would have to spend a certain amount in obtaining and looking after the metal goods. In large lines of metals the Department might buy cheaper, or they might not. I think I could get sufficient men to do the work at the Base without extra inducements, such as a travelling allowance of 2s. a day or providing them with cooks. Of course, if there was some other work going on where these extra inducements were provided, it would be hard to get the men. I have thought for a long time that we have had a soft-hearted Government to provide all these things. In trenching for pipes, about 3s. a yard would be a fair estimate down to a depth of 4 feet. The stuff has to be shifted and put back again, and left decent. The price would be less for a depth of 2 feet.

144. *To the Chairman.*—In making up my estimates, I did so with a full knowledge of the conditions prevailing in Victoria. I have to abide by the decisions of Wages Boards or Arbitration Courts. Men employed by the Government should not have any greater privileges than men employed by private contractors. All men should be on the same basis—that is, the basis of the law. If I tendered for the work, I would desire to carry it out according to the law and the conditions of the contract. Cast-iron pipes have risen from £13 to about £16 or £17 per ton in the last twelve months. The estimate of the Department for 12-in. pipes works out at £13 15s. a ton.

145. *To Senator Needham.*—I do not know of any Federal or State award differentiating between Government and private employees, except that the Wages Boards do not always apply to Government work.

146. *To Mr. Sinclair.*—In carrying out contracts I have used the bonus system. Thus, if a man does 10 feet a day as a normal thing, I pay him the ruling rate of wage for that, but if he does more, I give him so much more for every extra foot he does. I have found men jump at the idea.

147. *To Senator Henderson.*—I practically set a "stent." I generally estimate what a normal man can do. I have found that in team work, while the men do not work any harder, they work better together when they have something of that sort to encourage them.

James Starr, contractor, sworn and examined.

148. *To the Chairman.*—I have mostly undertaken sewerage works, storm-water drains, and earthworks generally. I have not been at Flinders Base. I have looked through the detailed estimates. If I had a contract of that sort I would get the men to camp there, as on any other public work I have been on. Men working for the Government should not get any privileges over those working for private employers. If tenders were called for the sewerage and storm-water work, I believe that it could be done for 10 per cent. less than the prices run out in this schedule. I would undertake to do it for that. I have had no experience of water supply work. I base my estimate on sewerage works I have done in the past.

149. *To Mr. Sinclair.*—The Government are setting up a costly set of conditions at the Base if they are allowing the men 2s. a day travelling

expenses and that kind of thing. It would not be very ruinous to "chuck" the cook in. It simply means that the men are boarding on the job, and the contractor has to pay the cook. Even if I had to provide one cook for every twelve men, I would still stick to my estimate of 10 per cent. less. There is no necessity for the bulk of the men to live off the job. I have had thirty years' experience, and that is my opinion.

150. *To Senator Needham.*—I base my estimate on the rate of wages existing on sewerage work to-day. If, before I finished the job, the rate of wage was increased by an award of the Court, the loss would be mine. I would be prepared to take the risk of that for six months, but if the contract was for twelve or eighteen months I would have to add some protective clause.

(Taken at Melbourne.)

THURSDAY, 18TH OCTOBER, 1917.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Sampson,
Senator Needham,	Mr. Sinclair,
Mr. Mathews,	Mr. Laird Smith.

William Charles Burne, President of the Master Builders' Association of Victoria, sworn and examined.

151. *To the Chairman.*—I have been been contracting for 25 years in the erection of buildings. I have done very little Government work. Unfortunately, the contractors do not get much opportunity in that direction, because the bulk of the Commonwealth work has been carried out by day labour. Under the State Government, however, with the exception of works controlled by the Railway Department, most of the works are done by contract. Unquestionably, the contract system is the better. The fault in the day-labour system is the lack of supervision and the absence of self-interest on the part of the men who are in charge of the work. There is no personal inducement for a man to get the best results, and a supervisor is nearly always subject to political influence. The result is that it is not worth his while to get the best work out of the men. A little time ago, a committee of the Master Builders' Association investigated the facts in connexion with the erection of the electric power-house and sheds at Jolimont and the Post Office building in Spencer-street, and in each instance it was clear that there would have been a considerable saving if the jobs had been done by contract. It is a significant fact that the Electric Supply Department of the Melbourne City Council and the Melbourne and Metropolitan Board of Works, both of which work under the contract system, have been able to reduce their rates recently, notwithstanding the increase in wages and material, whereas the Postal Department has been obliged to increase the telephone charges, and the Railway Department to increase its fares, in order to compensate for some of the expenditure incurred under the day-labour system. I have had the opportunity of perusing the plans and estimates in connexion with the warrant officers' buildings to be erected at Flinders Naval Base, and I can see no fault in regard to the architectural design. Not even in the details does there seem to be any extravagance in the planning. If I were called upon to erect those buildings by contract, I should be governed by the awards of the Wages Boards in regard to the conditions of labour and the rates of pay; and the inspectors are always busy in seeing that the awards of the Board are observed. I understand that the Committee has been informed that bricks can be delivered at the Naval Base for 42s. per thousand. I am of opinion that the bricks will cost £3 per thousand delivered at the Base, but, basing my calculations on even that price, and complying with the conditions of the departmental schedule as a whole, I believe that if that work were thrown open to competition it could be done 10 per cent. cheaper than the cost estimated by the Department. It is quite possible that the Works and Railways Department is receiving a rebate in connexion with freights on materials sent to Flinders Naval Base, but that is not very probable. I have made inquiries in regard to railway freights, and I estimate that it will cost about 4s. per thousand to rail the bricks to the Base. I should be prepared to guarantee that if tenders were called for the erection of those buildings, contracts could be obtained 10 per cent. below the departmental estimate. During the last twelve months there have been increases in various building materials. Three months ago, the price of bricks rose from 36s. to 41s. per thousand, and since that date there has been a further increase. About two years ago, cement rose in price to about £1 to 22s. per cask, but the price dropped again. Cement to-day is only about 2s. per cask dearer than it was before the war. Building costs generally have increased about 25 per cent. since 1914. In galvanized iron and constructional steel there have been considerable increases. There has also been a big advance in the price of imported timbers, but local timber has not substantially altered in price. During the last twelve months the materials required for an average building have advanced by about 10 per cent. The substitution of tiles for galvanized iron on an ordinary roof does not effect much of a saving.

152. *To Mr. Sampson.*—My estimate of a 25 per cent. increase in the cost of building since the outbreak of war covers both labour and material, and, of course, has reference to an average building. I shall prepare and submit to the Committee a statement showing the increases in labour and material in each twelve months since the commencement of the war. I should be quite prepared to enter into a contract to build the warrant officers' quarters at a figure 10 per cent. below the schedule prices, and to submit to the closest supervision in order to insure that the specifications were adhered to in their entirety. Very few builders have any overhead charges. We have our working foremen, but clerks of works are always provided by the proprietor. In arriving at an estimate for a job, a contractor debits the work with insurance and all other legitimate expenses, allows a certain amount for his own time, and then adds 10 per cent. to the total estimated cost for his own profit. Of course, he does not always get that profit. The majority of reputable builders do the whole of their work by day labour, with a foreman in charge of each department of the job. That is preferable to letting sections of the job to piece-workers. The piece-worker likes to do the job in his own way, and that way may not be convenient to the contractor, who prefers to have control over the whole of the work, and to have everything done according to his own wish. Then, again, some piece-workers are not always to be relied upon, and

when they reach a difficult piece of work they walk off and leave the contractor in the lurch. I have had a large experience of both piece-work and day labour, and for the carrying out of big works I prefer the latter system; for smaller jobs, piece-work is better. The piece-work system is cheaper, but we adopt day labour because we are always working against a time limit. In estimating the time required to complete a job, various factors must be taken into consideration. The weather is one of them, but I estimate that if I were contracting to build the warrant officers' quarters at the Base, I could undertake to complete them in four or five months as a maximum time. Recently, there has been a decided objection on the part of the workmen to the carrying out of the sections of a job by piece-work, because they consider that piece-work has a tendency to speed up. That could be obviated by an arrangement between the masters and the workmen. My experience is that the majority of workmen are very fair-minded. As a body, they are not in favour of slowing down; nevertheless, slowing-down practices do get on the job. The union leaders try to induce the men not to adopt slowing-down methods. I think it would be possible for a conference of masters and representatives of the men to fix the minimum quantity of work to be done by the average man, and arrange to pay extra to better men. I prefer a conference between the parties to an award by a judicial tribunal, because the latter cannot have the expert knowledge which the parties to an agreement would have. I certainly believe that an amicable arrangement is possible, and any agreement of that kind could be registered and enforced. Undoubtedly, the Government could do its work more cheaply by contract than under the present system of day labour, and it would have an assurance that the anticipated cost would not be exceeded. In regard to my reference to the carrying out of work by the Electric Supply Department of the City Council under the contract system, I have been informed by the City Engineer that in 1902 the City Council charged for electric light 4.68d., and in 1916, notwithstanding all the increases in the cost of labour and material, the price was reduced to 3.22d., whilst power was reduced from 3d. in 1902 to 1.29d. in 1916. All building required by that Department is done by contract, and I think the reductions I have mentioned show that the better management and supervision obtaining in that Department conduce to efficiency. There is no definite basis on which to estimate the amount of work per day to be done by each man. Each building is distinct. On some buildings a man would lay 2,000 bricks per day without any effort; on another building he might lay only 600 bricks per day and still be working hard. I represented the employers on the Bricklayers' Wages Board, and the Board decided that the minimum number of bricks which a man should lay on a job, such as the warrant officers' quarters, is 800 per day. Plumbing costs are hard to estimate. We base our price on the labour and material for each item.

153. *To Senator Henderson.*—The majority of Government works are carried out under the supervision of men who very often are not capable. A contractor takes all sorts of care that his supervisor is capable; he does not appoint him because he is a good fellow. Even capable supervisors in the Government employ are not encouraged to get the best results. For instance, if a supervisor on a Government job sacks a man who has been loafing, that man goes to the member for his district, or he may be a prominent man in some Labour organization. At any rate, influence is brought to bear, and the foreman receives instructions to reinstate him. When that happens, all supervision is gone.

154. *To Mr. Mathews.*—I admit that the object of the contractor is to make money, and I am also prepared to concede that political influence to secure the reinstatement of a dismissed man is more often threatened than actually used. It may be that in 90 per cent. of such cases no action is taken by the union officials or the member of Parliament, but still the threat is there, and there is no inducement to the supervisor to keep a stiff upper lip. I know that on occasions the supervisor who is threatened by a dismissed man will ignore him and his talk of exerting political influence, but there is not the same inducement to the supervisor to do that on a Government job as there is on a private contract. At times, men on my jobs have threatened to report the foreman to me, and he has told them to go to somewhere that is hotter than this planet. But such independence and firmness are not common in Government employment. I should say that it will cost 15 per cent. more to erect the warrant officers' buildings at the Base than it would cost to erect the same buildings at Fitzroy, Albert Park, or Malvern. The cost at each of the last three places would be about the same; the difference in cost of cartage would be so small as to be immaterial. In carrying out work at the Base we should have to pay the men a country allowance according to the terms of the award. In that respect the Government and the contractor would be in the same position, except that the Government pay for time that is not worked; the contractor never does that. The present industrial crisis has not appreciably affected the prices of building materials. I should not be prepared to dispute a statement that the prices of building materials have increased 33 per cent. since the outbreak of war; in mentioning 25 per cent. I was trying to keep well within the mark. I have heard it said that the contractor makes his profit out of the alterations, but my experience is that he is not keen on having alterations made on a job. Each alteration humbugs him to some extent. He might be delayed for a fortnight because of a £5 alteration. If a contractor were building the warrant officers' quarters, he would agree to be bound by the schedule rates. We estimate on certain quantities at prices agreed upon, and if any alterations take place our price is increased or reduced accordingly. I have sometimes heard that it is to the interest of the contractor to scamp his work. You mention the cracking of the plaster in Queen's Hall, Parliament House. I make bold to say that the faultiness of that work was not in any way due to the contractor. I have done jobs on which the plaster has cracked for no accountable reason. If the defect in the work in Queen's Hall were thoroughly investigated, it would be found that the contractor was not to blame. It must be remembered that the contractor has too much at stake for it to be worth while for him to scamp his work. Before he is paid the work must be passed. Of course, you will find in every walk of life individuals who do dishonorable things. Contractors are no more angels than are other people; but, generally speaking, self-interest is a strong incentive to the honest carrying out of their work. I have said that in taking a contract I prefer day labour to piece-work, because it is more satisfactory to me to have complete control

of the whole job. The Government cannot prefer day labour for the same reason, unless they are indifferent as to the cost. Without being egotistical, I question whether the Government employ any men who have the same expert knowledge as has the private contractor, because few men possessing such knowledge would remain in Government employ. Of course, there are exceptions; but, unfortunately, capable men in the Government service are not given the same freedom in the carrying out of work as I have in connexion with my contracts. They do not care if a job costs a little more than the estimate, and they have no inducement to expedite the work. My experience is that the union officials do all they can to combat slowing down, but men who practise slowing down find their way on to both Government and private jobs. Wet weather would tend to reduce the number of bricks laid per day per man. It may be that the men at the Base were paid for a lot of wet time when they were not working, and that fact would considerably increase the cost. A man would be justified in saying that he could not lay as many bricks in bad weather as he could in good weather. I should decidedly prefer to have fine weather for the carrying out of any job.

155. *To Mr. Sinclair.*—The fact of political influence being exercised at times has a tendency to make the supervision of Government work weaker than the supervision of private contracts. The cracking of plaster would not be accounted for by a fault in the specification. Generally speaking, the specification is all right, but it is possible for faulty materials to be used without the knowledge of anybody on the job. Sometimes material has defects which are not apparent. Faulty plastering is often due to inefficient labour. Small cracks all over the surface of plaster work is usually due to shrinkage in the material. I have seen plaster crack in one room and not in another, although the same material was used in both. A large crack in the plaster is generally caused by settlement, but sometimes is due to carelessness. In regard to foundation, brickwork might be cheaper than concrete in one position, and dearer in another. Much depends upon the class of work that is being carried out. Some brickwork would be cheaper than concrete, and some concrete cheaper than brickwork. It is not the concrete foundation that guarantees the stability of a building. Settlement is caused by the ground underneath giving way. Concrete is used in the foundations mostly for the purpose of levelling up inequalities in the ground. If the ground underneath is good, I do not think there is any difference between brick and concrete for foundations, as regards their effect upon the strength and stability of the building. In Melbourne the difference in cost between brickwork and concrete with a gauge of 9 to 1 would be so small as to be hardly worth considering.

156. *To the Chairman.*—The award of the Wages Board in regard to the laying of bricks by piece-work allows for varying classes of work. For work similar to the warrant officers' quarters the rate agreed upon is £5 per rod. That provides for first class work—hollow walls with one face struck. If two faces were struck, the price would be increased by 10s. per rod. I should think that labour at Flinders would be 15 per cent. dearer than in Melbourne. You tell me that the cost of labour in connexion with the brickwork in the seamen's barracks was £15 6s. 11d. per rod, including faced and struck joints both sides in both solid and cavity walls, hoop-iron binding, tie wires, damp course, camber bars, pointing door and window frames in cement, building chimneys, and plumbing. Leaving out of account pay for wet weather and holidays, for which a contractor does not pay, I regard that cost as excessive. When I am told that labour for the seamen's barracks, the captain's house, senior married officers' quarters, and the junior married officers' quarters cost £15 6s. 11d., £15 3s. 5d., £13 10s., and £12 8s., respectively, I feel sorry to have missed jobs for which that money was paid. Those costs are excessive. They mean that money is being thrown away, and they give no benefit to the workmen, because they are being encouraged to waste their time. The costs of material, which the resident engineer has mentioned, for those buildings do not seem excessive. In regard to the number of bricks which a man can lay per day on solid work like foundations, I have employed a man who has laid as many as 4,000 per day; I have had other men who have laid not more than 1,000 per day; but 2,000 per day is well within the mark. To allow workmen to lay only 450 to 500 bricks on solid foundation work is only encouraging them to be lazy. That is spoiling good men. There are men who will not do more work than they can help, but there are others who are honest enough to do a fair thing. An average of 280 to 300 bricks per day on cavity walls is scandalous. The Wages Board agreed that 800 bricks per day should be laid by each man on similar work including inside 4½-in. walls.

157. *To Mr. Mathews.*—The first coat of plaster is laid on, ruled off, and hand floated, and there is no occasion to waste any time over it. If the second coat receives extra trowelling, it has a better face and is a little harder. The extra trowelling does not prevent cracking to any great extent, although sometimes it will obviate the fine firecracks which hot weather produces in new plaster. I cannot conceive of any conditions that would warrant so small a number of bricks being laid per man per day as has been mentioned by the resident engineer.

158. *To Mr. Sampson.*—Unless extraordinary circumstances arise, a contractor is compelled to carry out his work for the amount of his tender In only one instance has any allowance been made to me, and that was in connexion with the building in which there was a lot of reinforced concrete. The architect instructed me to defer that work for three months, and in that time the steel rods increased £3 per ton. I was allowed the amount of that increase. If I had contracted in the early part of 1915 to erect the buildings which have been constructed at the Base by day labour, I should have been obliged to do the work at the price mentioned in my tender, notwithstanding the war. If, as I am informed, the estimated cost of those buildings is £111,000, and that, although still incomplete, they have already cost £141,963, the Commonwealth would have saved £30,000 by accepting a contract for the erection of the buildings at the estimated cost. The non-arrival of special materials required from overseas is one of the risks that the contractor would have to take. Immediately on signing a contract the builder enters into another contract with the merchant for the supply of his materials, and thereby secures himself. No doubt, in exceptional circumstances, such as the refusal of the British Government to allow structural steel to leave England, some concession would be made to the builder. We always recognise that we are bound to carry out our work

according to our tender, unless considerable alterations in the job are made. If the work is carried out according to the original plan, the builder would have no hope of getting any increased payments, unless in very extraordinary circumstances. Had I contracted to build the seamen's barracks at the estimated cost of £30,000, no circumstances could have intervened to have increased that cost to £37,000, so long as the original plans were adhered to.

Ebenezer Shaw, Commissioner, Victorian State Rivers and Water Supply Commission, sworn and examined.

159. *To the Chairman.*—The Commission is carrying out a scheme, one of the objects of which is to provide a water supply for the Naval Base at Flinders; but, because of the uncertainty of weather conditions, it is difficult to say exactly when the work will be finished; an abnormal winter has retarded it. In summer, however, good working conditions are to be expected, and, given these, the work should make good progress, so that the Base requirements may be met in June next. But should the weather remain bad, it is impossible to say how much longer will be needed to complete what is to be done. I am not certain what is the present cost of cast-iron pipes, but I think that it is about £13 or £14 a ton. We are not using much cast-iron, except for special fittings, the price being prohibitive; we use reinforced cement pipes, which we have put down in various sizes, ranging from 4 inches to 2 feet in diameter. Of course, there has not yet been time to thoroughly prove these pipes, but we have reason to believe that they will be effective. The largest head of pressure to which we have yet subjected them is about 150 feet, though we expect to work up to a much larger head than that. As a matter of fact, there is a trial length in the Sunbury main which within a week or two will be tested under a working head of 250 feet. That test is to be made so that we may know what to expect on the next section of the Cranbourne line in connexion with the Mornington scheme. It will be made with an 18-in. pipe under absolute working conditions. There is in Adelaide a 12-in. main, a few chains in length, which is working under a head of about 350 feet, and giving satisfaction. Cement pipes are fastened together by means of a collar joint, which is a short length, a little bigger in diameter than the pipes which it joins. This collar joint is fitted over the ends of the two pipes to be joined, and the space between is filled with bitumen, which is cemented round the outside to prevent it from squeeezing out. So far, that joint has acted satisfactorily. I do not know exactly how 12-in. cement pipes would compare in cost with cast-iron pipes, but I should say that at present prices they would not be more than half as dear, and perhaps even less than half. The cement of which they are composed is made in Australia; it is Geelong cement. The sand and gravel, of course, are got here; the only material entering into their composition which is imported being the wire used to reinforce them, and there seems to be no reason why it should not be drawn in Australia. I believe that arrangements are being made now to have the wire drawn here. Cement reinforced pipes are being used in connexion with reticulated supplies as well as for main lines. We are putting in certain fittings, which will enable connexions with them to be made in the usual way. Cast-iron pipes have been so dear that we have had to do this, and we believe that the result will be satisfactory. We are putting down a certain length of reticulation pipes in Warracknabeal, and are connecting them with the mains in the usual way, though using special fittings. There is a 15-in. main going through Warracknabeal. The cement pipes have not been tested for durability over a long period, because they are comparatively a new invention, but there is no reason why they should not be at least as durable as cast iron. We shall know more about their durability twenty years hence. As to the carrying of sewage over a swamp through cement pipes borne on trestles, I cannot pronounce any opinion without knowing all the circumstances; but I do not see why cement pipes should not be used for the work. We are using practically all cement pipes in connexion with the supplying of water to the Base.

160. *To Mr. Mathews.*—The use of cement pipes for all purposes may be said to be largely in the experimental stage, but I think that they would probably be quite as effective as cast-iron pipes, even under a good head, and where the ground was not considered very sure. A cement pipe made under proper conditions should be as effective as a cast-iron pipe, generally speaking. I say that, with that reservation, the use of these pipes is a new thing, and their capabilities can be judged only from general knowledge based on the experience with cement in other work. I see no reason to suppose that cement pipes would not prove as durable as cast-iron pipes, though there has been no opportunity to prove their durability. For medium heads of pressure two cement pipes could be got for the price of one cast-iron pipe, that is, 12-in. pipes, at present prices.

161. *To Mr. Sinclair.*—All materials, including iron, perish in time, and cement will do the same; but we have had such good results from cement work generally that we believe that the life of cement pipes will be long. We have laid a good many lines of wooden pipes, which have proved satisfactory so far as our general experience goes. They have been cheap, and have done what we expected of them. But they would not last nearly so long as cement pipes. Recently cement pipes have been even cheaper in first cost than wooden pipes. Then, again, the cement pipes are made almost entirely of Australian materials, whereas the wood needed for wooden pipes must be imported. An endeavour is being made to discover suitable wood in Australia, but, so far, such wood has not been found. What is needed is a wood that is soft and will swell, like Oregon pine. I do not know why reinforced cement pipes, when supported with trestles, should not be used to carry sewage, provided that the supports were properly arranged. Cement pipes are now being made in long lengths; 2-ft. pipes are being made in 8-ft. lengths. There is a certain amount of longitudinal reinforcement, and the pipes should be of service over fairly long spans, though we have never tried them in that way. We do not put them underground further than ordinary pipes; we treat them in that respect like any other pipes. I do not see why the Naval Department should not proceed almost immediately with the reticulation of the Base, because it will take about as long to do that work as we shall need to bring a supply of water to the Base. There will be a head of about 130 feet on the pipes lying on the flat near the Base. The water will start

from the head of the Bunyip at about 360 feet. From there it will be brought into the Beaconsfield reservoir, mostly through a race, where it will be at about 340 feet. From there it will be brought through pipes, and in the service reservoir will be at about 160 feet. There will not be much head of pressure on any of the pipes except near Cranbourne, where there will be about 250 feet head of pressure at one place. Water is used for motive power in other countries, but under natural conditions different from those of Victoria. The flow of our rivers and the falls on our catchment areas fluctuate greatly. A great deal of water conservation would be necessary to obtain a sufficiently steady output to provide hydraulic motive power, though I believe that there will be a good deal done in that way in the future. The amount that we could get from the works of the peninsula scheme would not be worth bothering about.

162. *To Senator Needham.*—I cannot say what is the cost of making reinforced concrete pipes. Certain sizes cost about half what cast-iron pipes cost at present prices. In the small sizes cast-iron pipes nearly hold their own with cement pipes; it is in the large size that the cement pipes are cheaper than the cast-iron pipes. Averaging the sizes, I should say that, at the present time, the cost of cement pipes compares with that of cast-iron pipes as 3 to 5. In a normal period the comparison would be more favorable to cast-iron pipes. The price of cast-iron pipes had risen even before the war began, and it has increased during the war. It is more than five years since prices were what I should call normal. Under normal conditions I should say that the cost of cement pipes compare with that of cast-iron pipes as 3 to 4. Of course, I cannot to-day give an exact statement on a subject like this. We have no experience on which to determine the life of a reinforced cement pipe, but my opinion is that cement pipes will last as long as cast-iron pipes. I should be prepared to use cement pipes in connexion with the works that the Committee has under consideration, but other engineers may hold a different opinion regarding them.

163. *To Mr. Mathews.*—The weather conditions between November and March make it easier to cut trenches and tunnels for water supply and sewerage work than the winter conditions, and it would be well to use as much of the spring and summer as possible in carrying out such work.

Clements Langford, master builder, sworn and examined.

164. *To the Chairman.*—I have been thirty-seven years in business, and forty-five years at my trade. The works that I have carried out have been constructed chiefly in Melbourne. I have done a little work for the Railway Department, and I have occasionally done work for the Government, but I have done very little Government work, though work that I have done for private persons has been, I think, quite as good as Government work. I was present this morning during the examination of Mr. Burne concerning the plans and details of buildings to be carried out at the Flinders Naval Base. I do not consider those designs extravagant; on the contrary, they are very good, and do credit to those who prepared them. A maximum of comfort will be obtained at a minimum of cost. The specifications are fair for the class of work to be done, and quite in keeping with those prepared by private architects for residential buildings round about Melbourne. I have gone carefully through the specifications and plans of the building designated "Residence for warrant officer No. 2," and have taken out the quantities as I would take them out were I tendering for work in the ordinary way to the design of a Melbourne architect. I should be prepared to take a contract for that building, to erect it at the Base, for £1,250. I should be prepared to sign a contract now to undertake that work. If I could get five or ten such buildings to do together, my tender would be slightly lower. In carrying out the work I would comply with all Arbitration Court and Wages Boards awards in force in Victoria. The Master Builders' Association is always ready to do that. Its members feel that they must in duty support whatever is the law of the land, but they are not prepared to submit to requirements which are not comprised in awards governing the trade. As to the amount of work that a bricklayer could do in setting a solid foundation, I agree with the evidence given by Mr. Burne. I have seen jobs on which men could lay 4,000 bricks a day. They could almost lay the bricks with their feet, and put in the mortar with a shovel. If a man were laying only 450 bricks a day on solid foundation work, he would not be a man whom I or any other contractor could afford to employ. On such work a man should lay at least 1,000 bricks a day. As to hollow walls, a conference was held between the bricklayers and master builders, by which the matter was thrashed out, and it was agreed that 800 bricks a day would be a fair thing. In the price that I have quoted I have allowed £22 a rod for brickwork, including labour, material, and everything else, and bricks are now a good deal more than they were. They charge 10s. for shunting trucks from the main siding at the Base. That is the charge, irrespective of the number of trucks to be shunted. If there were only one truck to be shunted, it would mean a charge of 2s. 6d. per 1,000 on the bricks in that truck. Roughly speaking, it would cost 18s. a 1,000 to get bricks to the base. Bricks now cost 43s. a 1,000. Probably the bricks used at the Base cost about 34s. a 1,000, or 9s. a 1,000 less. In my opinion, the prices set down for brickwork in the Government estimate are very high. It is the lack of personal interest that causes Government enterprises to be so much more costly than private enterprises. There is on the part of those engaged in Government enterprises no personal interest at stake. Those who are carrying out private work, however, have to make a profit out of each contract. Moreover, they are men who have risen from the ranks. I served my time as a joiner before going into business, but I know the whole game from A to Z, and know what every man employed by me should do. I keep my men constantly employed, and those who do not do a fair thing are run out. The men know that unless they give fair results they will not be kept. We know when men are doing a fair thing, and the men know that we know it. Last year I was asked to make a comparison between the value of certain tram sheds in 1914 and their value in 1916. I went carefully into the matter, taking every item separately, and comparing the prices in 1914, before the war, with the prices in 1916. My investigation showed that, in connexion with the work investigated, there had been a general rise in prices over that period of 33 per cent. Oregon, for instance, was 17s. per 100 super. feet in March, 1914. It rose by various stages to 26s. 6d. in May, 1916, and it is now 40s. Its present price is 23s. per 100 feet more than its

price in 1914. Similarly, hardwood has risen in price from 13s. in 1914, to 17s. at the present time.

165. *To Mr. Mathews.*—On a private job, men are not paid when the weather prevents them from working. If they were paid for every working day, then in a week like this, with two wet days, you might have to pay twenty men for sixteen hours each, that is 320 hours in which not a brick was laid. No contractor could afford to do that. If private contractors were compelled to pay men for time in which they were not working, houses would become too expensive to build.

166. *To Mr. Sinclair.*—It would not be difficult to build a roof with wooden trusses to cover a span of 65 feet. There is, in Bourke-street, not far from this building, a motor garage with a roof spanning 70 feet. That is carried on wooden trusses. In Adelaide, there is such a roof with a span of about 110 feet.

167. *To Mr. Mathews.*—Special provision would have to be made if there were machinery to be supported. I am of opinion that timber would be as effective as iron for the roof of a building like a power-house. There would be more rigidity in a timber roof. The lateral strength of an iron construction is rather weak.

168. *To Mr. Sinclair.*—The use of wood for the roof would save some feet of brickwork. The iron roof shown on the plan requires an extra 4 feet of brickwork. Probably a truss could be designed which would save that 4 feet of brickwork, but I am not an expert in the designing of steel roofs. If only the roof has to be carried, I think that a wooden truss will be more economical than an iron one, but oregon is now 40s. per 100 feet, and would cost 45s. for a length of over 36 feet. It would be necessary to use Oregon for such a large span. Of course, the tie-beams might be made in pieces and bolted together, but it would be cheaper and better to have them in one piece. Jarrah would be too heavy for such construction, and karri would also be too heavy. I do not employ men on piece-work. We tried to get the Wages Boards to provide piece-work for carpenters, but it was not allowed. I think, however, that in Sydney flooring can be laid by piece-work, though I am not certain of that. Occasionally, inspectors are too exacting, but there is a clause in our conditions of contract which allows us to object to men whom we consider unjust. I would sooner forfeit a deposit than allow an unjust man to lord it over me. I am prepared always to do a fair thing, and would rather throw up a job than submit to undue exactions. If there were a Government inspector who was thought to be acting unjustly, we demand an inquiry. Some men are martinets. Our undertaking is to carry out work according to the specifications and in the ordinary way. The master builders claim to give a fair thing, and to do faithful work. We do not defend bad work, and when a dispute arises give a fair opinion as to the nature of the work in question. My experience of Government work is very small. I believe that some years ago the supervision was more exacting than it is now. I have heard no serious complaints against Government clerks of works during the last three or four years, but several instances are on record in which a very severe view of specifications has been taken, to the detriment of the contractor; an extraordinary job has been expected for ordinary specifications, and we object to that. Galvanized iron corrodes fairly quickly, and when used for roofs should be painted. It has a life of ten or twelve years in very exposed places such as near the sea or railway buildings. I prefer tiles to both galvanized iron and slates. We have found that in Melbourne slates deteriorate very much in 25 or 30 years. This may be due partly to the sulphur contained in smoke. At the seaside, slates seem to shell off and deteriorate. Iron walls and roofs make usually a cheap construction suitable for workshops, but after three or four years the iron should be painted with an anti-corrosive.

169. *To Senator Needham.*—Baltic timbers have increased in some lines from about 11s. to 18s. Half-inch lining, which was 7s. 6d., is now 19s. If Mr. Jeffery says that the increase has been from 116 per cent. to 124 per cent. he is quite right. The average for seven lines of Baltic in 1913 was £3 4s. 9d., in 1917 it was £7 11s. I am of opinion that there is a slowing down on Government works, though I have no personal knowledge of it. The tendency to slow down is corrected on private works. I do not agree that the difference between the results of the day-labour and contract systems is wholly a matter of supervision. What you have under a contract system is the motive of personal interest, which is wanting from Government work. When a man asks me for a job, I ask him what he has been doing, and if his reply is satisfactory I engage him. Next day, I inquire of the foreman whether he suits. If he does not, he is discharged, but if he is a good man he is retained. Thus I have a slow man in my employ only for a day or so, but on a Government job such a man might be kept on for several months. That is one of the causes why better results are obtained from the contract system than from the day-labour system. Then, again, my men know that I am in business, not for philanthropy, but for profit, and they are aware that, having to compete with other contractors, I cannot afford to pay men for loafing. They know that if I am to pay 20s. in the £1 I must get value for my money. Those considerations do not enter into the performance of Government work. What I am looking for is 100 per cent. of efficiency. Perhaps my foreman is satisfied with 70 per cent., but I think that the Government supervisor gets only about 30 per cent. Were I given the construction of five houses at Flinders Naval Base, I could reduce my price a little, because of certain savings that could be made. It might, for instance, be possible to use two sets of scaffolding for the five buildings, and it would not cost more to supervise five buildings than to supervise one. If I were carrying out this work, I should not pay my men for holidays or wet weather. I consider that it enervates men to coddle them. I am ready to pay the full award rates, but I am not willing to provide cooks and do other things that are not usually done on private jobs. At the same time, I undertake to give satisfaction to the men whom I employ. I have had men employed before on country work. I am sure that I could get men to go to Flinders Base without providing cooks for them. There are men who have been working for me for 34 years. My men get fair treatment, and act fairly by me. I have sometimes allowed a shilling a day extra, and put on a man to boil water for the midday meal, also providing quarters on the job. Were I given this work, I would make arrangements that the men would be glad to accept. The master builders, as a whole, treat their men fairly, and pay all award rates. But, having

done that, they have done their duty as employers. To coddle men is neither good for them nor for the community. In the national interest the less we have of that the better.

170. *To Mr. Sampson.*—With reference to a list of buildings comprising warrant officers', junior officers', and senior officers' residences, wireless telegraph station, magazine, stores, torpedo school, naval stores, armourers' work-shop, and seamen's barracks, the estimated cost of which was £111,000, had I taken a contract for the whole lot, I would have had my materials secured at the outset. A contractor is bound by the terms of his contract, but I believe that it is sometimes arranged in Government jobs that, should the rate of wages be increased during the carrying out of a work, an allowance will be made for the increase. Had I taken a contract for this work, I should have carried it out for the price arranged for. It is not usual to stipulate that the amount to be paid shall be increased if wages rise, but I think that an allowance on account of a rise in wages was made recently in connexion with some railway work. A man may, however, tender to carry out work for the Government, paying certain rates of wages, and stipulate that if those rates be increased the sum that he is to receive must be increased accordingly. If the works in question have cost £141,000 odd to carry out, or £30,000 more than the estimate, the difference is the amount that would have been saved had a contract been let for the amount of the estimate. Had I undertaken to do the work for the amount of the estimate, I could not have claimed a penny more than the contract price. Roughly speaking, wages have increased by from 10 to 15 per cent., and material by more than 30 per cent. If I were carrying out work at Flinders Base I would have to pay the various trade awards to carpenters, bricklayers, plasterers, and so on; but I would not give an extra allowance to a man living a mile or two from the scene of operations. That is not done in Melbourne. Nor would I provide cooks. I have a job now about 4 miles from Footscray, and arrange to have the men driven to and from the train, because the distance is too far for them to walk. In a £1,000 villa job, the bricklayers' work would cost about £75, the carpenters' about £110, the labourers' about £60, the masons' about £15, the plumbers' about £20, the painters' about £123, and so on. I shall supply you with a statement showing the cost of labour and material on average jobs of different kinds. I prepared some figures for the Arbitration Court some time ago, and can easily adjust them to the increases in the price of labour and materials. I think that if I accepted work on a 10 per cent. basis, instead of in the usual way, it would affect the return I got from my employees. Some time ago I did £13,000 worth of work on the 10 per cent. basis, but only my foreman and myself knew what the arrangement was. There is a tendency for men to slow down when they know that they are on a commission job, and I make it a stipulation, when accepting such jobs, that no one is to know that I am receiving a commission instead of making the usual profit. When men know that it is a commission job, they get into their minds the idea that the boss is not so eager to get things done cheaply. Now, I have to carry on my business with all the energy of which I am capable, and to get out of my men all that I can. If they slowed down on a commission job worth £10,000, that might not hurt me much; but they would also slow down on the rest of my work, of which that job might be only 10 per cent. As a matter of policy I cannot permit them to slow down at all. In nearly every case my foremen are members of unions, but it is they, and not the men, who are the bosses. Nearly all of them are men whom I have trained myself. I have had apprentices in nearly all the building trades for the last thirty-four years. Many of the foremen are union officials, but they do an honest thing by me. I have two bricklayer foremen who are second to none in the Commonwealth, and similar carpenter foremen. In Melbourne, the boss usually makes it worth the while of foremen to play the game fairly, and the men respond to his treatment. If a foreman does his bit for the boss, he gets on with the men; but a foreman who is a tyrant is of no value to his employer. I have twenty to thirty foremen who get on well with the men, because they act fairly towards them and towards me. I had some years ago in my employment a man, his three sons, and four grandsons. When a man slows down, he makes himself incompetent. A slow man is either an incompetent man or a thief. If he can do a fair day's work, and does not do it, he is robbing his employer or the country of money that he does not earn.

171. *To Senator Henderson.*—I would not employ such men very long. In private employment they are soon found out, and have to seek another job.

172. *To Mr. Sampson.*—Contractors do not count the number of bricks laid each day. They know, when a job has been finished, how many thousand bricks have gone into it, and how much they paid for labour. When I go on to a job, I can see whether the men are doing a fair thing, and I have foremen whose business it is to get a fair thing out of them. The foreman is an expert. If he finds a man slowing down, he reports him to me, or gives him his money. We do not have any words about it. The number of bricks that a man will lay in a day depends altogether on the kind of work that is being done. As I have said, there are jobs in which men could almost lay bricks with their feet, and other jobs, such as the construction of arches, on which a man might not lay more than 100 bricks in a day.

173. *To Senator Henderson.*—Bricks laid with mortar are easier to lay than bricks laid with cement. The quality of sand will make a difference in the rate at which bricks are laid. If a private contractor gets a load of sand which does not suit, he sends for another. When mortar is supple, a man will lay 50 or 100 more bricks with it than with bad mortar.

174. *To Mr. Sampson.*—We estimate the cost of work by the rod. Recently, when I was laying a lot of flooring in a factory, I ordered 2¼-in. nails, but the ironmonger sent 2½-in. nails. When I went on to the job, I said to the foreman, "You seem to be getting on slowly," and he replied, "Well, look at the nails you have sent." Had the men been paid for piece-work, they would not have used those nails, because it takes more effort and more time to drive in a 2½-in. nail than to drive in a 2¼-in. nail. On a Government job, however, if 3-in. nails had been supplied they would have used them. It is in these little matters that personal supervision pays.

175. *To Senator Needham.*—Had I, in 1915, taken a contract for the buildings at the Flinders Naval Base, I would not, when the work was finished, have asked for extra payment, because I would have known that I would not get it. Were such a claim made, the contractor would be told, "You signed the contract with your eyes open, and you must abide by the result." I do not know of any case in which the Government has allowed for a rise in the cost of material, but if such an allowance has been made, I am glad to hear of it. I rejoice to know that a fellow contractor has not suffered by the rise in prices. Whatever awards may be made respecting payments and allowances, the Master Builders' Association is prepared to accept them, whether they be just or unjust. We have no sympathy with those who will not obey what is the law in these matters.

John Charles Monteath, iron-foundry manager, sworn and examined.

176. *To the Chairman.*—I am interested in the manufacture of cast-iron piping. We have two recent quotations for iron at our works at South Melbourne—G. and C. Hoskings charging £10 15s., and the Broken Hill Proprietary £10 per ton. With iron costing £10 per ton, the cost of 12-in. cast-iron pipes would be £15 10s. a ton, or 11s. 8d. per foot. There has been an increase of from 30s. to £2 a ton in the cost of iron during the past two or three months, and the cost of cast-iron pipes has increased accordingly. The cost of 9-in. pipes is about £15 10s. a ton, or 7s. 11d. per foot. The cost of 6-in. pipes is 4s. 5d. a foot. The standard 12-in. pipe has a thickness of $\frac{8}{}$ths inch, and weighs 9 cwt. per 12-ft. length. The 9-in. pipe is 9-16ths inch thick, and weighs 6 cwt. 11 lbs. to the 12-ft. length. The 6-in. pipe is 7-16ths inch thick and weighs 2 cwt. 1 qr. 24 lbs. to the 9-ft. length, and the 4-in. pipe is $\frac{8}{}$ths inch thick, and weighs 1 cwt. 1 qr. 20 lbs. to the 9-ft. length. Six-in. and 4-in. pipes cost about £16 a ton. These prices are based on the ordinary steamer rates for freight, and are liable to be increased or decreased as shipping rates increase or decrease. There is no difficulty in getting supplies if freight can be obtained.

177. *To Mr. Mathews.*—A contract for the supply of pipes would be based on the present cost of raw material, freight, and manufacture, together with incidental expenses and overhead charges. I would prefer to take a contract on the understanding that the prices should rise and fall with the rise or fall of the price of material. There is a little competition with wooden pipes for low pressures, and in the past there has been a good deal; but, for many reasons, cast-iron pipes are cheaper in the long run. For one thing, cast-iron pipes will last for 100 years. Pipes brought from Scotland have been pulled up in Melbourne after they had been down for 60 years, and, having been cleaned, have been relaid. Nothing is known as to the life of the wooden pipe—these pipes having been in use only for five or six years. It must be remembered that the scrap iron which could be recovered from the cast-iron pipes after their life as water mains would be of some considerable value which should, in normal times, represent about a quarter of the present cost of the cast-iron pipe, and the lead between the joints will pretty well pay for the cost of taking them up. It is necessary for the joints of cement pipes to be very tight to withstand pressure. But cement is fragile, and in the process of ramming cracks may be made which will cause leakage. I have not heard that bitumen has been used with success to prevent this. I do not think that an efficient joint can be obtained with cement pipes under heavy pressure. My firm has been making cast-iron pipes in Victoria for about 37 years, and for about ten years in Western Australia and Queensland.

178. *To Mr. Sinclair.*—At the present time, scrap iron is difficult to obtain. We mix it with pig iron to get a close grain. There is no fear of a shortage in pig iron. The Broken Hill Proprietary is putting up a big furnace, to be ready in March next, in addition to its present furnace. I do not think there is any reason for fearing a shortage of supplies in connexion with the requirements of the Flinders Naval Base.

179. *To Mr. Laird Smith.*—Wood pipes take a pressure of about 25 lbs. to the inch. They could not be used for very high pressures. Each cast-iron pipe is tested with hydraulic pressure at our works in the presence of an inspector appointed by the Government, or whoever the pipe is being made for. Each pipe is tested to a pressure of 260 lbs. to the square inch, or to a pressure of 300 lbs., if necessary. The iron used by us would be all Australian. I have not heard of damage being done to pipes in Melbourne by electrolysis.

(Taken at Melbourne.)

TUESDAY, 29TH JANUARY, 1918.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

Herbert Reah Harper, Electrical Engineer to the City of Melbourne, sworn and examined.

180. *To the Chairman.*—I have examined the plans that you have here in connexion with the proposed electrical installation at Flinders Naval Base, showing the power that will be required for large workshops, also for electric lighting, a telephone system, and certain small outside smelting plants. If one knew why the Navy Department desired a direct current, one could more readily answer your question as to whether a direct or alternating current is preferable. Looking at the project as a purely lighting scheme, apart from any reasons that the Department may have for putting in direct current, I would suggest a three-phase alternating current. Assuming that the primary object was power for the workshop, I should still see no advantage in putting in a direct current as against an alternating current. A direct current is more or less rigid in its application to lighting and power, whereas an alternating current would give a far more elastic system capable of expansion to any extent and to any distance. In the absence of any reasons for the Department's preference, I should say that a three-phase alternating scheme would be preferable. It would be less expensive to install, bearing in mind that the generating plants and motors would be cheaper than a direct current plant. The three-phase alternating scheme would be as cheap as, if not cheaper than, the direct current plant to work. The alternating current system would allow of expansions to any extent—it would meet any extension of the Base, and would give conditions under which you could supply lighting

and power without difficulty on the most economical lines. With a direct current system and low pressure, of course you would be limited to a small radius of a mile or a mile and a half. Even if, as you say, this would always be a compact scheme in which it would not be necessary to carry electrical power more than 2 miles—and then only for lighting purposes—I fail to see that the direct current would give anything more than would the three-phase alternating current. In addition to that, the three-phase system would be simpler and cheaper, and thus less costly to maintain. I do not think that the difference between the alternating and direct current, both at low voltage, for lighting purposes would be much; except in respect of the outlay on mains and copper there would be a slight advantage in favour of the three-phase as against a three-wire direct current distribution. There would be a saving in copper.

181. *To Mr. Laird Smith.*—The saving would be very considerable, as between high voltage alternating current and low voltage direct current, as pointed out by Mr. Harold Whitmore Smith, Assistant Engineer (Electrical) to the Department of Works and Railways, in his evidence before you. In Melbourne we never think of conveying power any distance at low voltage. We step up to a high voltage, and the economy then becomes very great.

182. *To the Chairman.*—We supply direct current to the inner portions of the city within a distance of about 1 mile from the power house. That system was installed some 20 years ago, when the three-phase alternating current supply was not so well developed as it is to-day. At that time the power demand was exceedingly small. A great deal of importance was also attached to the working of elevators, and on that account it was decided to put in direct current. I doubt very much whether, if we were starting, *de novo*, we should put in direct current. In the outlying portions of the city we have only the alternating current. As to the desire of the Navy Department that the men employed in the workshop should be capable of being transferred on board ship where the direct current is used, I should say that while there is a difference between the two classes of work, a man trained only in direct current work would have but a very narrow training. I have not found amongst my own men any tendency to specialize on the one side. A man who takes up electrical work should become proficient in all classes of supply. There is a good deal in what you say in the desire of the officers of the navy to carry on at these workshops on conditions approximating as nearly as possible to those on shipboard. At the same time, the men could easily be given all the training they required by setting apart a portion of the Base for direct current work. Direct current is easily obtainable from the three-phase alternating current by the introduction of a rotary converter. In that way the necessary training could readily be given. I presume that direct current is required on board ships for working the searchlights and signalling apparatus. The point as to training should receive consideration, but it is by no means vital since the difficulty could easily be overcome in the way I have suggested. A man who had experience of alternating current would have little difficulty in understanding direct current. I fail to see, however, why the men in the workshop should not have training on both sides. There would be no difficulty in putting in a small storage battery, with a small rotary converter, at one part of the Base, where they could charge and discharge. Coming to the question of overhead wires, our practice in the city is to provide for an overhead supply whenever we can do so because of the enormous saving thus obtained. It would have been impossible to supply so large a part of Melbourne as we are doing if we had been prohibited from using overhead wires. We only put the lines underground in the centre of Melbourne —in such thoroughfares as Collins-street and Bourke-street—where, for aesthetic reasons, overhead wires would be undesirable. One has only to go to Montreal to see how overhead wires disfigure the principal streets of a large city. Our policy is to put up overhead wires unless aesthetic and other considerations demand that the wires should be put underground. I have not been to the Flinders Naval Base, and it is, therefore, impossible for me to say what is necessary in this regard there. I would certainly say, however, that where the supply is not to be in a city the lines should be overhead. The overhead wires can always be taken down at little cost, if necessary, whereas if they are put underground a great deal more cost is involved. In such circumstances I would recommend overhead wires every time. I have only used concrete posts for lamp pillars. I have not used them for carrying wires, but I see no objection of their being used for such a purpose. They are being used in some parts of the metropolitan area—in Brunswick for instance—for that purpose. The price of wooden poles to-day is from £2 15s. to £3, as compared with about 35s. some years ago. If an order were given for a number, concrete pillars would be cheaper. They are quite efficient. There is a little feeling of greater security when using a wooden pole, which is a good insulator, except in wet weather, when it becomes otherwise. But quite apart from that, I would say that reinforced concrete poles would make a better job. There would be no greater danger of concrete poles carrying the electricity to the earth than there is of wooden poles doing so in wet weather. With the adoption of one or two safeguards, there could be no objection to the telephone wires being carried on the same poles that carried the power wires. By transposing the overhead supply wires every third or fourth pole, or less frequently, you would get over any objection. I am not a telephone man, but that is my opinion. I understand that a company at Port Kembla is endeavouring to proceed with copper wire making. A plant was ordered from Great Britain some time ago, but some of it, I understand, has been lost. The company, however, will soon be able, I believe, to turn out stranded copper cable. The prices of all metals have gone up very appreciably since the war. Bare copper cables before the war were obtainable at 1s. per lb., whereas now you cannot get them under 2s. or 2s. 3d. per lb., by indenting, and local stocks run up to 3s. per lb. We have not used electricity for heating or cooking on a large scale in Melbourne. I am afraid our tariffs are too high to justify its use on a large scale in that way. I have not had any experience in the heating of a large building by either hot water or steam. I should think that the heating of a building on a large scale would be a very serious problem if carried out by electricity. To make electricity suitable it would be necessary to have very cheap motive power—say one-tenth of the charges prevailing in Melbourne at the present time. After all is said and done, heating by electricity is a roundabout process, whereas heating by steam is a little more direct. In the latter system they avoid some of the loss inevitable in the process of converting the energy from coal into electricity and heat.

183. *To Mr. Laird Smith.*—I know Mr. Harold Whitmore Smith, Assistant Engineer (Electrical) of the Works and Railways Department. He has come into contact with my department to a considerable extent. I have seen that part of his evidence in which, in answer to question 82, he said—

> If I were asked to design a whole scheme for the Naval Base, I would certainly consider a high pressure alternating current system preferable to a low potential current, regarding the matter from the point of view of a general electrical supply. Whether there are any particular requirements in the navy demanding a direct current plant such as is used on board ship, I do not know; but from the supply point of view there is no doubt that a high pressure alternating current system is the better and cheaper. If a high pressure system were used to supply the buildings as outlined in my estimate, the total cost of installation would be cut down to £10,000.

That means a reduction from £16,000 to £10,000. I should think that is quite possible. I have also read that part of his evidence in which he says—

> At the woollen mills we generate a three-phase alternating current of 415 volts 50-cycle, and supply about 800 horse-power. In the case of the Caulfield Military Hospital we buy power from the Melbourne Electrical Supply at 4,000 volts, and transform it to 400 and 200 volts. At Canberra we generate three-phase currents of 5,000 volts 50-cycle, and supply about 30 miles of 5,000 and 10,000 volt lines.

At the woollen mills they have adopted a low voltage, generating a three-phase alternating current of 415 volts 50 cycle. In that case there is practically no advantage in having an alternating current as against a direct current system, because there is no transmission. There is, of course, an advantage in the matter of the cost of the motors. The three-phase motors are certainly cheaper and less troublesome to look after. We have thousands of horse-power direct current motors in the city, but I would advocate the alternating current motors as preferable to the direct current system. The fact that they supply at the woollen mills about 800 horse-power would justify the use of a three-phase system, although there is no advantage arising from any transmission of power. The scheme adopted at Canberra is quite right considering that it is for a town supply. I have read the evidence given by Mr. C. E. M. Whyte, Engineer Constructor of the Navy Department, in which he says—

> I am not an electrical engineer, and I have not consulted with any electrical engineer as to the class of plant to be installed at the Base. The matter was arranged before I was appointed to my present position. Admiral Clarkson seemed to be quite clear as to what he required.

You ask whether it would be preferable to accept such evidence rather than that of a qualified electrical engineer. I have no desire to criticise any one, but one is naturally inclined to ask why the naval authorities do not state their requirements. If those requirements were stated, and seemed to be in opposition to the opinions of, say, a good electrical expert in the Federal service, then the Navy Department should give its reasons for basing its requirements on a certain scheme. According to the evidence given by Mr. Whyte, no reasons were advanced for the desire of the Navy Office that the direct current system should be used. As to Mr. Whyte's further statement that "Admiral Clarkson considered that the direct current was better than the alternating current for driving machinery," there again we are in the dark as to what is wanted. It is impossible to generalize in dealing with a definite scheme. If a witness said, "We want the direct current system for a certain specific purpose," and proceeded to name it, then the whole matter could be discussed. A man who wishes to qualify as an electrician or electrical engineer, must obtain a knowledge of the alternating as well as the direct current system. I should say that having grasped the one he would readily grasp the other. If a low pressure direct current were required for training purposes, it would be much cheaper to install a small plant such as I have mentioned rather than spend an additional £6,000 on wiring in connexion with a complete direct current system. As to the question of poles, I have heard the theory that poles taken from land where the timber grows steadily, last much longer than poles taken off basaltic country, where the timber grows very rapidly. I have not had an opportunity, however, of confirming that theory. We have an officer who regularly visits the Otway forests districts where contractors are cutting poles for us, but I should not like to pass an opinion on the theory you have just mentioned. We have had no trouble in obtaining wooden poles. We use ironbark and messmate. I admit that these timbers are becoming rare; we have to go further afield for them, but we are able to obtain them. We always try to get them cut in the autumn when the sap is down.

184. *To Mr. Mathews.*—I think the suggestion that iron instead of copper wire might be used at the Flinders Naval Base is worthy of consideration. The question has been considered in Melbourne because of the high price of copper. There are difficulties, however, in the way of using iron wire, its characteristics limiting its usefulness for, at all events, long distance transmission. As to its use within an area like that of the Flinders Naval Base, I can only say it is possible, but I would not commit myself to a definite opinion without first going into the figures. One would have to consider such matters as resistance and reactance before passing an opinion on the comparative advantages of iron wire and copper wire. I suggested recently to the Commonwealth authorities the use of iron wire in connexion with a supply wanted at Point Cook. I am afraid, however, that its use would not prove economical there since an iron wire over so long a distance would have to be very large. In the case of a concentrated area, such as the Base, its use would be worthy of consideration. The Committee would have to consider, however, the effect of sea air upon it. We all know the destructive influence that a salty atmosphere has on iron, and in such a district an iron wire might not last long. Copper wire costs from £230 to £240 per ton, whereas iron wire is about £26 or £30 per ton. It is necessary to bear in mind, however, that the iron wire would have to be heavier than a copper wire which would serve the purpose.

185. *To Senator Newland.*—I believe that concrete poles would cost less than wooden poles, and that the extra cost of handling would not counterbalance the reduction. I presume that the concrete poles would be made on the spot. Even if all the material is not available locally, the freight on cement to that point would not be very considerable. There would be no difficulty in regard to the appliances for erecting concrete poles. I do not think there is anything in the argument that the extra weight of concrete poles as against wooden poles would mean such

an increase in the cost of handling and cartage as to counterbalance the difference in cost. The price of wooden poles has been going up during the last six or seven years owing to the increase in wages, and to the fact that the contractors have to go further afield for them. We are now paying about £2 15s. as against 35s. per octagonal pole 35 feet long, about 7 inches wide at the top, and 11 inches at the base. I have had no experience of electric lighting on shipboard, and cannot say why the Navy should prefer direct current as against the alternating current system. I presume the direct current system is favoured because of the use of searchlights and signalling, as well as variable speed motors on board. Having regard to such considerations, the direct current system would probably be more attractive to the Naval authorities. I should not like to say that the use of the direct current has been retained by the Navy merely because the service has not progressed as people outside have done. That would amount almost to a libel of the service. In all departments of life we find a little of the conservative attitude, which is best summed up in the expression, "Stick to what you have." In the United States of America, as well as in other modern navies, they are, in a sense, getting away from the use of the direct current system; but that is mostly in respect of the power required for propulsive purposes. Their battleships are now being propelled by large motors driven from steam turbines driving generators. The generators supplying the current for the motors are of the three-phase class. It is quite likely that they still use the direct current for searchlights and signalling. I cannot say whether the three-phase system is used throughout the modern battleships of other countries. In mining, as well as in wooden workshops, or where any inflammable material is used, it might be preferable to use the three-phase rather than the direct current system, because of the danger of sparks which you suggest. The risk in such cases would be greater where the direct current was used. The direct current system is not used in mines, because there is always a fear of a spark igniting the surroundings. A direct current motor would never be used in a magazine or in inflammable stores. Where there are inflammable surroundings I would prefer the use of a three-phase motor, which has not a commutator—a part of the D.C. motor which might cause what is called a fire risk.

186. *To Mr. Sinclair.*—In Melbourne we are gradually changing from arc lighting to metal filament lighting for outside purposes. A year or so hence we shall have no arc lighting in our streets. One reason for the change is the question of labour cost. The item of labour in trimming arc lamps is a serious one. That item is dispensed with by putting in metal filament lamps of large candle power. We also free ourselves in that way of the necessity of importing carbons. As I have already said, we have a direct current in the City of Melbourne. The power is generated from the same machine as that from which the alternating current is generated. There is no reason why a direct current should not be used in the power house if it is necessary, and an alternating current outside. It is physically possible. It would mean the use of different types of machines. There is a good deal to be said for the use of three machines where you are installing a power plant to carry a certain load. In the case of the breakdown of any one machine, you would still have two plants in operation, and the liability to a complete breakdown would be more remote. With three plants you could allow the output from the power-house to grow to a larger extent—that is to say to two-thirds of your total plant—and still have a third plant as a standby. With two machines you could only provide for a supply from the power house amounting to one-half of the total capacity. Coming to the question of lighting, it is true that we have large storage batteries in the city. They have been put in more to meet an emergency than for any other purpose. They are there in the event of a slight local breakdown, and are capable of taking up the supply for a short period. I do not advocate batteries in every set of circumstances, because they need special skill in supervision, and to keep them in good order. They go wrong very readily, but provided you have skilled attention they are very satisfactory. They have not, however, a life of more than eight or nine years. I should not like to say off-hand whether it would be cheaper to run only two shifts, and have a storage battery to supply the requirements of a third shift, or to work three shifts. Your plant capacity would have to depend upon the demand, for instance, in the daytime. The big load would be in the daytime when the shops were at work. That, however, would scarcely affect your plant capacity. Your plant must be capable of coping with the whole of the demands at the heaviest time, namely, during the day. It is always wise to fit in your plant capacity with your requirements. If your plant is only partly loaded it is running uneconomically. That is an axiom which we have always to bear in mind.

187. *To Senator Needham.*—I think a concrete pole would have a much longer life than a wooden pole. The life of a wooden pole in the City of Melbourne averages from twelve to fourteen years. The life of a concrete pole would be indefinite.

188. *To Mr. Sampson.*—I have read Mr. Smith's evidence. You ask whether, having regard to his statement that, where a variation of current is required for the working of machinery, probably the direct current would prove the most flexible, it would be advisable in the circumstances to have the two systems working side by side. My answer is that you would have to convert half the output of your power-house to direct current. That would mean an inevitable loss of 20 per cent. of the power put into the converter. It would not be wise, in the absence of some very good reasons, to waste all that energy. All the training required to fit the men in the workshops for work on shipboard could be obtained in the way I have already described. It would be quite possible to install a direct current system for training purposes, and for the working of the machinery in the shop, and, perhaps, in the wireless school, while at the same time having the alternating system for the lighting of the Base; but I should think twice before I would consent to converting a large portion of the power. It would be possible to have an alternating plant put down to the extent of the lighting requirements, and a direct current plant put down to the extent of the bare requirements for training. I should not like, however, to recommend such a system on the score of economy. It would be better to have the alternating current supplying both the lighting and the great bulk of the power required, leaving only a small proportion to be converted in order to give the direct current training required for the men. While I should say it is quite practicable to do what you suggest, I would not recommend it on the score of economy. My opinion would be largely affected by the requirements of the Navy Department. If they could set out in black and white why they require the direct current system, one would be able to express a clear

opinion on the subject. They have apparently some special reasons for desiring the direct current, but they have not disclosed them. If they would only disclose them they could be carefully considered and a proper conclusion arrived at. As to the statement that the Department has ordered three engines, and that two will have to be worked to provide the necessary power, it would be quite practicable to use two of these for supplying alternating current and the other for a direct current supply. It would not, however, be an economical way of dealing with the situation. It would be more expensive to the extent of the portion supplied by the direct current system. You suggest that a saving in wiring might be secured if the alternating current system were applied to the lighting. It is, however, a question of transmission. If the workshops were near the power-house, what you suggest might be done. But if the workshops were at a great distance from the power-house no benefit would be secured.

189. *To the Chairman.*—If, as you say, the power will be generated within the workshop, that makes the proposition worthy of consideration.

190. *To Senator Newland.*—I am not a telephone man, but I should say that the direct current system is the only one that would be used for telephones. Storage batteries are generally used. I am referring now, of course, to what is necessary for speaking only, not for ringing. Our power-house is a little out of date, but its engine-room walls are from 35 feet to 40 feet high. In the old days a very high roof was required for workshops so as to allow of an overhead crane travelling from one end to the other. But where turbines are used, as they are to-day, the walls are not so high. I should say that 35 feet would be the average height of a power-house engine room.

191. *To the Chairman.*—I served my time in a big engineering workshop, but have not had to do with the designing of workshop buildings. The height of the walls of a workshop must depend largely upon the nature of the operations to be carried out. Provision in any case must be made for an overhead travelling crane, and the hook must be well above the height of any work to be carried out in the building. The height of the walls must be determined first of all by the maximum height of the operations to be carried on in the building. If, as you say, marine boilers amongst other things, are to be repaired at the Naval Base Workshops, I can well understand provision being made for walls 42 feet high, since the travelling crane must be high enough to carry a load over any work in progress. The tendency in erecting workshops of late has been to provide for high roofs, so that work may be carried from one side of a building to the other. The Committee will see at once how necessary it is to have a high roof if it visits the Newport Railway Workshops power-house. There the roof is from 60 feet to 70 feet high, and yet the turbines are not very much more than from 12 feet to 15 feet above the ground. They have lifting machinery of great capacity, and they prefer to have plenty of head room.

192. *To Mr. Laird Smith.*—If I were directed to carry out an electrical installation, I should certainly ask first of all the load to be carried and the variation of the load during the twenty-four hours. We generally put forty poles to the mile, the spacing being about forty yards apart. That is increased as the pressure or voltage is increased. The height of the poles or towers is increased until with a transmission scheme of 100,000 volts you may have only 10 to the mile. In the case of a permanent speed variation the change could be made by the use of belting. Motors can be designed to provide for temporary speed variations, so as to allow of their running up to 50 per cent. above or below normal speed. I have not found it necessary to provide for any great variation of speed in ordinary operations. but there are cases where variations are required. You might find it necessary, for instance, to run a centrifugal pump at a greater head of water and that could be done only by increasing speed. Where you want that variation of speed you can provide for the variation of speed and head at the motor.

193. *To Mr. Sinclair.*—Where a variation of speed is required in the case of lathes, gears can be put in to provide for it.

194. *To Mr. Laird Smith.*—I know of a system under which it is possible to vary the speed of an alternating current motor. The speeds of three-phase motors can be readily regulated by introducing resistance in the rotor circuit. If you want a very much wider variation of speed, a commutator motor can be used.

195. *To the Chairman.*—As to the distance at which metal filament lamps should be set apart in order to secure effective lighting, everything depends on the height at which your lamps are suspended and upon the candle power. In some of the streets of Melbourne where we have metal lamps of about 300 candle power suspended across the roadway we have them spaced at about 80 yards apart. The distance varies and depends, amongst other considerations, on the class of street to be lighted.

196. *To Mr. Mathews.*—The presence of trees very often compels the closer spacing of lamps, but where you have buildings on both sides of a street, the lighting is improved by reason of the reflection of the lighting off the buildings.

197. *To Mr. Sampson.*—You can convert from the direct to the alternating current by the use of a revolving machine known as a rotary converter. We have a large number running in this city. Years ago, when the supply was on a smaller scale, we generated all our direct current for the inner portion of the city. We now generate only the three-phase, and have but one class of machine. All the direct current is converted from the three-phase in the substations. You simply introduce three-phase current at one end of the rotary converter and draw it out as a direct current at the other. It means a loss of from 15 per cent. to 20 per cent. of the energy put into the converter. The loss would be the same if the generator were close to the power-house. It occurs in the converting process.

198. *To Mr. Sinclair.*—Similarly, you can convert a direct current to an alternating current, by the use of the same machine. You simply reverse the process. The loss of energy is the same in both instances.

199. *To Mr. Laird Smith.*—If you have to carry power any distance the potential falls, and you can "boost up" by using a booster.

(Taken at Melbourne.)

WEDNESDAY, 30TH JANUARY, 1918.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair.
Mr. Mahony,	Mr. Laird Smith.

Tom Tunaley, carpenter and joiner, sworn and examined.

200. *To the Chairman.*—Until recently I was secretary of the Amalgamated Society of Carpenters and Joiners for two years. At present I

am acting president of the Building Trades Federation. I prefer to speak for the carpentering trade only. In my opinion, the plans for married warrant officers' dwellings at Flinders Naval Base are very plain. I do not see that they are drawn on extravagant lines. I would not recommend any reduction in the size or in the conveniences to be provided. Not being interested as a contractor or as a man in control of contractors' work, I have not gone into the matter of estimating the cost of buildings, and I would rather not commit myself to an estimate of what a building of the size projected should cost within 4 or 5 miles of Melbourne. Speaking from a social point of view, I should say that it is essential to provide for married men in the metropolis the same reasonable comfort as is proposed to be supplied for the warrant officers at the Naval Base. A suburban house of the size projected would command a rental of about 25s. per week. I am living in a weatherboard house half the size and pay 12s. 6d. per week, but the rent of a house depends on the locality in which it is erected. I would allow about 3 per cent. for the upkeep of a brick building and for insurance. Much depends upon the situation of the building. A house that is subjected to heavy weather, particularly that coming from the sea, may necessitate a little more attention than is required for one surrounded by other buildings. I would not like to pay £3 per week for a house of the type to be provided for the married warrant officers at the Naval Base. I understand that £1,450 is the estimated cost of these dwellings. The ordinary public would look for 10 per cent on the cost of construction, and 10 per cent. on that amount represents £145 per annum. I do not see any extravagance so far as the architecture is concerned, except that the front verandah appears to be rather broad, and out of proportion compared with the usual size of verandahs. I have not worked at the Base; but, with others representing the building trade, I have visited it on two occasions in connexion with impending disputes in respect to the distance allowance, and I had a vague opportunity of glancing at the buildings for an hour or so. At that time the men, whose residences were more than a certain distance from the job, were receiving an allowance of 2½d. per hour in addition to the fixed rate. An agitation developed for an increased allowance, and the Building Trades Federation took the matter in hand. As a result of an urgent telegram I received, and of a deputation from the Base, I went down the following morning, after consulting Mr. Hill, the Director of Works, who supplied me with the minutes of a conference we had held with Mr. King O'Malley, who was then Minister for Home Affairs. As a result of an interview with the men, I was successful in avoiding a dispute at that particular juncture, and the matter was afterwards presented to Mr. Justice Higgins for adjustment. There was a conference in Chambers, and, as a result, His Honour awarded an allowance of 2s. per day for six days in the week. Various awards in the building trade provide varying allowances for men working beyond a certain radius from their homes. The carpenters' award provides for an allowance of ½d. per hour beyond 3 miles, 1d. per hour beyond 5 miles, and 4d. per hour for any distance beyond 12 miles. In the case of plumbers, the rate is higher. In the case of painters, the rate is lower at the longer distances. Therefore, complications arose, and the men working at the Caulfield Hospital in October, 1916, having made a request for an increased distance allowance, the Department of Home Affairs decided that the increase would be granted if we could have it embodied in our award. We had that done, and the increase was made applicable to the Caulfield Hospital. We then asked for its extension to the Naval Base. That was also done, and the carpenters employed there were paid an extra 4d. per hour, making an increase of 2s. 8d. per day for distance allowance. The fact that the carpenters were receiving this extra payment caused dissatisfaction among the other artisans employed at the Base, some of whom were only getting 1s. 6d. per day extra. With a view to having the matter adjusted, and in order to bring about a uniform allowance, the question was brought before Mr. Justice Higgins in Chambers, and the result of his award was that a carpenter, instead of receiving the 2s. 8d. per day extra as distance allowance received only 2s. per day extra. Men who are living at Hastings are paid a travelling allowance, I believe. Contractors must observe the award rates fixing a distance allowance. Any contractor who engages men in Melbourne to work outside a radius of 12 miles from Melbourne must pay his carpenters a basic rate of 13s. 4d. per day, and 4d. per hour extra as a distance allowance or as a compensation to them for having to live away from their homes. I think that the minutes of the conference held before Mr. Justice Higgins will show that this particular allowance was given because a man had to keep two homes going. The State Public Works Department has a special tender form. Any contractor tendering for the building of a State school, or any similar class of work, must comply with the Wages Boards determinations ruling in respect to the various trades. A contractor who was building at State school at Seymour was sued in the Seymour Court for not having observed the conditions laid down as to extra payments, and was compelled to pay the full Wages Board rates. Contractors are penalized if they do not observe the extra rate. I understand that the Commonwealth paid the extra rate at the Langwarrin Camp, at Seymour, and also at Broadmeadows to men who did not live on the spot, and had to travel backwards and forwards night and morning. In the case of the Flinders Naval Base, before uniformity was brought about in regard to the distance allowance, the fixing of the uniform rate was a disadvantage to the carpenters, though it meant an increase to other trades. Speaking generally, the Department gained the greatest advantage. If the Commonwealth inserted a clause in their tender forms that Wages Boards determinations and Arbitration Courts awards must be observed in their entirety, the contractors would have to pay the same rates as are payable by the Commonwealth. The distance allowance for a plumber works out at 6s. or 7s. per day. If the tender form sets out that the contractor must observe the respective determinations of Wages Boards, he would be required to pay the plumber 6s. or 7s. per day as distance allowance; but if it is set out that he must pay in accordance with previous conditions, he would pay only 2s. per day to the plumber in accordance with Mr. Justice Higgins' award. If a contract is given the Government should see that the terms it sets out are observed by the contractor. The Government should not pay any more than the awards that apply generally. Prior to the war, carpenters were receiving 12s. 8d. per day without any distance allowance. To-day the rate is 13s. 4d. per day, to which have to be added the distance allowances, which I have already mentioned, running from ½d. per hour up to 4d. per hour. Contractors are now paying 4d. per hour to men who work more than 12 miles from their homes. That rate has not been affected by Mr. Justice Higgins' award. That award was only given to meet an emergency,

and is applicable only to the Naval Base and Point Nepean. When I was at the Base, I heard no complaints about the excessive cost of work, but I did hear complaints about the large number of foremen who were employed in comparison with the number of men at work. The complaint was that there were more foremen employed than a contractor would have on the job, and that though the number of men might be reduced the same number of foremen was kept on. The system in operation when the work was started at Flinders Naval Base was that the men should register for work at the Commonwealth Offices. Consequently the union did not know anything about the capacity of the men engaged. The tendency is for men to seek work near their homes rather than to travel long distances for it. Naturally the good men get the work lying nearest their homes. The same thing applies in the metropolitan area. The good men get constant work from contractors. The probability is that a contractor would submit a lower tender than £1,450 for the type of dwelling proposed to be provided for married warrant officers at the Base, but he would know that there would be extras, and would calculate on them. I understand that Commonwealth tenders are all called under a schedule, but at the same time there is often necessity for a change of design. That may not happen in the case of a small building, but such buildings have been considerably altered when partially built. On occasions, work already done has had to be pulled down. All this leads to extra cost. I know of no complaint that has been made down at the Naval Base from the workmen's stand-point, except that in respect to over-staffing. However, there is one point I would like to make in connexion with securing cheaper and more efficient work. It is a matter that was placed before Mr. King O'Malley when he was Minister for Home Affairs, and it deals with the manufacture of joinery work. It was pointed out to the Minister that if the Department intended to carry out a successful day-labour system, it was essential that it should have control, not only of the work itself, but also of the necessary material for carrying it out, that is to say, of the plant for the manufacture of the joinery work required. We cannot expect the day-labour system to be successful if we allow contractors who hold the essential materials, and possibly the essential manufactured articles under their control, to retain that control. The system cannot be as successful, cannot work as smoothly, as efficiently, or as economically as it would if the Commonwealth had control of the essential material, by which I mean timber and joinery work. At present, the Commonwealth joinery work is in a farcical condition. The Defence Department, the Navy Department, the Public Works Department, and the Postal Department all have machinery for the manufacture of joinery work, and each plant is run under different control. If all the machinery in the various Departments was marshalled into one factory under one control, all the joinery work required for the Commonwealth Departments could be manufactured there, the cost being allocated to the particular job requiring the joinery. If the facts were looked into, it would be found that thousands of pounds worth of joinery work is done by private contractors as well as by the respective Departments running their own plants, and from what I can learn the Departments are invariably at a disadvantage in regard to delivery at their jobs, in consequence of which work is frequently held up. If my suggestion were carried out it would bring about smoother work, and more efficiency in regard to the day-labour system. In the Naval Depôt at Williamstown, where I worked for six or seven months, there is joinery machinery. At Sturt-street, the Postal Department had a joinery plant for making telephone cabinets and other essentials. The plant has been removed to Spencer-street. The Defence Department had similar machinery at Seymour, and at Victoria Barracks. There is also a small plant for the manufacture of joinery at the Naval Base. At the same time these Departments rely on private contractors to supply their timber. In spite of having their own machinery, they allow work of an important character like that in the new postal building, Melbourne, to get into the hands of a private contractor, namely, Mr. Pengelly, of South Australia. If that work had been done in a Commonwealth Department, we would not have had the spectacle of the fittings being thrown on one side when a new Minister came in, and changed the internal design of the building. I have no doubt the discarded fittings were retained by the Department, but what they can be used for I do not know. Probably the alterations in the design of the building would still have been made if the workmanship had been carried out in a Commonwealth Department, but the timber could have been used up in the manufacture of other joinery work by the Department. It is bad administration to have your joinery machinery scattered over the whole of the State in four or five different Departments. It should be marshalled into one establishment. I doubt whether the Government can buy timber as well as outsiders can. The person or contractor who holds his own timber stock uses the quantity of timber which is useless to the Government or the person to whom he is supplying it, in the manufacture of joinery work to his own advantage. For instance, if he cuts up a log, he uses the portion which is not to be supplied to the consumer to his own advantage, and yet charges up the whole amount to the firm originally ordering from him. Take the manufacture of rifle butts, where the article is delivered cut to shape, and simply requires finishing. There is a lot of waste material which the timber merchant uses to his own advantage, yet it will all be charged in full to the Government.

201. *To Mr. Sampson.*—My union has given the question of piece-work versus day labour close consideration, and feels so strongly on the matter that it has a rule denying the right of members to work on piece-work or butty-gang work, holding that it is not only to the welfare and efficiency of the workmen, but also to the advantage of the employer that piece work shall not be done. The man employed on piece work cannot make an efficient article. The system tends to the slumming of work. It also deteriorates the workmen, and there is a tendency to sweating. The matter has been examined from every stand-point—both from the experience of the past, and in the light of schemes that have been brought forward from time to time with a view to securing larger production. We are still of opinion that the piece-work system is not advantageous from any stand-point. It tends to increase production to the advantage of the employer, but to the disadvantage of the employee. Invariably the prices set for piece-work do not give a fair remuneration compared with the greater energy required from the workman. An award of a Court fixed a rate for piece-work in the Cairns district, Queensland, but within nine months both parties concurred in eliminating the piece-work conditions from the award. The reasons actuating this step I cannot give you, because I do not know them. Each district is empowered to frame its own industrial

agreement. The only line in which the piece-work system has been considered, as far as carpenters are concerned, is that of ship-building, but I will leave that matter to be discussed by another representative who will appear before the Committee. In the Victorian railways the butty-gang system operates, not only in railway construction, but also in the building of waggons. The union has not discussed any piece-work scheme which would eliminate the abuses of the past, and substitute a system that would give efficiency of workmanship, and at the same time give greater encouragement to the efficient men to earn more. I have no desire to express any opinion on any alternative system. All I can say is that piece-work so far as the building trade is concerned has not been a success so far. It has not been my experience that the amount of service rendered by workers is reduced in conformity with the establishment of a flat rate of pay. I do not think that there is any set principle adopted by the men with that object. The union does not stand for that sort of thing. It believes that the men should give a fair thing so far as their capacity and physique are concerned. It has not been my experience that there is a tendency on the part of the majority to do only as much work as is done by the minority who are not so skilful. The union says that each man is at liberty to do what his capacity and physique will allow him to do. It is optional on the employer to pay more to the man who does more work, but the unfortunate situation we find is that when an award is given, the employer, who is at liberty to pay more for greater skill, makes the minimum rate fixed by the Court for the poorest class of worker the maximum rate for the man with the greater skill. I do not know of any instance in which the majority of unskilled men have claimed the higher rate paid to the more skilled minority. I have worked in shops where men have been receiving higher rates for greater ability. There may be jealousy among the less skilled men, but there is no organized objection to the more skilled receiving higher pay. So far as I know, where an employer has been allowed to pick out a man who is worth more money, and pay him more, there has been no protest on the part of the other workmen. Differentiation of pay is already in operation in many establishments. If I were an employer, I might approve of it. As a representative of the union, I do not discourage it. That is as far as I can go. Contractors generally purchase their material from timber merchants. I understood from Mr. King O'Malley that the timber merchants did not do him justice in the supply of material as compared with their treatment of private contractors. I have not been employed on any large job for three or four years.

202. *To Senator Henderson.*—The period of apprenticeship in the joinery business in Melbourne is approximately seven years. Lads are indentured to the trade. Some contractors also indenture their apprentices. There may have been many reasons actuating a contractor in saying that he could build a house at a 30 per cent. cheaper rate than the estimate of the departmental officers, but if he claims that the sole reason for the excessive cost over his estimate is the adoption of the day-labour system, then I cannot give credence to his statement.

202A. *To Mr. Mathews.*—I have had experience in Great Britain before coming to Australia. I have worked under contractors and under the Government, but only in Australia under the Government. There is always a possibility of inferior material being used by contractors; there is a tendency to "ring in" inferior material. If a contractor demands that his men shall speed up he cannot expect the same amount of efficiency, particularly from skilled artisans, that would be obtained under other conditions. As a rule a contractor in engaging men picks the quickest workers he can get. None of the foremen employed at the Naval Base was engaged through the union. Many of the men employed joined the union after being engaged. Whether they got their jobs through political influence or not, I do not know. The contractor takes good care to see that he engages the men who will give him the most work for the money they receive. There are many men who cannot do the same amount of work that others can do, and if a man cannot compete with the fastest he does not get a chance. When the union has been asked to supply labour every man is given a fair opportunity. The contractor keeps his fast men in constant employment and picks up others as he requires them, but the others have to follow the fast men, because it is the contractor's object to get the most that he can out of his men. The Government should not follow that system. The day-labour system will not stand for it. It gives better work, although perhaps it is not turned out at such a rapid rate. If the contractor sees that the day-labour system is proving advantageous he will undoubtedly make more favorable offers to the Government in order to secure work. As secretary to the union, I have never been approached by any one for the purpose of using political influence to protect any workman. No instances have come under my notice of men on a Government job threatening their foremen that they will see their member of Parliament. I understand that the Commonwealth Treasury building is a work carried out by day labour which comes within a reasonable amount of the estimated cost. In reference to the marshalling of joinery plant in one establishment, I consider that the Commonwealth could bring soft timbers here in its own steamers, and negotiate with the State Governments for its hardwoods. It could then establish its own timber mill, and supply its own timber to the joinery establishment. There is a lot of profit to be made in the working up of by-products in a timber mill. For example, the timber merchant who has to cut up a big log for one customer may have bad edges, which he cuts into moulds and beads for another customer who makes sash frames and windows.

203. *To Senator Newland.*—It would be necessary to establish a plant in each State. The quantity of timber required in each State could be easily ascertained to see whether a plant would be justified. A large mill could easily be employed in Victoria at its fullest capacity. Unfortunately, one of the biggest contracts for joinery work in Victoria, that for the new postal stores, went to a private contractor in South Australia, because the Commonwealth Government did not have the necessary supply of seasoned blackwood available. I do not say that there should be a plant in Victoria to supply the whole of the requirements of the Commonwealth Departments for Australia. I say that if the amount of joinery work for the Departments in Victoria justifies the erection of a mill, it should be established. Similar plants should be put up in the other States if the amount of work justifies it. Carpenters' wages have increased by approximately 10 per cent. I account for the fact that a work estimated to cost £680 in 1915 cost £1,465 last year by the increased rate of wages, and the great increase in the cost of building material.

Some classes of material have gone up considerably, and very unjustifiably, too, in the case of local products. Another item of cost is the overstaffing that the men at the Base complained of. Alterations in designs would be another item increasing the cost, not as the result of any departmental fault, but because some other Department which has a say in the work has brought about a change. Men living in Melbourne who went to work at the Naval Base were provided with tents. When I visited the Base, there were no floors to them. The Department subsequently put floors into the tents, and this obviated a great amount of sickness. The men were also provided with a cookhouse, where they dined. I understand that the Government provided the cooks and the cooking arrangements, and that the men, through a Committee, paid for the food consumed. I had a meal there which cost me 8d. Men who reside at the Naval Base with their wives and families do not enjoy the distance allowance.

204. *To Mr. Sinclair.*—I do not know of any job that has been sufficiently large to justify a contractor providing the men with a cook. The Commonwealth did it because of the large number of men employed at the Naval Base. It may be the usual practice where a job is large enough. Mr. Justice Higgins, in giving his award, was fully aware of the conditions operating at the Naval Base, and if he had thought that the rate allowed was not justifiable because cooks were provided, he would have made his award accordingly. Seeing that His Honour gave the award under conditions well known to him, if a private contractor secured a tender for work there, the men would undoubtedly look to the Government to provide in the conditions of the tender that the contractor should give them what they have been receiving at the hands of the Government. The Commonwealth were responsible for the cost of the upkeep of the cooks at the Naval Base, and I do not see how it can be put on to the men. Mr. Justice Higgins has justified the present arrangement. The cooking may cost the Commonwealth 9d. per man per day, but it is a justifiable cost. If the Commonwealth Government insert in the terms of tendering a condition by which the men will receive the rate of wages fixed by an award of the Court, plus 2s. 9d. per day, or plus 2s. per day, and the cost of cooks and the cooking arrangements, the contractor must comply with those conditions; but I take it that the conditions laid down by Mr. Justice Higgins will apply. If the Government let a small contract where it is not worth while employing a cook, I do not think that the men will be entitled to claim an extra 9d. per day in lieu of a cook. They will be entitled to the terms of Mr. Justice Higgins' award, which granted 2s. per day under certain conditions, with which His Honour was well acquainted. I do not wish to go further than the statement that His Honour's award should be observed by any contractor. Under the conditions which I have mentioned in respect to the departmental manufacture of joinery work, I think that the work can be turned out as cheaply as it could be purchased from the various wholesale firms.

205. *To Mr. Mahony.*—I have not worked in any big government works in Great Britain, but I understand that cooks are provided by the Government for men employed in their establishments. Big engineering firms provide dining-rooms as well as cooks, and attendance and so forth for the men in their employ. The provision of cooks on large jobs at a distance from the metropolis is an inducement offered to men to work away from their homes. I have no desire to discriminate between Australian workmen and workers in the Old Country, but I do say that Australian workmen are good artisans, and that the class of work they turn out is generally of a high standard. If unionists are employed by contractors, they are all members of the same union as those employed in the Government service. I do not know of any reason to discriminate between the class of work done by men employed by contractors and that done by men employed by the Government. We have found many instances in which men employed in the Government service have had to do equal work to that which a contractor would demand, or else be dismissed. In some instances, foremen on Government work have the power to dismiss men that they considered are loafing, or are incompetent. In other cases, they have to report to the supervisor in charge, or to the resident engineer, before a man can be dismissed. As a general rule, if a man is incompetent, or is a deliberate loafer, he is very quickly dismissed. I have had to work for the Government just as hard as I have had to work for a private contractor. If a contractor states that he can erect a building 30 per cent. cheaper than the Government can do it, I would not account for the difference by saying that the workmen do more work for the contractor than they would do for the Government—not to that extent by a very long way. Contractors get just the same amount of work out of men as do the Government. Men do their best for the contractor or for the Government. They do a fair day's work no matter for whom they are working. The secretary of the branch of my union at the Naval Base was dismissed, and came to me to submit his case. As a result we interviewed the Director of Works, Mr. Hill, and the matter was adjusted. No political influence was brought to bear. If a man is unjustly dealt with by a contractor, and the case is reported to me as secretary of the union, I am instructed by my executive to negotiate with the contractor with a view to having the matter adjusted. The same procedure is followed in dealing with the Government. It is futile to go to the foreman who has sacked a man. We must always go to the foreman's superior.

206. *To Senator Needham.*—I cannot say that I have found that the contractor has more pull over his men than has the supervisor in a Government Department. The duties of the foreman in either case are identical. I have not had the experience that the advantage lies with the contractor in this respect. The Public Works Department has inserted in the conditions of tendering the provision that awards of Wages Boards must be observed. When a contractor submits a tender he prepares for all eventualities such as that an increase in wages may be awarded during the period of his contract. He generally has a pretty good idea of the probabilities in that respect. I cannot say that he would not lose very much by any increase in wages; it all depends on what the increase is, but he fixes a fair average percentage over and above his actual cost to provide for any increase that may come about. It was the men who told me that the work at Flinders Naval Base was over-staffed, and that though men were dismissed the same staff was kept on. Piece-work is injurious to the employee. Past experience shows that it is beneficial to the employer. I have not seen the premium bonus system in operation. I do not know whether it is employed anywhere in Australia. It is optional to the employer to give his men an increase if he thinks they justify it. Seeing that

the piece-work system is injurious to the employee from the health point of view, the bonus system should also be injurious to him to a certain extent. My knowledge of the piece-work system leads me to oppose the introduction of the bonus system.

207. *To Mr. Laird Smith.*—I have been in Australia about ten years. There is nothing in Australia similar to the working conditions at Port Sunlight, or at Bourneville. The better the working conditions are the better the health of the workmen is, and the greater is their capacity to do their work. In our union we do not demand that a man must have been indentured. We take it for granted that a carpenter is a carpenter; but we prefer to have efficient workmen, because it lifts the standard of the organization. The rules can be made elastic enough to accept untrained men as members. There are certain classes of work for which the untrained man is suitable, and we cannot deny him the right of unionship. In our union we recognise the principle of co-operation so far as the Commonwealth is concerned—that is the underlying principle for which we are fighting—and we have no time for the man who loafs on his job. We realize that the whole fabric must fall to the ground if men do not do a fair thing when at work. I do not see that there can be any objection to the Government engineer being compelled to submit a tender side by side with private firms, if it is done with the object of securing stronger control of the supervision of a work carried out by the Department. But at the same time there should be sufficient controlling power in the Department to see that the engineer in charge of the work carries it out in a proper manner. If a contractor is not getting efficient work from his foremen, he removes them. It is quite easy for a contractor to find out within a week whether his foremen are the right men for the job, just as the foremen can find out whether the men under them are the right men for the job. I do not see any reason why, under a Commonwealth Department, there should not be similar efficiency. If there is lack of efficiency in the control of work, then the men in charge are undoubtedly unfitted for their positions, and should be removed.

208. *To Mr. Laird Smith.*—I see no reason why the engineer should not be required to submit a tender in the same way as the contractor does. The only objection that might be offered is that such a system might cause competition between the private contractors and the Department, which would be disadvantageous to the Government. I should think the departmental estimate that the market rates for building materials showed an all round advance of 48.1 per cent. from 1914 to September, 1916, would represent the minimum increase that has taken place. I am of opinion that a big saving in supervision and in the running of machinery could be effected by the four Government joinery shops, which at present are operating in Melbourne, being brought together under one roof.

209. *To the Chairman.*—I have already stated that no foreman for the Naval Base has been appointed through my organization. I think that members of the union should be appointed to those positions if they are competent for the work. A contractor would undoubtedly employ a competent union man as a foreman. I mentioned the excess of foremen at the Naval Base as one of the overhead charges which are responsible for the increased cost of the work. In my opinion a contractor would not employ as big a staff as has been employed at the Base, especially on a job on which the number of employees was decreasing. Speaking only in regard to building operatives, there seemed to me to be more foremen employed than were necessary. I cannot speak of the clerical staff. I do not think that a contractor would have retained the same staff on the job after the number of employees had commenced to decrease. The number of men whom a foremen overlooks is regulated by the nature of the job. That is a matter for the discretion of the individual contractor. I cannot see that the employment of too large an overhead staff at the Flinders Naval Base is any argument in favour of doing the work by contract. All that is indicated by that fact is a lack of control. If a job is over-staffed the head engineer is responsible. The staff employed should be in proportion to the number of men on the job.

210. *To Mr. Laird Smith.*—In my union are a number of men who are working for private contractors as foremen.

Henry Watson, Secretary of Painters' Union, and a member of the executive of the Building Trades' Federation, sworn and examined.

211. *To the Chairman.*—As a foreman painter, and also as a contractor for painting, I have had experience in the control of big works. I had two years experience as assistant inspector of painting for the North-Eastern Railway, England.

212. *To Mr. Mathews.*—From my experience I believe that men are inclined to do less work on a Government job than when they are employed by contractors. Deep seated in the men's minds is the idea that the harder they work the sooner their job will be finished. The cause of that belief is to be found in our social system, but the belief exists, and it will take a lot of shifting. It follows, therefore, that if men are not hardly driven they will not do as much work as they otherwise would. On the other hand, speeding up for the contractor undoubtedly leads to scamping, and the results obtained are by no means as good as they are under the day labour system. Painting, being a comparatively small portion of a building job, is not an operation out of which the contractor can directly save money, but painting is a very useful means of hiding up defects in other work: thus indirectly the contractor may make a considerable sum of money out of it. Under the day labour system there is not the same need for hiding up defective work. It is almost impossible for a supervisor to insure that the contractor uses proper materials if the contractor is determined not to use them. In painting, day labour insures a better class of work, and offers less opportunity for covering up defective or scamped work than does the contract system.

213. *To Mr. Sampson.*—I am entirely against piece work, even under the supervision of Government officers. Theoretically it is an excellent thing, but in practice it has usually worked out to the detriment of the workmen. There is an immediate tendency to reduce the price given for a certain quantity of labour, and the result is that the men are hard driven. The only thing that would reconcile me to piece work would be the fixing of an absolute minimum wage for piece-workers. Piece work is hardly applicable to building operations in the same way as it is to task work in manufacturing, in which there is a constant repetition of a single task. Conditions vary on every building job according to the whim of the architect, or the necessities of the contract. No two jobs are exactly alike. It would be almost impossible to have piece work in connexion with house painting, because painting is used as a

means of covering up the defects in the other work. At the Naval Base somebody may order that the ceilings of a building should be painted dark-grey, and the doors and windows white. Then somebody else comes along and says that the doors and windows should be dark-grey and the ceiling white; consequently the whole colour scheme has to be altered. Then again, a number of posts which have been prepared to be placed in the building are allowed to lie in the sun until they crack, and then the painter with laborious care has to putty up the cracks and hide all the defects of the wood. That extra expense is charged to the painter's job, although, as a matter of right, it should be charged to the wood work. For various reasons I do not think piece-work is practicable in painting.

214. *To Mr. Laird Smith.*—I think that if the Government engineer were called upon to submit a tender for each job in the same way as the contractor, he would be in exactly the same category as the contractor, and would have the same inducements for rushing and scamping in order to do the job at the minimum price. If that happened all the advantages of day labour would vanish.

215. *To the Chairman.*—Some day, by the establishment of a better social system which insures a living to every workman, men will get rid of the idea that the harder they work the sooner their job will be finished. Working under contract the workman has always been under the whip, and immediately he escapes from the whip his tendency is to slacken down. That tendency will disappear when we have a fuller use and understanding of the day-labour system, but it exists now. A man who has been driven all his life at the utmost pace will take advantage of the first opportunity for relaxing his efforts, and justly so. I am prepared to admit that the go-slow policy has gone too far, but that is because the men have not realized the meaning of their action. Some day they will realize it, and the officials of the unions will help them to do that. The fault, so far as it is a fault, is due to the conditions under which men have worked previously, and it is not incurable. I have a general knowledge of building values, and I should say that the capital cost of a suburban house, for which the rental is £1 per week, would be about £700. The warrant officers' quarters shown on the plans exhibited to me look fairly elaborate, but not excessively so for men who will be receiving £350 per annum. I do not know that I could suggest any desirable economy in the plan. At a glance the houses appear to be such as would cost about £1,000 to build in the suburbs. But there is a vast difference between a building erected by a contractor and a building erected by a Government Department on the day-labour system. I live in what was originally a four-roomed brick cottage, for which I was to pay a building society £375. That place was built at the cheapest rates with the cheapest labour. The foundations are practically all on the surface. The mortar has been slipped in without being filled up. Behind the brick walls large hollow bricks have been packed in one on top of the other. The roof was slipped up against the parapet, which is packed with hollow bricks, and offers no opportunity for proper flashing. That is an instance of a contract-built house. But in these Government cottages you get the best planning, the best material, and the best labour, and there is no need for the workmen to hurry. Their instruction is to do a good job. The foreman of my house probably said, "Get it done, or we shall not get our profit out of it." There was never a supervisor born who could make a dishonest contractor do a good job if he did not desire to. I know in connexion with the erection of a nine-story building in Melbourne a highly competent supervisor was appointed, and if his back was turned for five minutes while the concrete was being mixed the contractor used a lesser quantity of cement than the specifications provided for. It is probable that if these Government cottages were let to a contractor, and a Government supervisor were appoined to watch their erection, they would cost less than the Department now estimates, but if the privileges given to the men—such as pay for wet weather and holidays and the allowance of a more reasonable time in which to do the work—account for the extra cost, I think that cost is perfectly justified.

Bernard Andrew Mulvogue, Secretary of the Builders' Labourers' Federation, Victorian Branch, made an affirmation and was examined.

216. *To Mr. Mathews.*—I have had considerable experience in the building trade in Melbourne, and have a knowledge of many buildings, both large and small, erected under the day-labour and contract systems. My experience teaches me that the object of the contractor is to make as much money as possible out of every job, and he is able to do that in a way that no supervisor can detect. It appears to be the function of a workman under a contractor to slum his work, and the more he can save for the contractor the more secure is his job. Scamping takes place throughout a building. The specification may stipulate a certain depth of excavations for the foundations. If the supervisor or clerk of works is not on hand the labourer is expected not to carry the excavations deeper or wider than he can help. The specifications provide that the concrete shall contain stated proportions of sand, cement, and screenings, and my experience with contractors in Victoria and New South Wales is that the more sand and screenings the workman uses in the foundations the better he is liked by the employer. Similarly in regard to the cement for the bricklayers, the workman need not bother about adhering to the specified quantities if the clerk of works is not watching. That has been my experience hundreds of times, and I know that these things are expected of the workmen by the contractor. Scamping takes place in connexion with bricklaying also. The Committee has been taking evidence as to how many bricks a man can lay on a solid foundation wall. It is quite correct to say a man can lay 800 bricks per day, and that as many as 4,000 bricks a day have been laid. In fact, on the Britannia Theatre job, on which the 4,000 per day record was put up, bricks put in at that place were not laid at all. The bricks are simply thrown into the wall, a hod of compo is tipped on top of them, and all the bricklayer does is to trowel the compo in. The number of bricks that can be well laid per day depends on the class of work and the nature of the supervision. A man might easily lay 800 bricks per day under one clerk of works, but another supervisor will make him lay every brick, and point up every row as he goes along. Of course, it is much easier and quicker to point up three or four courses at a time, but some supervisors will not allow that, and necessarily the number of bricks laid per day will be less under their control. Quick brick-laying can be produced by another method. There may be eight bricklayers on a line, and the speed of the fastest is governed by the speed of the slowest. Efficiency is a consideration that is paramount to speed. If work

is being slummed, a poor bricklayer can put down as many bricks as a first-class tradesman, except of course on the corners, where a contractor always places his best man. It is not so easy to scamp the woodwork in the roof and ceilings. The brickwork and plastering represent the biggest portion of a job, and the contractor looks to the plasterer, labourer, and bricklayer for his profits. I am certain that a contractor could not have given the same class of work and material as is in the Seamen's Barracks at the Naval Base for £30,000 less than they have actually cost. Any contractor estimating that he could have done that must have been relying on getting the men to work at the Base at the minimum wage. The Commonwealth Government did secure men at the minimum wage, but only because it agreed to pay for holidays, and a certain amount of lost time, and to provide a cook. If any contractor thinks that the workmen would have gone to Flinders for the minimum wage, and without the concessions I have mentioned, he is making a great mistake. Recently a contractor at Werribee thought he would get men on those terms, but he was mistaken, and he is now paying bricklayers up to 16s. per day. The position the men take up in regard to country work is that if reasonable accommodation is provided for them they will ask for nothing further than the wage fixed by the Arbitration Court, but if such accommodation is not provided by the master builder, he must pay rates to compensate for the deficiency. We recently compelled a master builder at Corio to provide a cook, although that is not provided for by the award of the Court. The wage of builders' labourers is fixed by an award of the Federal Arbitration Court, which also provided a country allowance in excess of the city rate of pay. I am certain that a contractor could not have got workmen at Flinders Base for any wage less than the Commonwealth is paying. Builders' labourers down there are receiving 14s. per day, including a country allowance of 2s. per day, and in addition the Government provides a cook. The same labourer in Melbourne is receiving 13s. 6d. per day. If a contractor did not provide a cook and pay for wet weather, he would have to pay a higher wage during the time the men were working, so as to make the conditions equivalent to those under which the men are working for the Government. I believe that if contractors had built the Seamen's Barracks the cost to the Commonwealth might have been less. I indorse the statement of Mr. Watson that workmen who have been under the contractor's lash may ease down to some extent when they are working for the Government, but the fact must be remembered that though the contractor does the work cheaper, the purchaser does not get as good a job for his money, therefore the Commonwealth does not lose anything by day labour. The cost of £50 6s. 11d. per rod for brickwork does not seem excessive. The walls had to be pointed on both sides, and I estimate that the pointing alone would work out at £5 10s. per rod. I am sure that the Government gets full value for day labour work, even though it may cost a little more. As a foreman under the Commonwealth, I was instructed to see that the concrete, the mortar, and the plaster were mixed according to specifications, but I have never worked for a contractor who told me to be particular about adhering to the specifications.

217. *To Senator Needham.*—In regard to the criticisms of the Master Builders' Association concerning the cost of the new electric car sheds at Jolimont, and the postal stores in Spencer-street, I can say from my own observation that both buildings contain first-class work. The postal stores are, in my opinion, the best brickwork that has been done in Victoria, and the Jolimont car sheds are almost on a par with them. The last quotation I heard for bricks was £2 5s. per thousand. That price would not cover delivery on a job such as Flinders Naval Base. I know that the Northcote Brick Company even refused to pick the bricks for the Naval Base. I selected for the Department a special man to do that work, and the Government paid him 14s. per day to pick the bricks in the yards and send them to the Base. His pay must, of course, be added to the price of the bricks. If the job at Flinders Naval Base was overstaffed, the fault lies with the system which permitted two Departments to carry out the same job. The Defence Department and the Works Department were working separately at the Naval Base, and there was a duplication of officers and engineers, and a general entanglement of men right throughout the job. Probably, if the Government had carried out the whole of the operations under the control of one authority the cost of the buildings at the Base would not have been the subject of inquiry to-day. Undoubtedly there has been overlapping. There should have been only one Department in charge, and only one set of officers, instead of which there were two engineers with separate sets of officers belonging to the Defence Department and the Works Department respectively. As a union official I had occasion to visit the Naval Base at times, and I saw gangs of men working within a few feet of each other, and they were under different departments, and receiving different rates of pay. In regard to the suggestion that the Government engineer should be required to submit a tender in the same way as the contractor, I think that policy would put the engineer in competition with the contractor. Of course, the union could guard against the men being penalized, as it does now, but it could not insure the efficiency of the work. Perhaps if the engineer had to estimate alongside the contractor, he would guard against the overstaffing of a job, but I think that system would place the Government engineer in the same category as the contractor. In order to get the work he would try to tender lower than the contractor, and the consequence would be more scamping in the carrying out of the job. I know that the object of the builders is to kill the day-labour system, and to that end they met my organization in conference. I have had no experience of engineers submitting tenders in competition with private contractors, but I have worked under engineers who have told me that they made a practice of estimating the cost of their job, and the actual results worked out sometimes above and sometimes below the estimates. I believe that a man should do a fair day's work, but I also believe that every man should be paid enough to allow him to live as well as anybody else.

218. *To Mr. Sampson.*—My statement that if the Flinders Naval Base buildings had been erected by contract substantially cheaper than the cost by day labour, the Government would not have got the same class of work, is based on my experience of working for contractors and for the Commonwealth Government. As a workman I have been instructed by contractors to use certain proportions in making concrete, and the instructions were different when the clerk of works was on hand. Under the day-labour system the workmen must mix the materials according to specification, but the contractor does not expect him to be too particular. I will not say that the practice I have alluded to is general amongst contractors, but I do say that many times to my own knowledge the instructions were different in the presence of

a clerk of works from what they were in his absence. I will not say that such occurrences are the exception rather than the rule. That is not my only reason for saying that the contract system does not give as good a job as does the day-labour system. Working for a contractor, a man is required by the foreman to work at his maximum all the time, and flurried working must necessarily mean inferior results. A man cannot do brickwork in a hurry as well as if he is allowed to work at a reasonable pace.

219. *To the Chairman.*—I have never done any bricklaying. The invitation of the Committee to the unions representing the building trade was received some time ago, and considered by the various organizations. I cannot give any reason for the bricklayers not having sent a representative to give evidence before the Committee, except that the bricklayers and the masons are peculiar bodies of men. They take up the attitude that their work must stand by itself. They are convinced that the work was done satisfactorily and as cheaply as it could have been done under any other system, and they say they will not attend to offer any excuses for it. They regard giving evidence before this Committee as being equivalent to offering an apology for something that has happened, and they will not do that. They are strongly in favour of the day-labour system, and believe in ultimately eliminating the contractor altogether. I was amused when I read the evidence of one of the departmental officers in regard to the number of bricks a man can lay. There are several different bonds, and each one occupies a different time. The thickness of the wall and the quality of the work to be done are other factors to be taken into consideration. On some jobs the men are told that they must keep one colour in the wall, because the bricks are not to be painted. Then again, they are told that all joints must be struck. But if a man has merely to throw bricks into a wall he can easily lay a thousand per day. Looking at the plans of the warrant officers' cottages, I should say the brickwork—4½-inch cavity walls plastered inside—would not be dear in Melbourne if done at £10 per rod. On a three-story building in Melbourne the brickwork, pointed up ready for the inside brush, would not cost less than £11 per rod. Of course I am not alluding to the ordinary brickwork in which the bricks are just thrown into the wall; I am estimating on the assumption of first-class work. As to the contractor's statement that the average cost of brickwork is £5 to £8 per rod, it might be possible to do the work for £5 per rod on big 24-inch or 30-inch walls, into which the bricks are tipped out of a hod, but not otherwise. In connexion with the building of the Seamen's Barracks, there was a lot of pay for lost time and holidays. A contractor may claim to do work for 40s. or 50s. per rod cheaper than the cost under the day-labour system, but the conditions under which the men work must be taken into consideration. There is a lot of difference between work done under the more comfortable conditions of Government employ and the results obtained under the slave-driving methods of some private employers. When the Committee is told that work can be done for £5 per rod, it must be remembered that a labourer receives 13s. 6d. per day, and he needs to be a first-class man, and working hard, to carry 2,000 bricks per day. As to the statement that an inferior class of labour was employed at the Base, I believe that at the commencement of operations the Government made a mistake in the selection of the men, with the result that some inferior workmen were on the job for the greater portion of the time it lasted. The Department would have done better had it applied to the union officials, who know which men are competent to do the different classes of work. As far as I know all the men employed at the Base gave a fair deal. There may have been at the Base, as there are everywhere, some men who took advantage of the circumstances, but the initial mistake was in the Government not applying to the union for the men. I do not hold that conditions of employment under the Government should differ from those under private contractors, but I do say that the conditions of private employment should be brought into line with those in Government employ. I am not one who believes in Arbitration Courts and Wages Boards. Those tribunals try to determine what is a living wage before they ascertain what money a man requires to live on. But while we are working under those systems no wage below the minimum fixed by the Court or Board should be paid. We have no objection to the employer paying a higher rate than the minimum; in fact, we are making him do that now. We do not object to a contractor paying six out of a dozen men 2s. per day above the minimum, because we know that the lower paid men will be brought up to the higher level in a few days. The contractor cannot carry on under any other conditions. We know that if he regards some men as worth 2s. per day less than others he will get rid of them. I do not think that any one man is much superior to another, but some men suit one boss better than they suit another. One master builder condemned a particular workman as being no good, and I sent him to another builder who pronounced him to be a really good man.

220. *To Mr. Mathews.*—The contractors talk about the unions exercising political influence in order to keep inefficient men on the job. There is no foundation for that statement. If a contractor dismisses a man, and we think he has been penalized because of his union principles, we stop the job until his grievance is remedied. We believe in that policy, and we put it into operation only yesterday. At the Naval Base we were generally able to settle any trouble by going to the departmental officers. I do not recollect any instance in which we attempted to hold up a Government job; I always found the officers of the Works Department ready to listen to a reasonable argument. At the Base there were only two cases brought under the notice of the union, and two more complaints were made at Queenscliff. We inquired into the four of them, and I think we only asked for the reinstatement of one man. We found that the other complaints could not be substantiated. We find it necessary to take more drastic measures in dealing with the contractors than are required to get justice from the Government. I have never once approached the Minister for Home Affairs or the Minister for Works in regard to any dispute on a Federal Government job. I have always been able to settle the trouble by reference to Colonel Owen, Mr. Hill, or Mr. Mackennal.

221. *To Mr. Laird Smith.*—In preference to a Wages Board or Arbitration Court I think that the unions should organize and be strong enough to demand a fair and reasonable wage, and it should hold its members to that wage as a minimum. I do not believe in going before any Court to give evidence in support of a claim for a living wage, because, after all, the decision rests with one man who does not understand the circumstances.

222. *To Mr. Mahony.*—The workman should get the full value of the product of his labour, and he never gets it from the Arbitration Court.

223. *To Mr. Sampson.*—I believe that the union should fix the wages. No compensation is given to the contractor for holding up his job if the union finds that the workman who made the complaint is in the wrong. I do not believe that brickwork could be done at £5 per rod as stated in evidence by one of the contractors.

William Joseph Duggan, Secretary of the Building Trades' Federation and Assistant Secretary of the Plumbers' Union, sworn and examined.

224. *To Mr. Mathews.*—Having regard to the necessity for workmanship of the best quality, I do not think that plumbing can be done as satisfactorily under the contract system as under the day-labour system. Scamping of work takes place on every contract job, notwithstanding the supervision of the Inspectors of the Board of Works, who are responsible for seeing that the work conforms to the by-laws. The Caulfield Military Hospital was built by day labour, and there is not in Victoria an ironwork job that could compare favorably with it. The Cool Stores, on the other hand, were built by contract, and the poor class of work put into them can be seen by anybody. Plumbing is a work having scientific requirements, and, to be efficient, should be done regardless of cost. I can assure the Committee that it was only with extreme difficulty we were able to get plumbers to go to the Naval Base under the conditions prevailing. However, some of our men are so obsessed with the principle of day labour that they were prepared to go to the Base and put a little ginger into the job. They would not have gone there to work for a contractor under the same conditions. I have no complaint to make against the departmental officers in regard to the treatment of the men, and we, for our part, did our best to send suitable men to the job. The only complaint I have is that the Department did not give the union an opportunity of choosing the foremen. In respect of two or three persons the Department was unfortunate in appointing men who were not qualified to act as foremen. A little extra expense resulted from that fact. I believe that had the Department intrusted to us the responsibility of picking foremen the job would have turned out better. It must be remembered that whilst at one time plumbing was only a trade or calling, now, owing to the requirements in connexion with deep drainage and health generally, it has been raised to the status of a profession. I know from experience that on a contract job the men do not finish their work as thoroughly and conscientiously as they do when working under the day-labour system. When on the one hand the contractor is hurrying them in order to increase his profits, and on the other hand the supervisors of the Board of Works are making them work according to the by-laws, the men are working under difficulties.

225. *To Mr. Laird Smith.*—No members of my union are working for private employers as permanent foremen at present. The examination to be passed before one can get a plumber's licence is one of the most severe in the world. I should have no objection to an engineer submitting a tender alongside the contractors provided that a percentage preference were given to the Government officer, so that he would not be compelled to compete with the contractor who gives a different standard of work.

226. *To the Chairman.*—Most of the big contractors prefer to do the plumbing by day labour. Some of the smaller men sublet the work. I should like to mention to the Committee one aspect of the day-labour system. A strike was threatening at the Naval Base, and I went there and called a mass meeting of the men. As the meeting was likely to extend over the meal hour I asked the officer in charge to extend the meal hour, because I thought that by talking to the men I could prevent any cessation of work. He agreed to that, and within twenty minutes the trouble had been cleared up. Had that been a private job the contractor would have ordered me off the work, and a strike would have occurred, but by appealing to the men's own sentiment in favour of the day-labour system I was able to prevent any trouble. I think I have noticed at times a desire on the part of somebody in the Department to discredit the day-labour system. Certain fittings had been ordered, and four months elapsed without their being delivered on the job, but the foreman plumber could come to the city and buy those same fittings over the counter from the successful tenderer. Interference of that kind will break down any system. You may suggest that the order could have been cancelled, and the goods purchased elsewhere, but there is no elsewhere in a case like this. The contract principle is at stake, and interested parties have no compunction about injuring the Commonwealth in order to further their own policy. Much has been said about the Commonwealth providing a cook for the men at the Base. But the provision of a cook and the payment of 2s. per day as country allowance still leaves the cost to the Commonwealth 3d. short of the allowance a plumber would be entitled to if working for a contractor anywhere under the same conditions. So far from a contractor being able to do the work at Flinders Base 12½ per cent. cheaper than the Department has carried it out, I believe that the contractor's cost would have been 12½ per cent. greater. The contractor who estimates to the contrary is counting without his host. At the time of the trouble to which I referred earlier, there was a probability of the work being held up for some months, but the Government facilitated a reference to Mr Justice Higgins, and the whole trouble was settled in six weeks. Had we been dealing with a private contractor the job would have been idle for probably six months. I may say that the union officials have no sympathy with the man who loafs for the sake of loafing. We are against that policy as much as is any contractor. It is our desire that the day-labour system should be made a success. If there has been any excessive cost in connexion with the plumbing work at the Base, I can attribute it only to the conditions under which the men were working. Men were walking about the place with a ton of mud on their feet, and it is unfair to compare work done there under the old conditions with what might be done under existing conditions.

(Taken at Melbourne.)

THURSDAY, 31ST JANUARY, 1918.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

Joseph Risley Settle, Director of Naval Works, further examined.

227. *To the Chairman.*—When the Committee were at Flinders I gave certain evidence in regard to future works, but full particulars were not available at that time as to the roads, footpaths,

and other matters. I am now prepared to give fuller information, but it is not quite so complete as I had hoped owing to the fact that lately we have been working very hard. We have only partly finished the plans showing the additions in the way of roads and footpaths. I have here what we term the preliminary plan made for submission to the Naval Board for approval. It is on this plan that the estimate was based; and I have also the detailed working plans which are being prepared for the carrying out of the work approved. On these detailed plans there are slight modifications as compared with the preliminary plan, and these have been made in the light of more information obtained on the ground as to actual conditions. The preliminary plan, however, is kept as a general guide, and I have marked on the detailed plan where the slight modifications occur. These modifications have to do with the direction of various footpaths and similar matters; but if these alterations cause the estimate to be exceeded, we shall, of course, go over the matter again, and cut them out. There is no framway except the tramway from the magazine to the mining school, and thence to the jetty.

228. *To Mr. Sampson.*—The tramway will be used chiefly to bring down explosives from the magazine, and to put these and torpedoes abroad the destroyers. The tramway connects the magazine stores and torpedo shed with the jetty. I think it probable that the proposed modifications and additions may increase the amount of the estimate; but, as I say, if it does, we shall knock them out, though they are certainly necessary. Our object is not to exceed the proposed expenditure of £11,000. Of course, we shall put the money for the completion of the work on next year's estimate.

229. *To Mr. Mathews.*—I do not see why we should not spend £11,000 this year, of which there are five months yet to run.

230. *To the Chairman.*—The whole of the work with which I am now dealing is within the Base proper. It is proposed to carry out those roads only where they are coloured on the plan. There is no need to carry the roads from the barracks to the northern end of the square at the present time, because the buildings beyond the coloured roads are not going up yet. The main road is one of 24 feet. The roads will be constructed of heavy stone. We did propose 3 inches of ashes, 6 inches of spalls, and 3 inches of metal. The alternative, if we cannot get ashes, is 9 inches of spalls and 3 inches of metal above. I do not think there is any chance of getting metal down there. There are no footpaths on the roadways, of which there are about 4,000 feet within the area. The roads will not be tarred, but simply metalled, exactly in the same way as are the roads there now. It has been decided that there are not to be tramways, but that the roads are for motor traffic; and the Committee may assume that tramways will not be laid. The only tramway is that from the magazine to the jetty. I think the material for the roads will be obtained from near the city, though I do not know which quarries. I presume the material will come from the same quarries as supplied the existing roads. As to gravelling, I have inspected two places near the Base, and I think we ought to get good material there, though I have not had time to have a trial pit sunk. At the southern end of the Base there is a place where we can get ironstone gravel, but at what the depth is I do not know. I shall have a trial shaft sunk there; the place is only about 4,000 feet from the centre of the Base. There is another outcrop on the northern side of Hann's Inlet about 400 or 500 yards on the downstream side of the coaling and watering jetty.

231. *To Mr. Sampson.*—That material will be conveyed by the tramway in one case, and by cart in the case of the gravel at the south end. That gravel is only for the footpaths; the metalling for the roads on the top of the spalls will have to be crushed material.

232. *To Mr. Mathews.*—I am told that this gravel will not make good binding for the roads, though I am rather of the opinion that it ought to. It would not do for heavy work, but it ought to do for the footpaths. I am told that it is not recommended as binding material, because the weather and heavy rains disintegrate it. The footpaths shown in the newer plan will give complete access to the works already built, and those to be built in the immediate future. The drainage will be considered in connexion with the roads and footpaths. Where the sewerage is to be taken across the footpaths and roads, it will be taken across before the footpaths are made, and the drainage will be included in the cost. The total estimate for the roads is £11,000, and there is £7,000 for storm-water reticulation.

233. *To Mr. Sinclair.*—The special object of putting ashes under the metal is to form a cushion and to make the roads more elastic. Personally, I would never think of putting 3 inches of ashes, but it is the practice here. I maintain that 1 inch is enough. The ashes will be impounded in a channel so that they cannot get away. I mean by ashes, ordinary cinders.

234. *To Mr. Mathews.*—The ashes from the railway would be good for the work, but I am afraid we could not get the quantity we require from that source. My experience in regard to heavy traffic is not favorable to cinders at so great a depth as 3 inches; I prefer heavier spall. If the ashes are kept in their place it is all right, but the main difficulty is the elasticity; if the roads give way at all, cracks are opened on the surface of the metalling, and, once the water gets in, the surface is done. I have not yet estimated the cost per yard of the metal; as a matter of fact, the estimates are not completed.

235. *To Mr. Sampson.*—As to the position of the anærobic tank, to which Admiral Creswell objected as being too near the buildings, I may say that I knew nothing of the subject until I received from the Naval Board a request to make a report on the plans of the Department of Home Affairs, and the carrying out of the sewerage system. Although I have had some experience, I do not claim to be an expert sanitary engineer. I certainly believe in the whole septic treatment; that is, anærobic and ærobic. Before I made the report, I had a conversation with Admiral Creswell, and I said that if the whole septic treatment were carried out, I certainly would have no objection to the effluent going into Hann's Inlet, because there the volume of water to effluent discharge is billions to one. Even if the effluent is not so clear as engineers would like, it would be innocuous in the large volume of sea water. I further said that, seeing we have such a vast country, it appeared to me that it would be a good idea to move the tank further away from the buildings than is shown on the plans. At that time I had no idea it had already been dealt with, except tentatively by the Home Affairs Department. I suggested that, as we had such a length of sewer, it would perhaps be better not to place it where shown, but at twice the distance away, where the work would be no more expensive. I said that if the tank should prove to be not odourless, it would be on

the windward side if further away, and would give less odour. Admiral Creswell said that I had better express my opinion in writing. I think that in nine cases out of ten odour does arise from an anaerobic tank used for pumping, owing to the expansion and contraction which take place in the tank structure due to the weather. There are two small pumping stations in the centre of the Base, but the volume is small in the case of these tanks. I am not prepared to give an expert opinion on the matter, but if it were left to me, and it was a matter of expense, I would carry the work out in accordance with what I have seen in my practice in the past. The question of the odour is one to be more properly dealt with by a specialist.

236. *To the Chairman.*—There is only a small length of railway from the power-house to the workshop. The railway will be continued right into the workshop and the power-house, with a 2-ft. tramway to the torpedo shed and the magazine, and so on to the jetty. There are no tramways to the stores under this scheme; but the railway is already in for the receiving stores, and the goods will be passed over in a covered way and distributed by motor car and lorry. I do not recommend that cinders or ashes be laid below the spalls.

237. *To Mr. Mathews.*—The proposed new roads are not of the same design as the old roads, as the spalls in the old road foundation are laid on the excavated surface, without a layer of ashes. The crown of the roads is 20 feet, and that is the only metalling that will be done, with so much on either side to form a gutter. I agree with the practice of tarring roads when they are for motor traffic, but for that traffic only. Tarring does preserve roads, because the destruction that takes place is due to water. If you have an impervious surface, a road will last as long as the surface. If you cannot get that result with what is termed binding or blinding material, you must get it with some other substance, and that substance at present is tar. Tar is not necessary at the Base for ordinary road traffic. If there is to be motor traffic, then undoubtedly the roads will have to be tarred, but we do not propose to tar them at the present time.

238. *To Mr. Sinclair.*—The heavy traffic will be only to the sheds and stores. All this traffic will come by railway into the receiving store, and from there the goods will be distributed.

239. *To the Chairman.*—In carrying the sewage from the Base over to the tank, we have to go over a swamp, and for this purpose it is proposed to have cast-iron pipes on trestles.

240. *To Senator Newland.*—I have had a fair amount of experience of reinforced concrete. I do not think that reinforced concrete pipes would be any stronger than ordinary earthenware pipes for the purpose. It is a question of carrying them in case the ground gives way. If the support of the ground is taken away, and there is a weight on top, even a cast-iron pipe would crack; it all depends on the foundation under the pipes. As to whether it would be more costly to provide trestles for concrete pipes than for iron pipes, I should like to know whether the trestles are above ground. If the pipe trestles are above ground level, the saving in weight between cast-iron pipes and concrete pipes would not make any difference to the scantling for the trestles. There would, therefore, be no saving in trestles whether the pipes be in cast-iron or in concrete.

241. *To the Chairman.*—I would much prefer to have cast-iron pipes over the trestles, and I think that cast-iron pipes 15 feet long can be obtained—certainly pipes 12 feet long. As to obtaining concrete pipes of the same length, I do not know the capabilities of people here to make long homogeneous concrete piping. Concrete telegraph poles of even greater length may be made, but the material for that purpose is not so homogeneous; there are not the same provisions required in a telegraph pole as in a sewer or drain pipe. Before expressing an opinion, I should like to inquire as to what can be done in the way of concrete piping.

242. *To Mr. Mathews.*—I do not know that cement pipes have ever been used for sewage; I have no experience of that.

243. *To Senator Newland.*—There will be very little pressure in this piping. My objection to concrete piping is on the score of the extra number of trestles required, and the durability of the pipes. I should give precedence to cast iron. If, however, cast iron would last three times as long as concrete, but would cost double, I should say it would pay to put in concrete pipes. If it be said that in the case of concrete piping there is not the same liability to rust and pitting as in the case of iron piping, I point out that we do not know what disinfectants or dressings are going to be used at the hospital, or whether they would prove deleterious to concrete. Such piping would be very thin, and if by any cause the chemicals were to get through the concrete, and finally attack the reinforcement, the piping would be done at once. I think that the chemical constituents of the flow from the hospital should be looked into before anything outside cast iron is used. I would not like to say that chemicals are not more likely to affect iron than concrete, but cast iron is always used for this particular purpose. We used it at Gibraltar for exactly the same work. I have had no experience with wood pipes; but some acids or chemicals would undoubtedly affect such piping. I should like to have expert information as to what effect the disinfectants and other chemicals discharged through the sewer at the hospital would be likely to have on reinforced concrete pipes.

244. *To the Chairman.*—I have not yet taken over the control of the whole of these works at the Base, but it is in process of transfer. At present the works are in charge of Colonel Owen. The workshops and the machinery within them have not come under my supervision or inquiry yet, nor has any reference been made to me in regard to the permanent or temporary hospital at the Base. My negative reply to the latter is both correct and incorrect, in a sense; and I might explain: As the representative of the Navy, I have dealt with the position of the sites, of which there is more than one, for the hospital. On Thursday of last week I went down there with the Director of Medical Services to look at the site for the temporary hospital, in view of this becoming the permanent site, but nothing definite was arrived at. I believe a Committee went down yesterday to look into the same matter; and that is all I know about the hospital. I have had experience in connexion with other Bases of this description. It is proposed to erect detention barracks at a cost of £5,715; and detention barracks are very necessary. The Imperial authorities generally design such buildings in the light of their past experience of dealing with large bodies of men, and the average figures over a number of years, and the number of urinals, cells, and so forth are arranged and tabulated. For instance, if at Flinders it was proposed ultimately to have 5,000 men, and the authorities had had the same experience as the Imperial authorities, they would decide that a certain number—twenty-four or

thirty—of cells were required, and on that basis they would design the building. I do not know what data we have in this connexion.

245. *To Mr. Sampson.*—The number of men at Gibraltar varies according to the Fleet; there have been probably 25,000 men there at one time. At Gibraltar there are simply first class repairing shops, employing probably 4,000 men altogether. Flinders is hardly comparable with Gibraltar. The Chief Engineer's shop at Gibraltar has a floor space of 410 x 320 feet, and the structional engineer shop is the same. Then the Navy store is about 340 x 220 feet, and there are similar buildings for the staff-captains' department, the electrical department, and so forth. The 4,000 men there are all workmen. There are no seamen's barracks at Gibraltar. The only barracks are what are called two receiving ships, where the surplus men who come out are housed. As to whether there should be a brick and steel building for the workshops, or one of steel and iron, I can say that if the materials were equally easily obtainable, steel and corrugated sheeting are the best. I presume the building is designed to take a certain number of machines, but if, in a short time, an additional machine were required, it would be quite easy to knock a hole in the sheet-iron wall, and place the machine in a sort of annex. Then, when the point is reached where further development is not likely, brick walls can be erected. In such a building as I have suggested, I do not see that there would be any more discomfort in the summer time than in the winter. If we could at once decide what the requirements were for the next fifty or sixty years, I should certainly say we should build a proper building, but at present I prefer iron, because it is more easily extended.

(Taken at Melbourne.)

FRIDAY, 1ST FEBRUARY, 1918.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

George Vincent, Heating and Ventilating Engineer, sworn and examined.

246. *To the Chairman.*—I make a specialty of hot water heating mechanical ventilation and vacuum cleaning; domestic engineering. Heating with electricity does not come within my province. Electrical heating has been carried out in Melbourne only on a small scale, as by the provision, perhaps, of two or three radiators in an office. I do not know of any general system of electrical heating in Melbourne, nor do I know of any such system in Sydney; but some years ago I saw two churches in Hobart that were heated with electricity. The difference between the cost of electric heating and of hot water heating is generally regarded as fifteen times in favour of the hot water systems. That is the opinion held in the United States, where electricity is provided more cheaply than it is in Australia. My recommendation for the heating of the buildings at the Flinders Naval Base would be a circulating, low pressure hot water system. Whether a low pressure or a high pressure system should be adopted depends upon the nature of the work to be done. Sometimes it is better to provide circulation by means of forced heating; at other times it is better to employ low pressure, or gravity, heating. I have done a great deal of work with both systems, and usually choose one or the other as I think it the better for the particular building to be heated. Until about two years ago I had done all the heating work required by the Commonwealth Government since the inception of Federation. I find from the list I have prepared of heating systems carried out by my firm that at the Military College at Duntroon I carried out the heating of nineteen buildings, providing for 14,000 square feet of radiation. I carried out also the heating of the Customs House at Melbourne, the heating of the old General Post Office, and the Stamp and Note Factory at the Flinders-street extension; of the old portion of the Military Barracks on St. Kilda-road, and of the Meteorological Bureau in East Melbourne. In addition to the ordinary heating systems provided at Duntroon, there is a separate installation for a hospital, which has its own boiler. There is also an installation for the hospital at Canberra, but only for the operating theatre. I installed the heating system at the General Post Office, Hobart, and in the Telephone Exchange at Perth. The last contract with which I was connected was to provide heating for the new military head-quarters at Keswick, South Australia, buildings of the type and height of those the Committee has under consideration. Buildings in which I installed the forced hot water or pressure system are the Commonwealth Clothing Factory, the Commonwealth Offices in the Treasury Gardens, and the Harness Factory at Fitzroy. Apart from Commonwealth buildings, I have installed a heating system in the Public Instruction Department's buildings in Bridge-street, Sydney—6,000 square feet of heating by means of a forced system; and in seven separate buildings at the new Melbourne Hospital, with a total radiation of 10,700 feet. I also carried out the heating of the Commercial Travellers' Club in Melbourne, and that of the new railway station in Melbourne, the design of which was prepared by the Railway Department. In addition, I have installed heating systems in hotels, training colleges, the University of Tasmania, and other buildings throughout Australia. Except at the Central Railway Station, Melbourne, I have been responsible for the design of the installation as well as for the specifications. The work has in all cases been carried out by contract. Shortly after I started work for the Commonwealth, the departmental officers, wishing to make sure that the conditions were as fair as they could be for the Government, got me to prepare designs and full specifications, giving every detail, and a schedule of quantities. This schedule of quantities was carefully gone through by the departmental officers, and the rates scrutinized, and it formed the basis for contracts. I have seen the schedule that has been prepared in connexion with the work that the Committee has now under consideration. The Department could, undoubtedly, protect itself by that schedule if a contract were called for. It is a schedule similar to that which I customarily prepared for the Department. If any of the items were struck out or reduced, the contract price could be lowered proportionately, and if any were increased the contract price could be increased. The schedule is like a bill of quantities for a building. An engineer who was arranging a contract under it should be able to thoroughly protect the interests of the Crown. The Departments were always well protected by the very full schedules and specifications prepared in connexion with the work that I did for them. I have seen the plans of the

buildings now under discussion, and understand that it is proposed to subsequently increase the number of buildings. Without studying the matter carefully, one cannot give a definite engineering opinion regarding the scheme, but from what I have seen of the plan, I should say that one boiler house and one system of heating for the whole of the buildings, including the proposed extension, would be the best. By having one boiler house you would save expense in maintenance, because you would have but one staff; but when a boiler house is at a long distance from the furthest point to which steam has to be conveyed that is a disadvantage. I have, however, carried steam 2,000 feet from the boiler without there being much drop in temperature. In this case I understand that the furthest point from the boiler house would be 1,500 feet. At the Melbourne Hospital the greatest distance is 1,200 feet in the main piping. What has to be guarded against is the radiation of heat from the surfaces of the piping, which requires special attention as to insulation. I understand that the pipes in this case will be placed in concrete conduits, and properly lagged. I should say that it would be perfectly feasible to have the boiler house placed in the position shown on the plan, with a steam circulation from it to the hospital and to all the proposed barrack buildings. There is no difficulty in providing steam for cooking as well as for ordinary heating. For ordinary heating and the provision of hot water a pressure of 5 lbs. at the calorifiers, or points of heating, is ample. For cooking from 12 to 14 lbs. may be required. In the Melbourne Hospital scheme a 5-inch main is carried from the boilers, branches from which lead to all the blocks, and provide for the heating of the wards, the making of hot water for the baths, and for the hot and cold sterilized water supply; for the sterilizers in the operating theatres, and for the cooking plant in the kitchen. It is all a question of size of pipes and insulation. There is less radiation of heat when the pipes are underground than when they are above ground, if properly insulated. When the pipes are in proper conduits, they are more accessible underground than above ground. We use what is called red steam pipe. It is painted red to distinguish it from black iron pipe. It is heavier, and of a better quality than gas piping, and is known as best red wrought-iron steam piping. The pipes are carried away from the boilers, underground in concrete conduits, with removable covers at the expansion bends, which should be made of copper to give the necessary elasticity, and there are runners for the pipe to travel up and down so that the expansion can take place freely. At the Melbourne Hospital the pipes are lagged with mineral fibre. It is an elastic material, which is properly smoothed with a trowel and painted. It is a magnesia fibre, containing some asbestos. We usually employ a medium pressure wrought-iron steam boiler, which will carry a pressure of from 60 to 80 lbs., but will stand a test of a pressure of 100 lbs. There is the water tube boiler and the ordinary boiler in which the fire passes through the tubes. The water tube boiler is the more expensive in first cost, but is the more easily repaired, but the boiler that we usually install is the Colonial type return tubular boiler. Ninety per cent. of the boilers used are of that class. The water tube boiler is considered too expensive for this work. The consumption of coal depends largely upon the method of firing. With automatic stokers and induced draught the coal consumption may be kept down considerably. An automatic stoker regulates the supply of fuel according to the needs of the boiler, but some firemen in hand firing will use 10 per cent. more coal than others will use. I would recommend the installation of automatic stokers at the Flinders Naval Base, because of the saving in maintenance which they effect. I cannot speak with certainty, not having figures available, concerning the saving effected in fuel by the use of such a boiler as the Sterling, but I know that it is generally considered that the Colonial type of boiler is an efficient heating agent. It is used by all classes of engineers in all countries. I cannot speak off-hand regarding the relative consumption of fuel with that type of boiler and with water tube boilers. Water tube boilers are economical where you want high pressure steam, but with an installation such as I am speaking of, the ordinary return tubular boiler is equally effective. Besides, it is commonly made in this country. We have boilermakers here equal to any in the world, and get first-class workmanship. Taking everything into consideration, I say that there is no need to import a boiler for work of this kind. That remark would apply to any increase in the system. The Melbourne Hospital scheme is larger than that proposed for the Flinders Naval Base, especially in respect to the hot water supply. Furthermore, at the Melbourne Hospital hot and cold sterilized water is provided in each building, as well as steam for the sterilizers, blanket warmers, and disinfectors. It is difficult to say off-hand what is the difference between the cost of an installation now and its cost just before the war. The cost of piping is about 200 per cent. more than it was, and the cost of radiators about 80 per cent. The cost of labour, which is a big part of the cost of any installation, has not altered. It is in regard to labour and supervision that most care must be exercised. I am prepared to accept the statement that the increase in the cost of materials, taking everything all round, amounts to 33 per cent., comparing prices now with prices just before the war broke out. At the Melbourne Hospital the heating generally, including the cooking plant, cost £22,100, and I was responsible for £17,000 worth of that work. The mechanical ventilation was intrusted to me without competition, and the whole of the heating work was given to me at a schedule rate of so much per foot of radiation. The system that was put into the Melbourne Hospital was one for which I held the licence. The architect for the building, who had made a trip round the world, came back with the intention of installing that system, and without knowing his mind in the matter I, too, had come to the conclusion that it was the system most applicable to Australian conditions, and while he was away had written to secure the licence for it. The work was tendered for on what we call gravity heating and accelerated heating. My prices were lower than those of any other contractor for heating generally, and they were lowest for accelerated heating. I was given three blocks to do, and afterwards did the rest at a fixed price per square foot of radiation, with an increase, when the war broke out, to cover the rise in the price of materials. In three of the blocks the hot water system was not provided by my firm, but I did all the rest of the work. I am of opinion that the work proposed for the Flinders Naval Base buildings could be carried out for the amount set down in the schedule. But it must be remembered that there are two or three rather big items omitted from that schedule. For the hot water supply to the bathrooms at the Seamen's Barracks there is no provision in the schedule for copper piping, fittings, and labour, though on the plan it is stated that the material will be ordered.

The schedule provides for calorifiers and connexions only, but the work that I speak of will cost £650 more than is set down and must be provided for. Then no provision is made in the schedule for the tank shown with dotted lines on the blue print as to be fixed over the roof space, a 600-gallon tank to provide cold water supply for the hot water system. The cost of providing that tank would be about £60. The addition of those two items would increase the cost from £775 as shown on schedule to £1,485. Since the departmental estimate was prepared there has been a rise in the price of piping and fittings. The list price for steam piping is now plus 15 per cent., or 10 per cent. higher than when the estimate was prepared. This 10 per cent. increase in the cost of piping would make a difference of approximately £60 in connexion with the barracks, and of about £14 in connexion with the other small buildings. It would probably make a difference of £10 in connexion with the C.P.O and instructors' messroom, of which I had not the plan. In my opinion, the pipe lines are wrongly designed; both the horizontal mains in the roof space, the return mains, and the drop pipes. The design is not an economical one. What is necessary is to convey heated water to each point by the shortest route. This the design does not do, but makes the heated water take the longest possible route to the farthest point. What is needed is a divided circuit in the roof space for the floor mains with a similar divided circuit below the floor for the return mains. Those who have not closely studied heating systems are often afraid of allowing a rise in the main return pipe. In providing for the heating of the building opposite that in which the Committee is now sitting, the return pipes had to go below the asphalt floor, the boiler being above the floor, yet the circulation is free enough. With regard to the drop pipes, a loop is provided below the main return piping to supply the ground floor radiators; this will make the circulation in these radiators very sluggish, and they will not heat up properly and will be much lower in temperature than the top floor radiators. The design for the heating of the Military Head-quarters at Keswick, South Australia, was prepared by an outside expert, who wished to put the boiler 12 feet below ground. As the boiler house had been completed and the stack built, I was consulted in the matter, and asked if I would tender. When I sent in my tender I said that I estimated the cost in accordance with the design submitted, but that the work could be done for much less with a boiler above the floor and a proper pipe system. I was then asked to design and prepare specifications for a proper pipe system, and my plans and specifications were submitted to other tenderers to compete with me, but my tender was the lowest, and I carried out the work satisfactorily, with the boiler above ground. The circulation is as rapid as could reasonably be expected, and the system has been satisfactory. The boiler used is a cast-iron hot water sectional boiler. It is placed in an outbuilding, and the return pipe is below the ground in concrete conduit with a rise of 4 ft. 6 in. to the boiler. At the Flinders Naval Base return pipes which are carried at ceiling level could be carried better below the floor and the rise would be only about 18 inches. I should certainly say that the work could be carried out for less than the estimate, leaving a reasonable profit to the contractor. Installations of this kind lend themselves to expert contractors who understand the work and the reasons for everything that is done. I have not had an opportunity to go into this proposal thoroughly, but I calculate that the cost of radiation per square foot works out at 15s. 10d. The work that I did at the Melbourne Hospital without competition cost 6s. 6¼d. The pre-war price in America for similar work, having a general average throughout the States, is 4s. 6d.

247. *To Mr. Sinclair.*—Each of the sections of a radiator contains so many square feet of heating surface, and by multiplying the number of square feet in a section by the number of sections you get the number of square feet in the radiator. The radiator in the room in which we are sitting has thirteen sections, each with, perhaps, 4 square feet of heating surface, so that its radiation is 52 square feet. That amount of radiation, according to the departmental schedule, would cost £41 3s. 4d. at 15s. 10d. per foot. That, of course, allows for the piping, calorifiers, and other parts of the system necessary to the work.

248. *To Mr. Sampson.*—We get at the rough cost of an installation by ascertaining the number of radiators required. If I were asked by an architect for a rough estimate of the cost of a heating system, I should work out the radiation necessary, and, supposing that my calculation showed that 2,000 feet of radiation were required, I should put that down at, say, 6s. per foot—that would be the pre-war-time price, or £600. Before the war the standard radiator, two 38-inch columns, cost 1s. 8d. per square foot. Then there is a valve and a return union for each radiator, the cost of fixing, the piping system, the boiler and the expansion tank—the whole installation costing about 6s. per square foot of radiation for large systems. At the Duntroon Military College, if asked to estimate roughly the cost of a block, I should say that it would be about 8s. per square foot. This way of estimating the cost of an installation is similar to that of estimating the cost of erecting a building by allowing so much per rod for brickwork, so much per square yard for plastering, so much per square for flooring. It is the practice in America to estimate at per square foot of radiation.

249. *To the Chairman.*—At the Melbourne Hospital 10,657 square feet of radiation cost £3,479. Part of that work was done after the war started. At the Flinders Naval Base there is 3,952 square feet of radiation required for the barracks, which makes the cost 15s. 10d. per square foot. There are 2,520 square feet of radiation provided for in the schedule at a cost of £2,017, adding the cost of fittings, and that works out at about 15s. 10d. per square foot of radiation. Of course, prices are higher now than they were when the Melbourne Hospital installation was made. That installation was finished in the early part of 1915. The work would cost now more than 6s. 6¼d. per square foot.

250. *To Senator Newland.*—I would not recommend the use of a boiler of the Babcock and Wilcox type. Such boilers could be made in Australia, but it is questionable whether the demand would be sufficient to justify the laying down of the necessary patterns and plant. In my opinion, the estimate could be considerably reduced so far as it covers boilers, but I cannot give any definite statement, because I do not know what work the boilers will be asked to do, and therefore cannot say what horse-power is needed. If it were known what horse-power was needed, it is not stated in the schedule, a comparison could be made between the cost of an ordinary boiler and a Babcock and Wilcox boiler. In my opinion, the steam pressure in the boilers need not be more than from 60 to 80 lbs., and might, perhaps, be

reduced below that, because the highest pressure at any point of the system would be only 15 lbs., which would only be needed for cooking. The transmission of steam at a pressure of 100 lbs. would require a higher boiler pressure, a pressure of about 120 lbs. I think that a lower pressure would suffice. If automatic stokers were not installed, men in training at the Base could get practice in stoking by looking after the fires, under the supervision of the engineer. The use of mechanical stokers would prevent that. Manual stoking would increase the running costs slightly, but would reduce the first cost of the installation. It would be necessary to have two boilers, one to do the work and the other as a stand-by and as you increased the load, you would have to increase the boiler power. There would be a loss of about 15 per cent. of heat in the radiation from the piping services, unless special care were devoted to the insulation of the pipes. We generally allow 10 per cent. for pipe losses inside buildings. The loss increases with the distance the steam has to be carried, but can be reduced largely by care in insulating. In the big American central heating systems, hot water mains are laid through the streets, and hot water is supplied to houses just as cold water is supplied here. Their insulation is so good that the radiation losses are reduced to a minimum. The pipes are laid in concrete conduits, and are heavily insulated with a plastic material, and very often in addition they are covered with wood pulp. When the conduits get warmed, the radiation from the pipes is decreased. A radiator will give off more heat in a cold room than in a warm room; as the temperature of a room rises the radiation of heat from the radiator decreases. The pipe in this room which leads to the radiator has been left uncovered for the sake of cheapness and convenience. Heat would radiate from it. In many cases such piping is cased in. At the Melbourne Hospital the pipes are carried outside the walls, and are lagged, the lagging being protected from the weather with sheet-iron casing, which is painted. The pipes are brought down in the verandahs, so that they can be got at without difficulty. It is unwise to build this piping into the walls because of the expansion. In the plans before the Committee the return piping is shown inside the building, and is just below the picture rail of the Barracks Dormitory. This piping shown in the dormitory should be below the floor.

251. *To Mr. Sinclair.*—In choosing a boiler for a hot water system, you should try to get one which has the greatest area of heating surface exposed to the fire. Multiplying the number of square feet of radiation by the number of thermal units necessary to heat it, I estimate that in the winter time there would be a consumption of 22 horse-power in the boiler with only the four barracks and the small buildings, but with the extra barracks, the hospital, the cooking, and the laundry work, you would have the maximum load, and it would vary somewhat. While at luncheon time there is a big drawing off of hot water in the lavatories, that is compensated for largely by the reserve of 600 gallons of warm water in the storage tank, and by the water in the calorifiers, 150 gallons, so that the steam pressure is not so much affected. A vegetable cooker in the kitchen might require a pressure of 12 lbs. of steam, and to give that pressure at that point there would have to be a much higher pressure at the boiler, because of the loss in transmission. With a pressure of 60 lbs. in the boiler you could provide against the drop of temperature in transmission. There would be no need to have a pressure of 100 lbs. in the pipes. The Melbourne water is very soft, and iron pipes fur very rapidly when such water heated to a temperature of over 150 degrees is carried through them. It is the same with the water at Adelaide and Sydney; therefore we have to use copper pipes. In California, where iron pipes can be used, a heating system can be installed in a small cottage for about £15. There a hot water system is not regarded as a luxury. The Yan Yean water does not injure boilers very much. It does not affect boilers to the same extent as it affects piping. All its does is to cause a little scaling in the boiler. I have not had any particular experience with Cornish boilers. There is a great difference of opinion as to the amount of heating that should be provided for so much cubic measurement of space. At the Melbourne Hospital it was established that 12 square feet of radiation was sufficient to warm 1,000 cubic feet of space, but to estimate heating requirements at so much per cubic foot of space is an incorrect method. The proper method is to calculate the heat losses in the walls, windows, floors, roof, &c. You take the wall measurement and window measurements, and inside and outside temperatures, and by these and other factors arrive at your result. One building may need 15 square feet of radiation to 1,000 cubic feet of space, and another building may need only 10. A building in one position will require more than a building in another position. I have roughly checked the amount of radiation provided for in the schedule, and find that the allowance is fairly correct. In Melbourne, where the building is good, 10 square feet of radiation will usually heat 1,000 cubic feet of space, but a building like a hospital, which has a large number of windows, requires more square feet of radiation per 1,000 cubic feet. At Duntroon, where the temperature often falls below freezing point, and the cadets are housed in barracks with walls of fibrous cement, match linings and iron roof, it was necessary to provide 16 square feet of radiation per 1,000 cubic feet of space. A 20-foot radiator was put into each of the bedrooms of the cadets barracks at Duntroon without raising the temperature above 62 degrees. I could ascertain for the Committee the cost per patient, including the staff, of the heating system at the Melbourne Hospital. I know from experience that an ordinary radiator costs from 3½d. to 4d. per day for firing. That is fuel alone, without wages or any other cost. There is no more economical way of heating a building than the installation of a hot-water system. I think that at the Flinders Naval Base the pressure in the main steam pipe could, without difficulty, be reduced to 60 lbs. That would minimize the loss of heat, because the greater the steam pressure the greater the radiation from the steam main. You do not need water tube boilers for these installations; they are installed mostly where high pressures of steam, such as 200 or 300 lbs. to the square inch, are required. Boilers of a type made in Australia are quite suitable. They are cheaper than the others, and they give satisfactory results. An advantage of the Babcock and Wilcox boilers is that you can take out any tube, but a well constructed Colonial type return tubular boiler would do all that was wanted, and there would be a standby boiler to use when the working boiler was being repaired.

252. *To Mr. Mahony.*—If the lay-out of the pipe circulation were altered in the way I suggest, it would decrease the cost of the system by over £300, and would give a better and more economical service. The cost of boilers is increasing at the present time. I cannot say what it would cost

to purchase the boiler needed at the Flinders Naval Base, because I do not know what sized boiler is intended to be used. I should say that with present requirements an 80 horse-power boiler would be needed, but that is merely a guess. A Colonial boiler would be much cheaper than an imported boiler, and there would be this advantage in using one, that it could be manufactured in the country. As you suggest, it would cost considerably less than £2,250.

253. *To Senator Needham.*—I cannot say what the cost of installing an automatic stoker would be, because I do not know what the horse-power of the boiler is to be. In any case, I could not give the information offhand. Automatic stokers are driven with electric power, and would cost, with all appliances, I should think, £500. An automatic stoker reduces working expenses because it prevents the wasting of fuel. The boilers to which I have referred are maufactured in all the capital cities of Australia. Those in use at Duntroon were made in Sydney. I think they are 60 horse-power. The radiation there is 14,000 square feet, which is a great deal more than is needed at the Flinders Naval Base. At the Melbourne Hospital tenders were asked for the heating of the three blocks, A, D, and F. I submitted alternative tenders on what is called the gravity system and on what is called the accelerated system. My price for accelerated heating was cheaper than my price for gravity heating, and my price for gravity heating was less than that of the other tenderers for gravity heating, so that the work was given to me, and I did the rest of the work at the same rate per square foot. I think that the amount set down for the Flinders Naval Base installation could be reduced by having the work carried out under contract. I should be prepared to tender against the Departmental estimate. I am tendering all over Australia for work of this class.

254. *To Mr. Laird Smith.*—I should have no objection to the Commonwealth Engineer putting in a price. The Board of Works does that here, and the same thing is done in Sydney. The Constructor of Public Works in Sydney puts in a day labour price against every job constructed for the Works Department in competition with public tenders. For the fires you need clean fuel, which is generally considered to mean Newcastle coal. Victorian coal is very bad; it clogs the bars, and is wasteful. I prefer induced draught to a forced draught. At the present time I am making an induced draught fan for the Brisbane Electric Light Company. Hitherto such fans have been made abroad. This fan will be about 14 feet high and about 6 feet wide. More care is necessary in installing an induced draught than in installing a forced draught because of the hot gasses that must be dealt with, but the difficulties can be overcome. The boiler used to heat the building in which the Committee is now sitting is probably what is known as an "Ideal" boiler, a cast-iron sectional boiler, with a safety valve set at a pressure of 10 lbs. when steam is generated. The amount of heat that is got from the fuel depends on the way in which the firing is done. You get more heat from a given quantity of fuel with automatic than with hand stoking, and one hand stoker will do better than another. Sometimes the stoking is very bad. For work of the kind that we are speaking of a cast-iron sectional boiler is more economical than any other. To buy more elaborate boilers for this work is to waste money. There are other firms besides mine making hot water installations. I daresay you could get half a dozen tenders for a job of this description. It is essential that the jointing of the pipes should be perfect. When I started I employed plumbers, and then English steam fitters, but I found that the men that were needed were men with American experience. I was for two years in California many years ago, and soon found that I had to brighten myself up there to keep at work. The ordinary plumber relies too much on red lead and tow to make a joint tight, but a fitter relies on the trueness of his thread and requires proper dies, because he cannot be responsible for leaks if he cannot cut good threads. A steam fitter will do more work and better work than an ordinary plumber. When I undertook the Duntroon installation I employed at first, as the labour market was bad, a number of immigrants who called themselves pipe fitters, but I had soon to get rid of them and take capable men there from my other contracts. My contract for the Melbourne Hospital installation required me to keep it in order for two years. My contracts always carry that guarantee. If I were to carry out an installation at the Flinders Naval Base I should be willing to maintain it for two years, fair wear and tear excepted.

255. *To Mr. Sampson.*—I have said that I agree that prices have probably increased since the war to the extent of 33 per cent. all round, and another 20 per cent. would have to be added for work done in the country, because special rates have to be paid to men working on country jobs, and there are travelling expenses, freight, extra supervision, and the like to be met. I do not think that the rate per foot for any additional work would be higher than the rate for the work contemplated immediately. I would say that it would cost about 12s. per foot to install the proposed system, but that is only a guess. I do not think that the expansion of the system would increase its cost per foot. The cost would be practically the same whether you carried out the complete system now, or did a portion now and extended it to meet your requirements.

256. *To Mr. Mathews.*—The pipes used in a hot water installation are connected with thread joints. They are screwed into sockets. Lead is not used for jointing. You rely for the perfection of the joint on the fit of the thread. A junction or elbow or bend is carried out in the same way as a connexion between two straight pipes. Hemp and red lead are used where a thread is cut, but a good workman will never put a bad thread into a socket because of the risk of leakage. I would dismiss a man sooner for making a bad thread than for loafing, because leaks cause us a great deal of trouble and expense. Sometimes a leak costs as much as £10 to repair, as occasionally we have to make good plastering and painting as well. In the interests of his reputation a contractor has to supervise very carefully to prevent leaks.

257. *To the Chairman.*—If tenders were called for the proposed work on a schedule basis, I should be prepared to tender on that basis, and if I secured the contract, would keep the work in order for two years after completion.

258. *To Mr. Laird Smith.*—A big drop in pressure would not have the same effect in a heating installation as in a sawmill or other place in which machinery was used. In a mill you might require a pressure of 40 lbs. at the end of a pipe, but we need a pressure of only 12 lbs. at most. A steam mangle might require a pressure of 10 or 12 lbs., and a similar pressure would be needed for cooking vessels. At Mont Park they have put in a boiler carrying only 10 lbs. of steam, to provide both for

cooking and heating. The ventilation of kitchens is very difficult at times, because of the escape of steam from badly designed cooking vessels. We often reduce the pressure of steam from 20 to 10 lbs., and although the cooks say they must have a higher pressure they do not notice any difference when the lower pressure is all that they get.

259. *To the Chairman.*—A calorifier is a cylinder in which there is a coil of copper piping through which steam passes to warm the water contained in the calorifier. The coil may be vertical or spiral, or a Pemberthy injector may be used.

(Taken at Melbourne.)

TUESDAY, 5TH FEBRUARY, 1918.

Present:

Mr. GREGORY, Chairman;

Senator Henderson	Mr. Sampson,
Senator Needham,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.
Mr. Mathews.	

Engineer Rear-Admiral William Clarkson, C.M.G., Third Naval Member of the Naval Board, sworn and examined.

260. *To the Chairman.*—In connexion with the erection of the large workshop at Flinders I told the Committee on a previous occasion that, if I could not get a steel and iron structure, any sort of temporary building would do. It will not be necessary to have the walls 46 feet high in a temporary building. My idea is to get something done, and as the erection of a permanent building is apparently impracticable, it is better to put up any sort of building of any material that may be available in order that the machinery may be housed, and so that we may get on with the work which will be absolutely necessary at the Base as soon as we are in occupation there. If a building of a permanent character is erected the walls must be 46 feet high. My evidence in regard to that point has already been given. The matter has been gone into thoroughly on many occasions, and I believe that the Committee has been perfectly assured that it is necessary to have the walls that high in a permanent building. The workshop should be available when the establishment is removed from Williamstown to Westernport. I am still of opinion that steel and iron are essential for the permanent building. I recognise that the difficulties of obtaining that class of materials render it impracticable to use them now, but directly those difficulties are removed the permanent building of steel and iron should be commenced. Any building put up now will simply be required as a protection for the machinery and the men working on the machines, the idea being to pull it down at the first opportunity in order to allow a proper building to be erected. I prefer to adopt that method rather than to be given a permanent brick building at the present time. The question of the armourer's workshop was referred to a committee of officers of the depôt. They settled the details. I did not interfere. It seems extraordinary to me, however, that the estimate for the cost of the building should have been increased to £1,707. It has not come under my notice. The design of the buildings at the Base is not a matter that comes under my control. My control commences when the building is a going concern. Of course, as a member of the Naval Board, questions of general policy and general lay-out, which come before the Board for general approval, come under my notice, but the details are left to Admiral Creswell, the first Naval member, who has charge of the Works Branch. It seems a lot of money to spend £5,700 on a detention house, but you cannot wonder at the cost of anything nowadays. Everything costs a tremendous lot of money. It would seem to me from the plan of the detention house that the provision made will eventually be necessary when we get between 2,000 and 3,000 men at the Base, but personally I would not build more than will meet present requirements. Considerably less accommodation, in fact half of the full scheme, might do for the present. I am responsible for the electrical installation. It has been decided to install a direct current system with a voltage of 460 to 230. I do not think that an estimate which says that £6,000 could be saved in the wiring alone by installing the alternating current system, instead of the direct current, is altogether reliable. However, the lighting of the Base is not the principal thing to be considered. The alternating current system cannot be installed for the simple reason that it is a submarine base, and direct current is absolutely essential for submarines. We cannot charge the batteries on submarines with alternating current. Furthermore, at times we shall require all the current we can produce there for submarines or for the plant. There are many other reasons why the alternating current system should not be adopted at the Base. For one thing it is to be a training establishment for seamen. You never find alternating current on board ships except in connexion with very small installations for wireless. The men who are trained at the Base will go on board ships and take up their duties there by virtue of their training on shore. Therefore, it is very necessary that we should have the same current at the Base as we have on board ships. Again, the current is to be used for the workshops, and it is almost universally recognised—in the Navy at any rate—that direct current is more suitable in every way. There is not a single naval dockyard that I know of—and I have been to most of them—there is none in England at any rate, with the alternating current; it is all direct current. There is also danger attaching to a high voltage alternating current where there is a large number of men, all of them supposed to have some elementary knowledge, and some of them with expert knowledge of electricity. They will certainly be interfering, thinking they know what they do not, and the probability is that there would be many accidents. The main reason for installing the direct current system is that this is to be a submarine base. In all probability, we will have a number of submarines there almost immediately after the war. Not only will the batteries on the submarines require to be charged, but also there will be a great number of spare batteries in store, and if you once charge a battery you have to keep it charged, and direct current is an essential for charging batteries. In order to transform an alternating current into a direct current, we would need to provide transformers and no end of gear, so that the £6,000 saving on wiring—which I do not for one moment admit—would disappear very quickly. There would be a continual loss of voltage in transformation. By installing the alternating current a saving might be effected in regard to the wiring—undoubtedly it would be—but that saving would only be effected on the outside wires. The inside wiring is just the same for the direct current as for the alternating current. But in addition to the actual wiring, transformer stations would be necessary. Before you could take the alternating current wires into a

building, it would have to be stepped down in order that the voltage might be made safe enough inside the building. With an alternating current of a high voltage, there is always a liability to short circuits and blow-outs. I think that it is out of question to install the alternating current, and taking everything into consideration I think it would be more expensive. It has been proposed to light a jetty at Stony Point, but I have strongly opposed the idea. The wires must be taken underground, because there will be an aviation school at the Base. You cannot have overhead wires where there are aeroplanes. There must be an aviation school there. We have taken steps to bring out an expert to advise us in regard to the business. He will be here very shortly. The place has already been spoilt, to a certain extent, by the erection of towers of Babel. Our idea was to keep all the buildings low on account of the aviation school, and it is altogether against our proposals to have three-storey buildings. We opposed them very strongly. The place has already been sufficiently spoilt. I hope that it will not be spoilt any further by putting up overhead wires all over the place. We have always had the idea that there would be an aviation school at the Base. That is why we laid out a huge parade ground. These things are not made public as a rule. There is a complete scheme for the Base. It has been considered in all its bearings. The machinery for the workshop has not all been ordered. We have kept back several orders until the matter of the class of building to be erected should be decided. For the present it is only proposed to shift the machines which we have at Williamstown. There may be one or two more ordered, but no great quantity of machinery has actually been ordered. I state my requirements to the Works Department, and they carry them out; at least they do sometimes; generally they do not. A temporary workshop would be more satisfactory to me rather than a permanent brick establishment.

261. *To Mr. Sinclair.*—The site of the workshop was settled by me six years ago. I do not propose a temporary building now with a view to removing later on to some other site. My idea is to pull down the temporary building, making use of the material in some other way, and to rebuild on the same site. If brick is about as cheap a material as can be got at the present time, I do not mind a brick temporary structure being put up, because bricks can be pulled down just as easily as any other material, but when once a place is built of brick it looks so solid that people do not like the idea of pulling it down again. I am absolutely against brick as a material for a permanent workshop. There are plenty of boilers on the market which should be quite satisfactory for the purpose of heating the houses at the Base. They could not be used for training stokers. The class of boiler required for the purpose of heating houses is one which can be filled up once or twice a day and looks after itself for the remainder of the time. This class is largely employed in America. Any proposal to install two Babcock and Wilcox boilers for this purpose is ridiculous. The usual practice in America is for one man to contract to look after many houses. He fills up the boilers once or twice a day, and that is all the attention they require. They cost very little. But I do not see that very much heating will be required in the buildings at the Base. Open fireplaces should be sufficient. It is absurd to talk of having two water tube boilers costing £2,500. There is next to no pressure required on these simple little boilers that I speak of. They work on a circulation system. The hot water rises, and when it gets cool it comes back to the boiler again, and is heated once more. It is a ridiculous proposition to talk of steam pipes carrying a pressure of 100 lbs. for heating purposes.

262. *To Senator Needham.*—A man who learns the direct current system does not learn the alternating current system. The gear used in the two systems is different. What is suitable for a direct current with 460 or 230 volts is not at all suitable for the other system. There is no reason why we should not bury the lead cables. The undergrounding system should be carried out very cheaply, and the cost of maintenance should be very light. Once the wires are down they will stay down. In the event of a fault it only means digging down to the fault, but there should be no faults if the wires are properly put down. In Melbourne the other day I saw men putting down some mains in Toorak-road. They simply dug a trench and put down lead covered cables, and where the ground was damp they laid the cables in wood boxes, into which they poured bitumen. The cables for the electrification of the Melbourne suburban railways are simply put in a trench and covered over. If the material could be secured now, of course, it would be better to go on with the erection of a permanent workshop of iron and steel.

263. *To Mr. Laird Smith.*—I do not think that electrolysis will set up if the cables are simply laid in the sand. It is quite a common practice to underground lead covered cables in Melbourne. I speak of electric lighting cables. When once a battery cell is charged it cannot be left without current in it, else the grids, which are filled with lead paste, will go to pieces, and the stuff will tumble out of them. Once you put a current through a cell and charge the plates they cannot be allowed to discharge, which they will do in time if left alone even without drawing the current off; the cell must be topped up. You must be careful that you do not overcharge it, or that you do not let it run down too far. If you overcharge it the plate will buckle. If you let it run down too low the stuff will all drop out. I do not say that the cells should be continuously connected with a dynamo. I simply say that they must be kept charged. It is much better to use them to a little extent, that is, to take a little current out of them and put it back again; they keep in better order in that way than if they are simply left standing or are just topped up when the current leaks out. It does not take very long for the current to leak away, and if that should happen the battery is to a great extent spoilt. You must take a little out and replace it all the time in order to keep the batteries in good working order. A small dynamo would charge an enormous number of cells, but it all depends on how you use the current. The cells that will be in the store at the Base can be employed to light a few of the buildings, or all of them, if we had sufficient of them. We will require the direct current for charging the cells in the submarines. They will be using them every day. They will go out each day practising, and when they come back at night they will need to be recharged. In all probability, at certain periods of the day, in connexion with submarine work, we shall need all the current we are providing for, that is 3,250 kilowatts. When the lighting load is not on we shall require the current for the submarines and for power purposes in the shops. I am sure that we will get a direct current effective at the distance of $1\frac{1}{4}$ miles from the power station. It is all a question of the size of the copper conductor. The Melbourne City electric supply is a direct current system. I have had experience of alternating current motors. I know that they run

very smoothly, but there are a great many difficulties with them. The question was raised in America as to whether we should install the alternating or the direct current in the Small Arms Factory at Lithgow. I went through many of the factories where the alternating current was installed, and I was strongly advised not to put it in. The motors were perpetually going wrong, short circuiting and so on. On the other hand, I have known motors in the direct current system to run for years without giving trouble with the brushes. No person could safely come into contact with a current of 460 volts on a direct current system, but I maintain that the alternating current system is much more dangerous. Very great experience is necessary to prevent short circuiting in the case of an alternating system with a high voltage. The direct current system is very much more easily insulated. Extraordinary insulation is required for a high voltage, and at the present time it is rather difficult to get insulating material. I have had considerable experience all over the world, and I have looked into these matters carefully. The British Admiralty absolutely discarded the alternating current for their factories. I have been in hundreds of shops in Great Britain. They will not look at the alternating current. That is fairly good evidence. In addition, we do not have the alternating current on board ships, and it is our desire to familiarize our men with the conditions they will meet on board ship. I agree that a very large scheme like the Tasmanian should have the alternating current, but in our little bit of a tin-pot place why seek to complicate matters in order to save an original cost of a few thousands pounds, which I do not admit will be done, because transformers and all the gear that will have to be installed, and the increased working expenses, will cover that saving ten times over. We do not wish to train our men as electrical engineers. We have an electrical engineer, Mr. Cresswell, the Director of Wireless.

264. *To Mr. Sampson.*—At some period during the twenty-four hours we shall require the whole of the power for workshops and submarines, and that will render it impossible to divide the system, by having direct current for power purposes and an alternating current for lighting purposes. Any class of building will do for a temporary workshop that will prevent the weather from getting at the machines, and will provide shelter for the workmen. The price of tiles is abnormally high. We must just put up with the inconvenience of having a temporary building until things improve. It will not be long before the war is over, and then we should be able to get a permanent building under way. Until we can start straight away on the permanent building and have everything up-to-date, I would put up anything, even a slab building, if necessary, in order to house the machinery and protect the men from the weather. I would not proceed at present with the framework that would be required for the permanent steel structure, because we cannot get the steel for the stanchions. The other day I had to run a dragnet over the country in order to get sufficient material to put up transporters for coal at Port Pirie. If necessary some of the buildings now at Williamstown could be transferred. Any kind of cheap wooden cover will do. Until the permanent building is erected we propose to carry on the work now done at Williamstown, letting the private firms do the heavy class of work.

265. *To Mr. Mathews.*—It is certainly necessary for the efficiency of the Navy to remove from Williamstown as quickly as possible. The transfer should have taken place years ago, and would have taken place if we had not been saddled with that awful Department of Home Affairs, which has always blocked everything, and apparently is continuing to do so. We calculate on having about 2,000 men at Flinders eventually; it all depends on the ships we shall have to provide for. However, things are very much in the air at present. If everything is serene after the war, and there is no chance of further complication the service may be reduced, but, as I think will happen, there may be a great many complications, and the service will probably have to be increased. We should make provision as soon as possible for at least 2,000 men there. We cannot be too quick about it. The present proposal is to have 680 men and petty officers there. That is a greater establishment than there is at Williamstown now, but you see so many of our ships are away now. There will be a big demand for submarines. They will be one of the principal protection for Port Phillip

266. *To the Chairman.*—I recommend laying down lead cables in trenches. I hardly think wooden boxes filled with bitumen are necessary, but if there should be any danger from white ants they should be employed. I prefer a cheap system of undergrounding the cables. I would not have overhead wiring in any circumstances, because there will be an aviation school at the Base, and, furthermore, they are very unsightly, and may be in the way of men drilling. The telephone and fire alarm wires would also need to be put underground for the same reason. We cannot have any overhead wires at the Base.

(Taken at Melbourne.)

WEDNESDAY, 6TH FEBRUARY, 1918.

Present:

Mr. GREGORY, Chairman.

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

Arthur Peck, Architect, F.R.V.I.A., Acting President of the Royal Victorian Institute of Architects, sworn and examined.

267. *To the Chairman.*—I have been practising my profession in Melbourne for forty years, having commenced in the year 1878. I have designed buildings for erection in many places throughout Victoria, and also in New South Wales and Tasmania. During my career I have had but little to do with Government work. Plans and specifications, and a schedule of quantities relating to proposed buildings at the Flinders Naval Base have been left with me, and during one evening and one morning I went through them carefully, and am now prepared to express an opinion concerning them. I regard the plan as a nice, compact little design to provide a residence for men of the rank for whom the buildings are intended. There is nothing extravagant in the design, though I should prefer a roof with a steeper pitch. The pitch arranged for is one of only 25 degrees, and for tiled roofs a pitch of 30 degrees is needed. A heavy fall of snow would make a flat-pitched roof collapse like a pack of cards. I know the Flinders district well, owning land there, and as a yachtsman I am well acquainted with Westernport. I notice that the Government estimates that the brick work for the proposed building will cost £30 12s. per rod, but I should put down £24 per rod for brick work, making up the cost in this way: 4,000 bricks at 45s. per 1,000 at the kiln, £9;

freight and cartage, 30s. per 1,000—a very liberal allowance—£6; five bags of lime, 32s. 6d.; cement, 4s.; four loads of sand, at 8s. a load, at which it ought to be obtained in that locality, 32s.; and labour, £6. In Melbourne the laying of a rod of brick work would cost about £4 10s. The detailed amounts that I have given total £23 18s. 6d. For the concrete work the departmental estimate is 45s. per cubic yard, but I would allow only 41s., putting down 16s. for three-quarters of a barrel of cement, 12s. for metal screenings, 6s. for sand, and 7s. for labour. As to tiles, the departmental estimate is 29 squares of tiles. I have checked a number of the quantities furnished to me, and have found them to be correct, and I assume the rest to be so. There are 130 tiles in a square, and they would cost £2 1s. For freight I allow 9s., for labour 12s., though it is not worth more than 10s., and for battens 8s.; that is 70s. for each square, or £101 10s. for the roof. As for the painting, we architects have no time to measure up every yard of surface, but from my general experience I should allow £50 to cover painting. I do not think that the painting would cost so much. For contingencies I have put down £45, and over and above I have allowed for sundry plumbing £15, for sundry carpentering £20, for sundry brickwork £10, and as profit £105, making a total cost of the building £1,156 19s. If you were to advertise for tenders for the work you would find that you would get it done for that sum, though, as you know, tenders vary, and some of the tenders might be as high as £1,300 or £1,400. A little while ago, when I advertised for tenders for a building in the Western District, the lowest tender I got was £4,500, and the highest as much as £6,500. We always allow 4,000 bricks to a rod of brickwork, to be on the safe side. One thousand bricks is equivalent to 3½ tons. I am confident that I could get a contractor to tender for the work at a sum very near to my estimate, and possibly below it. I regard the estimate of £14 17s. 2d. for labour per rod of brickwork as absurd. A man should lay from 800 to 1,000 bricks a day working on a small villa, and, if building a thick wall, should lay more. If the labour for the brickwork of the seamen's barracks cost £15 6s. 11d. per rod, that was not a fair charge. Melbourne builders would make fortunes in no time if given such rates. As to prices before the war and now, I may mention that I have just let a contract for a building for Messrs. Sands and McDougall, the steel work in which will cost about £2,000. Probably before the war that steel work would not have cost more than £1,000. Bricks have gone up in price a few shillings per 1,000 since the war, and I think that bricklayers are now getting 1s. a day more than they were getting. Averaging everything, I should think that the increase in building costs is from 15 to 20 per cent. for ordinary buildings. But the increase in the price of steel is 100 per cent.; white lead is now practically £80 a ton, and galvanized iron is anything from £56 to £70 a ton. It is customary, when a builder signs a contract, for him to take the risk of alteration in prices. The builder of Lister House told me yesterday that, owing to the rise in prices and wages, he was a considerable loser on that contract. The conditions of contract adopted by the Royal Victorian Institute of Architects do not make any allowance for alterations in the rates of wages while the work is in progress.

268. *To Mr. Mahony.*—I was furnished with specifications for the proposed building, but they were not necessary for my purpose, as I was given also a schedule of quantities. A builder when preparing to tender for a contract may glance at the plans, but does not generally want to see the specifications. What he desires is a schedule of quantities.

269. *To Senator Needham.*—I am of opinion that the building that we are now considering should be constructed for £1,156 instead of £1,450, which I understand to be the Government estimate, and I believe that builders would be prepared to tender for the work at that price, taking the risk of any increase in the price of materials and any alteration in the rates of wages. I do not know of any contractor for a Government job having received £4,000 as compensation for an increase in the price of the material due to the war, and am surprised to hear that such compensation has been given. The contractor in question was very lucky. I think that bricklaying of the kind required in the specifications for this building, that is, ordinary 11-inch hollow walls, and 4½-inch interior walls, struck work, with no tuck pointing, should be done for £6 per rod of 4,000 bricks. I think, too, that £50 would more than cover the cost of three or four coats of paint, including both material and labour. The design is a good one for the saving of up-keep. The only external painting to be done is the doors, windows, and the eaves. The design is an economical one from the point of view of up-keep.

270. *To Mr. Laird Smith.*—I think that I have been furnished with sufficient data to enable me to correctly estimate the cost of the proposed building. I may, perhaps, not have allowed enough for cartage, knowing nothing about the local conditions.

271. *To the Chairman.*—If the site of the building is within 300 yards of a railway station, I have made an ample allowance for cartage, and if water would cost 10s. per 1,000 gallons, its cost would not amount to much on the whole work.

272. *To Mr. Laird Smith.*—A man who could lay only from 450 to 500 bricks per day on solid work such as foundations, and only from 280 to 350 a day in a hollow wall, would be kicked off any building in Melbourne. It is not my experience that in the city here the average number of bricks laid per day is only 600. At the very least from 800 to 1,000 bricks are laid per day in ordinary work. With a thick wall—a wall 1 ft. 10½ in. or 2ft. 3 in. thick—more bricks could be laid. An estimate of £15 10s. per rod of brickwork for labour only is excessive. The erection of a number of buildings at the same time would slightly reduce the cost of each. There might be a saving of £25 on each building.

273. *To Mr. Sampson.*—I had one upleasant experience of the day-labour system. I called for tenders for an eight-roomed brick building to be erected at Balaclava, and the lowest tender received was for £840. My father was going to put up the building, and I said to him that the work could be done more cheaply by day labour and subletting. Actually, however, it cost £960, or £120 more than it would have cost had I accepted the lowest tender; and that, although we were living within 100 yards of the place, and I bought all the materials in the cheapest market, and he got the trade discounts. Very often, for small jobs costing about £100, we prefer to employ men by day work instead of letting contracts. Sometimes we get better work done by day labour, though I have had bad work done under that system. Everything depends on the class of tradesmen employed. Contractors sometimes by hurrying their men too much prevent good work from being done. It is for the architect to see that the builder does not allow the work to be slummed. I have no difficulty in getting contractors to comply with the

specifications, because I pick my men, and I think it is the general experience of architects that builders carry out their contracts straightforwardly. There is always a chance that mortar and concrete may not be properly mixed. Sometimes a labourer will try to save his boss a cask of cement by altering the proportions of concrete. Therefore it is necessary to supervise the mixing of concrete. As for mortar, a good judge can generally tell at a glance whether it has been properly mixed. If I were a builder who had contracted to erect the work in question, I should visit it two or three times a week. If the work were being carried out with day labour, it would be necessary to have an inspector there all the time, which would increase its cost. A contractor would make an inspection two or three times a week. When concrete is being mixed, there should be a man constantly in attendance to watch the process. In all probability the concrete for the foundations of a building like that under discussion could be put in in a day or in two days at the outside. As to the mixing of mortar, one can form a good judgment by looking at the heap, or by examining the mortar when it is being laid. Of course, the only correct way to test the quality of mortar is to analyze it. Many years ago a building was blown up in Brunswick-street by a man who tried to destroy it by fire, and was killed. Subsequently, the owner, finding that jerry work had been put into the construction, commenced a law suit. I was called in as an expert, and we got Mr. Dunn, the Government Analyst, to analyze the mortar. He found, if I remember rightly, that it contained 10 parts of sand to 1 of lime. But you can get a good idea of the quality of mortar by looking at it, and examining it in your hand. With an inspector on the site all the time, if half-a-dozen buildings or more were being erected under contract, the Government would get practically as good work as if they were being built with day labour. With day work there is an inspector present all the time, or there should be, to see that the men do not loaf. Under the contract system there is an inspection, perhaps, only three times a week, and little, unimportant things may be slummed without detection. If half-a-dozen buildings were being erected at the one time, it might be advisable to have a clerk of works present on the site continually, and then the work should be quite as well done under the contract system as day labour.

274. *To Mr. Mathews.*—I believe that an agreement was come to between the contractors' association and the bricklayers that the laying of 800 bricks a day should be considered a fair day's work. My price per rod of brickwork does not include wall ties. I have allowed for the building in of the window frames and doors, but the £6 put down for labour merely covers the laying of bricks, the bedding of them in the mortar, and the striking of the joints. A bricklayer at the Base would get 16s. a day, and, laying 800 per day, would lay a rod, or 4,000 bricks, in five days, which would make his wages for that work come to £4. One labourer would keep two bricklayers going, and his wages would be 13s, or, possibly, 14s. a day; I cannot be positive to a shilling. A builder would not be prepared to pay men for time during which they were not working because of rain or holidays, nor would he provide a cook. Every man employed, except, perhaps, the plumbers, would have to pay for his own board. I understand that the Government has made all sorts of provision for the comfort of the men which a contractor would not make, but I think that a contractor could obtain efficient men for work at the Base more cheaply than the Government. I do not say that the best men could be got, because there is always enough work in the city and suburbs to keep the best men going. Recently when a big wool shed was being erected to my design in the Western District, the contractor put up tents for the men employed on it, but they cooked their own food. I do not know of contractors paying men employed at a distance from Melbourne an extra allowance for cooking, or providing cooks, but I should not be surprised to hear that that has been done in these days of uncertainty in the labour world. If board and residence had to be provided at Flinders for bricklayers, the bricklaying could not be done for £6 per rod. At the present time there is a scarcity of labour, and possibly you could not get many men to go to Flinders, but I do not think that private contractors would have the same difficulties in getting men that the Government have. They could get men more cheaply. If the same conditions had to be provided that I understand the Government have provided, my estimate would have to be increased accordingly. No private contractor would pay men for time during which they were unemployed owing to wet weather. Although under present conditions it might not be easy to get men to go to Flinders, a contractor could get men for work there directly the labour market was a little better supplied. I have often had to make contractors take out slummed work. That has often to be done when an owner has insisted upon accepting, against the advice of his architect, the lowest tender that has been sent in, especially if that tender has not been a fair one. I would not visit a building under construction for the Flinders Naval Base more than once a week if I were the architect for it. By doing that, I could see that all the specifications were being complied with, barring the mixing of the concrete, which would have to be specially supervised. Were I to be made responsible for the erection of a building such as this, I should not accept a contract from any builder whom I did not know well, or who was not provided with a reference from a well-known architect. A tender that was considerably under what I considered the fair value of the work I would not accept, because I should feel certain that the tenderer would not be able to carry out the work properly for the amount for which he had tendered.

275. *To Senator Newland.*—The rates of wages on which I frame my estimate are these: Carpenters, 14s. a day; plumbers, 15s. a day and board; bricklayers, 16s. a day; plasterers, 15s. a day; and labourers, 13s. a day. I may be a bit low in the case of labourers.

276. *To Mr. Mathews.*—Carpenters might get 1s. a day more than the sum I have put down.

277. *To Senator Newland.*—Although those rates may be below the Government estimate, making all allowances, private contractors would get work done for them. If the rates were at least 1s. 6d. per day higher than I have provided for, it would not considerably affect my estimate of cost, because of the sum I have allowed for contingencies. I do not think that the increase in the price of labour and materials in the building trade has been as much as from 30 to 37 per cent. during the last three years; I put that increase at about 20 per cent. I am certain that men do not do as much work now as they did a few years ago. They are undoubtedly slowing down. Recently a builder who was putting up a villa for me said that he only just about came out square, and he accounted for that fact by the slowing down of the men. Better supervision might minimize this slowing down, but a great deal would depend on the inspectors employed. Although, as I have

said, were I the architect responsible for the erection of the building under discussion, I would visit it only once a week, it must not be forgotten that under me would be the contractor, whose interest it would be to see that the men did not slow down. He would do much the same work as a Government inspector under the day-labour system would do. Had such a builder a number of contracts at Flinders, he would probably visit the jobs once or twice a week, and take care to employ a competent foreman whom he could trust, to prevent any slowing down.

278. *To Mr. Sinclair.*—My estimate of the cost of brickwork at the Base, namely, £24 per rod, comes to £6 per 1,000 bricks. As for the £11 10s. put down for the kitchen range, I know that what would be required would be a one-fire stove such as the IXL or the Andrews, of which I have put in scores. They are practically the same, and cost the same. The excavation work should be done for the amount of my estimate, and material not used for filling should be spread between the brick walls to make the ground under the floors higher than the outside ground, thus preventing water from lodging under the building. Half of the jerry-built houses have depressions beneath them which fill with water in the wet weather, and the dampness causes tubercular trouble to the residents. It would not cost anything to get rid of the material excavated from the trenches for the foundations of the proposed building. Even at from 3s. to 5s. per cubic yard the excavation would not come to much, because the quantity to be excavated is small. I think that from 2s. 6d. to 3s. is a fair estimate for excavation. I have put down £5 to cover the insurance premium for an accident and fire policy, but I had not time to ascertain exactly what the premium would be; it might cost, perhaps, a couple of pounds more, though I do not think so. Doors cost about 26s. each, but, in addition, there are the casings and the double sets of architraves. The Government takes out these separately, but in private practice we deal with them in the lump. Therefore, I have put down eight doors at 50s. I think that I have included in my estimate the cost of ties for hollow walls. They should not cost more than from £5 to £7, including the longitudinal binding of hoop-iron. For ties we are using now what is called bricktor, a sort of galvanized mesh. As I had not time to take out every item, I have allowed extra amounts for various trades which are practically contingency amounts. The cement I have reckoned at from 2s. to 2s. 3d. per square yard, taking the Government estimate of quantity.

279. *To Senator Needham.*—In estimating the cost of laying bricks at £6 per rod, I have allowed nothing for architect's fees or clerk of work's charges, or other overhead charges. Supervision would be extra. There is nothing in the departmental estimate to cover the overhead charges. A building such as that under consideration should be erected in from four to six months, according to weather and other circumstances. If a number of buildings were being erected at the same time, the contractor would employ a larger staff of men. Probably the best thing to do would be to get two buildings put up by one builder and two by another. A big Melbourne contractor might charge more for the erection of a number of these buildings than you could get them done separately for by smaller men.

280. *To Mr. Laird Smith.*—I am certain that the departmental officers would not get this work done for less than I have estimated. Contractors are very touchy, and I do not think that they would care to have a departmental tender put in against theirs. Nowadays you must prepare a schedule of quantities for every building which is likely to cost more than £2,500. Architects have the quantities taken out in order to get an idea of the probable cost of a building before calling for tenders. I am of opinion that a man should lay 800 bricks as a fair day's work.

281. *To the Chairman.*—Contractors if they are men of standing have scaffolding, concrete mixers, and other plant which they send to the country when they have work to do there. If there were ten villas to be erected at the Flinders Naval Base, you might call for alternative tenders for the construction of two villas, or of the whole ten. A contractor, as a rule, employs a good foreman carpenter, to whom he pays 1s., or even 2s., a day extra to supervise. As for overhead charges amounting to over 20 per cent. of the cost of work, I can only say that what private architects get is a commission of 5 per cent. and the contractor's charges do not approach 20 per cent. I do not think that any private contractor would provide for his men the conditions which I understand that the Government has provided at Flinders, and I cannot see any reason why the men employed there should receive concessions which workmen in other places do not get. I supervised the erection of a £2,000 house near Woodend for Dr. Caddy. He allowed the men the use of an old cottage, and they found and paid a cook.

282. *To Mr. Mathews.*—That was a little more than two and a quarter years ago.

Thomas Hill, Engineer, Department of Works and Railways, recalled and further examined.

283. *To the Chairman.*—When we were preparing estimates for the requirements at the Base, we had no definite information about accessories, such as the gymnasium, stokers' school, signal tower, recreation ground, permanent fixtures and fittings, fencing, lay-out, and general excavation, but Mr. Jeffrey and I have prepared the figures for the information of the accountant, and we included provision for the items now mentioned in a report which I now furnish to the Committee. Although the report is signed by Mr. Jeffrey, I am equally responsible with him for the figures. Members of the Committee will see that the cost of removing the existing gymnasium from Williamstown and re-erecting at the Base is set down at £840. The removal and re-erection of the stokers' school will cost £428, and the signal tower £285, while £1,500 is set down for recreation grounds and £5,000 for permanent fixtures and fittings. Although, with regard to the last two items, we had no information as to the full requirements, we thought it necessary to set aside a sum to cover the work for this financial year. The item of £700 for fencing, only includes fencing around the married men's quarters, as we have no data of requirements elsewhere. Then £1,700 is provided for laying out ground and general cleaning up, and £3,345 for general excavations. Members of the Committee will have observed on their recent visit that a good deal of work will have to be done in levelling up around the barracks between the main building and the kitchen. We have not done anything with regard to roads, as we do not know the probable requirements during this financial year. I should say that the work of removing and re-erecting the gymnasium could be done cheaper by contract than by day labour. All permanent fixtures and fittings also could be contracted for, and should be done cheaper than by day labour. We have a small joinery mill at the Base. The Postal Department also has small works at South Melbourne, where letter-boxes are made, and certain special postal fittings provided. The joinery works at the Base,

a constructional timber workshop, was brought over from Jervis Bay. I consider that the work required by the Department is of too erratic a nature to provide full working capacity for one big joinery shop, but if the Commonwealth are given power, as I understand is the case in Queensland, to compete also for outside work, when the mill was slack, I think we could possibly make a success of a joinery mill. I have seen Mr. Jeffrey's evidence in regard to the day labour system as applied to the erection of buildings at the Base. Speaking from memory, I think that, while I am not quite satsfied that bricklayers, for instance, could not have laid more bricks, we got as many laid as any other contractor under the conditions as then existing in the labour market. It must be remembered that, at that time, there was plenty of work available elsewhere for bricklayers. In my opinion, the cost of £15 8s. 7d. per rod for labour only on work at the barracks was a reasonable price under the then existing circumstances, because, as I have already pointed out, bricklayers at that time could get work readily in the cities. When such conditions exist we cannot get the same return out of labour in places at some distance from the city. Speaking from memory, I think the estimate for the Flinders Base buildings, as approved last year, was £111,000, and the figures for the completed cost are now £179,000. The whole of the difference is not accounted for by the increased cost of labour. In my opinion, the estimate in the first place was low; it was probably based on Melbourne prices, and did not take into account the conditions existing at Flinders Base. Recently we called tenders for the serum hospital in Melbourne, and the successful contractor is Mr. Shillabeer. Under our specifications the contractor usually takes responsibility for any increase in wages, but he would have a claim against the Commonwealth for any increase in materials due to war conditions. This is not actually defined in a specification, but I know that such increases due to war conditions have been acknowledged and paid for by the Commonwealth. I do not think, however, if the price of bricks increased in Melbourne owing to war conditions any allowance would be made to a contractor. I have not seen the plans or specifications for the proposed quarters for warrant officers at the Base. This work is in Mr. Murdoch's department. I should say that the buildings will be considerably better than those usually provided for ordinary workmen, the increased cost, I imagine, being about 30 per cent. I remember the evidence taken with regard to housing the workmen at Canberra, where it was estimated that a 3-roomed house could be built for £380, 4-roomed for £480, and a 5-roomed house for £580; but, in my opinion, none of the houses at Flinders Base can be compared with the proposed buildings at Canberra, because at that time we were not thinking of the same rank or class of men, as none of the workmen would draw the same wages as a warrant officer, who has a certain status which would probably entitle him to accommodation somewhat better than is usually provided for the ordinary working man. I would regard a warrant officer as on an equality with a good foreman, and I would hardly expect a good foreman to live in the class of house which can be built for £580 at Canberra. Then again, it must be remembered that at Canberra it was proposed to build a large number of concrete houses of one type, using as material the cheap gravel obtainable from the river, and generally they would be built under conditions much more favorable than at Flinders Base. I am aware that it is proposed to build twelve or thirteen dwellings for warrant officers, but altogether they are a much better class of house than was indicated in the evidence concerning workmen's buildings at Canberra. Messrs. Dixon and Lewis designed the hot water service. They were responsible for similar services at Spencer-street and Bourke-street, and have installed hot water services in most of the military hospitals, where the systems have been working steadily for the last few years for cooking, heating, laundry work, and other services. I am quite satisfied with their experience. We particularly went into the question of a high pressure boiler for the Flinders Base system, and I point out that there will be on the main steam system from the boiler-house about 3,000 feet of steam pipe from 3 inches down to 2½ inches in size. I understand that it is stated in evidence—I have not seen it—that a boiler giving steam at 12 or 13 lbs. would be ample, but at Flinders Base we propose to use a Babcock and Willcox boiler giving 100 lbs. of steam, with the result that we will be able to use 3-inch steam piping, costing about 3s. a foot, instead of 6-inch piping at 8s. 6d. a foot. Roughly speaking, a cubic foot of steam at 12 or 13 lbs. pressure would want four times the area of pipe to deliver it to the various buildings than steam at 100 lbs. pressure, so that considerable economy will be effected in the piping alone. Again, the heat loss in the case of steam at 100 lbs. would be approximately 10 per cent. from a 3-inch pipe and 20 per cent. from a pipe of larger diameter, and for larger piping there will be increased cost for brick troughing, as well as increased cost for lagging. I believe it has been mentioned that the cost of a Babcock and Wilcox boiler, and another of colonial type is about the same, but I wish to point out that it is particularly important to have a quick action boiler, one that will respond readily in the mornings when hot water may be required for baths, lavatories, kitchens, or other purposes, and, in my judgment, the Babcock and Wilcox is the more suitable. It is the best of its type, and we find by experience that its cost is no more than any other type of boiler, and certainly it is more reliable. We are trying to encourage the manufacture of these boilers in Australia, and it is our intention to purchase from Hawkes, of Kapunda, South Australia. As I have said, it has been estimated that the loss of heat from the larger pipe will be 20 per cent. as against 10 per cent. in the case of 3-inch pipes. Careful attention to lagging would not reduce the loss of heat in the bigger pipe, because its surface is so much greater. Given equal diameters the loss of heat would be a little greater in a high pressure system than with a low pressure boiler. I have had no experience of buildings in which high pressure boilers are used for heating alone. In the case of the Caulfield military hospital, we installed a second-hand tubular boiler, because the service required did not justify a bigger boiler. Where only short lengths of piping are used a low-pressure boiler is suitable. There is a small hot water service at the Customs House in Melbourne, also a small system in the General Post Office in Elizabeth-street, where about five years ago an old boiler was replaced by one of an ordinary radial type. At the Military College, Duntroon, there is a colonial boiler specially designed by Mr. Christie for the purpose. It distributes steam through about 400 feet of piping, but it has given a good deal of trouble. The question of undergrounding the electric power cables as a safeguard for the proposed aerial service at Flinders Base has not been mentioned to me previously, but I might state that at the present time we are dealing with the question of laying a high tension cable of 6,000 volts from Newport and Williamstown to the Aviation School at Point Cook. We have discussed this matter with Major Harrison and Major

Arnet, and had decided to underground the mains from within a distance of a mile of the school; but we are now considering whether, in view of the difficulty of getting underground cable, we will not run the wires right in and cage them, so as to protect aviators from shock in the event of an accident. We have to consider two points, namely, the possibility of accidents through entanglement with wires in the ordinary way independent of the voltage, and the possibility of aviators being injured by contact with high voltage cables. At Flinders Base the voltage is 230-460 d.c., and I understand that some persons can take this amount of current without great physical injury, but all the same it should be guarded against. If it were necessary to underground the electric cables there, it could be done at both ends of the parade ground, but there would still be danger of aviators colliding with the buildings, which will be two and three stories in height. We could overcome the possibility of danger by "caging" the cables at a cost of £80 or £90 a mile, and at Flinders Base it would be quite an easy matter to cradle the wires at, say, six or eight points between the poles, so that in the event of an aviator colliding with the wires, the current at the main switchboard would be cut off. This would cost about £300.

(Taken at Melbourne.)

FRIDAY, 8TH FEBRUARY, 1918.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

Silas Young Maling, Deputy General Manager of the Sydney City Council Electric Light Department, sworn and examined.

284. *To the Chairman.*—I studied at the Manchester Technical School, and served my apprenticeship with the British Westinghouse Company. I was on the staff of the company for a time, and then joined the Melbourne City Council, eventually going to the Sydney City Council.

285. *To Mr. Laird Smith.*—I have gone carefully through the evidence of Mr. Harper, and superficially through that of Mr. Smith, because I had but very short notice of this examination. I have frequently been brought into contact with Mr. Smith, and know him well. He is recognised as a very capable professional man. His statement that "with alternating current, motors can be used which have no commutator at all, and are much cheaper and less liable to give trouble" is a recognised opinion. I agree, too, with his statement that "a fundamental disadvantage of the direct current is that there is no means at present known of generating it at a high voltage and reducing it to a low voltage without using rotating machinery, whereas with the alternating current we have a device called a transformer which is about 98 per cent. efficient." An efficiency of 98 per cent. means that there is a loss of only 2 per cent. between the energy put in and the energy taken out, which is a very small loss indeed. A transformer is the simplest of electrical apparatus, and requires practically no attention. I have known transformers to be in use for from twelve to fourteen years without failing, although receiving very slight attention. In all modern power stations of any size the energy is generated as alternating current, and converted, when necessary, to direct current. For the charging of accumulators it would be necessary to put in either a motor generator or a rotary converter, to convert the alternating current to direct current. In a service in which accumulators were used the capacity of the accumulators would be regulated according to the purpose for which they were used. In big power systems storage batteries are used either as a standby plant to provide against the failure of the generating plant, or to take off the "peak," that is, energy is stored in a battery, and, when a heavy load comes on, the battery is discharged, instead of additional boilers and generating plant being called into use. There are, of course, many other uses to which batteries of accumulators are put. There is practically only one kind of storage battery. The Edison battery is used almost exclusively for electric vehicles, and for other small storage purposes; it is not used for large storage purposes. There is only one correct way of charging a storage battery, though there is variation in the rates at which batteries may be charged. That is a matter on which the opinions of engineers differ slightly, though these differences of opinion are not serious. The usual way of finding out the capacity of a battery is to charge it, and to measure both its input and its output. Its output is regarded as its capacity, which is generally measured in terms of the "ampere-hour." I have not had the opportunity, or time, to go sufficiently into the scheme before the Committee to know whether an allowance "for a load of 20 kilowatts for lighting, and 43 kilowatts for power, or 63 kilowatts in all" is sufficient, but the matter could be easily settled. Neither am I in a position to say whether "provision for 100 kilowatts, possibly extending to 200 kilowatts for lighting," is excessive, because I do not know the details. A kilowatt is approximately 1 1-3rd horse-power. The electrical horse-power required for a big shop would depend on the apparatus in the shop. Some apparatus might require 200 horse-power, while all the machinery in another big shop might be run with 50 horse-power.

286. *To the Chairman.*—And there might also be reserve power needed.

287. *To Mr. Laird Smith.*—The most modern practice is to use alternating current, three phase, fifty periods, for any factory and lighting supply, which is practically what is to be provided at the Flinders Naval Base, I understand. A reason for using the alternating current system is that it costs less for wiring than the direct current system; another reason being that it is more flexible and lends itself better to extensions.

288. *To the Chairman.*—I have seen the plans for the work proposed to be carried out at the Flinders Naval Base. I have not given consideration to the telephone part of the scheme, because I am not in any way an expert on telephone matters. I strongly recommend the adoption of the alternating current system. For the charging of batteries, such as submarine batteries, it would be necessary, with a direct current system, to reduce the voltage, or with an alternating current system, to convert from the alternating current to the direct current, so that in either case there would have to be transformation. I am not an expert in submarine batteries, and do not know what their voltage is, but I should say that it is not as high as 460. The voltage of a battery depends upon the number of its cells, and it is charged slightly above its working voltage. If the direct current voltage were appreciably greater than the voltage of the battery to be charged, it would be

necessary to reduce the voltage of the current before charging the battery, to prevent overcharging or charging too fast. This would require rotating machinery. Similarly, if an alternating current system were used, you would have to convert it into direct current. The larger the machines for the transformation of current the more efficient they are, as a rule. Approximately there is a loss of 20 per cent. in converting from alternating to direct current, and the loss would be about the same in reducing direct current for the charging of a battery. Both direct and alternating current systems can be used satisfactorily in a workshop, including the operating of cranes. I know one shop where there are about twelve 50-ton cranes in operation, three-phase alternating current being used. The advantage of direct current in a workshop, so far as operation is concerned, is where a variable speed is required on the motor, but generally a variable speed can be got by a mechanical contrivance such as variation of pulley ratios. The variety of alternating current motors is appreciably greater than that of direct current motors, and that balances, as a rule, the gain of speed variations that you have with direct current motors. In my opinion, the alternating current is as efficient as the direct current in a workshop. I would recommend the alternating current, even taking into consideration the desirability of training men to operate the direct current system on submarines and other war vessels. I consider that the alternating current system would provide for the more efficient training of men, if a laboratory were fitted up in which the processes of direct current could be properly explained. The fact that the lighting of the Base is to be provided for is an additional argument for the use of the alternating current system. It is generally recognised that the alternating current system is cheaper to install and to operate, and slightly more economical in operation, than the direct current system. The statement that there would be a saving of about £6,000 in the cost of lighting if the alternating current system were adopted, because smaller wires could be used, would, I think, be borne out. To put the wires underground would greatly increase the cost of any system, and the maintenance of underground wires is appreciably greater than the maintenance of overhead wires. The general practice is to carry wires overhead on poles at a height of from 30 to 35 feet above the ground. But in Sydney, where we carry very high pressures, pressures up to 33,000 volts, through suburban streets, we have the wires 70 feet above the ground. For a scheme like this under consideration, a height of from 30 to 35 feet would be sufficient. I have had experience of concrete lamp standards; in fact, I designed some for the Melbourne City Council. Concrete poles are used in parts of America, and also, I believe, in Germany and in Russia. They are almost indestructible, and would have advantages where white ants were bad. But their cost in Australia is much greater than that for wooden poles. When I was in the employment of the Melbourne City Council I went into the matter, and found that they cost about four times as much. In Sydney we use iron-bark poles. When wires are placed underground, a lead-covered cable is generally employed. This is laid in hardwood troughing, on little chairs, and is surrounded by some kind of compound, or bitumen. That is the standard practice in Australia. In Sydney we supply a great number of sewerage and water pumping stations with electric power. I have not known of lead-covered cables being laid without troughing, but armoured cables have been so laid by the Victorian railway authorities for the 20,000 volt feeders from the Newport power-house. These are more expensive than the lead-covered cables, and their use would be much more costly if a number of services had to be taken off them, because of the trouble of jointing. For a service of the kind under consideration, which is practically a public supply service, armoured cables would be more expensive than lead-covered cables in troughs for underground wires.

289. *To Mr. Sampson.*—In converting alternating current to direct current there is a loss of 20 per cent. between the input and output, in the form of radiated heat. You are converting from one kind of electricity to quite another kind, but in transforming you are merely reducing the voltage just as you might reduce the pressure of steam or water by means of a valve. There are no rotating parts in a transformer. The energy simply flows round a portion of a magnetic core, and is drawn off on the other side. Transformers are used only for alternating current. To convert alternating current to direct current you must have rotating machinery; putting aside a method of conversion which is suitable only for laboratory and other very small work. For commercial purposes a rotating machine is necessary, and of all kinds of rotating machinery the rotary converter is the most efficient. With small machines, the loss in conversion may be more than 20 per cent., but it would be about 20 per cent. for a medium-sized machine. To provide a direct current system for power purposes, and an alternating current system for light purposes at the Base, would be more costly in installation and less efficient in operation than to adopt the alternating current system, and convert when necessary to the direct current system. I am not familiar with the naval aspect of this question. Apparently the direct current system would be of advantage to the naval authorities chiefly because of the opportunity its use would give for the training of men, and for the charging of submarine batteries, but I think that that advantage is inconsiderable, and that for the charging of submarine batteries the alternating current would be as effective, with means of conversion, as the direct current system. I understand that submarines when below the surface draw energy for their propulsion from their storage batteries, but that on the surface they use fuel-driven engines which, in addition to propelling the ship, also drive generators to recharge the batteries. But I think that it would be inefficient to give the initial charge to the batteries by means of the ship's engines, that should be done from some outside source of power. Alternating current will not charge a battery directly. It can be used only indirectly by being employed to turn a motor, or by the use of a rotary converter, thus generating direct current. This procedure is quite efficient. In Sydney we have large batteries which we charge in this way. Our batteries are probably the largest in the southern hemisphere. I do not know why the British Naval authorities have adopted the direct current system, unless it be that for marine work they frequently use motors to drive fans to blow up the fires or to set up induced draughts, and find it necessary to vary the draughts according to the head of steam that they require. With the direct current they can get a variable speed on the motor itself, and the motor is generally coupled directly to the fan. Possibly, too, they have adopted the direct current system on account of their searchlights, and for signalling purposes. I think that the best way of imparting information regarding

electrical matters is to set up a suitable laboratory in which everything concerning direct current can be learned. That is better than to allow men to pick up first one bit of knowledge and then another. If a man had had practical experience with the alternating current system, he could, after such training as I suggest, operate the direct current system on board ship.

290. *To Senator Needham.*—If it be a fact that the direct current system is used in all the British dockyards, I do not know the reason for it. As to the objection that the overhead wires and poles at Flinders Naval Base may be a source of danger to aviators, I would point out that generally the wires and poles follow the course of a street which is lined with trees and buildings which are higher than the poles. A street is an unlikely place for an aeroplane to alight in. The danger to life from the blowing down of poles by storm is almost negligible. I have frequently seen aeroplanes ascend and descend in an area as small as the parade ground shown on the plan, and I should think that there is ample room there without danger from electric light wires. I do not express an opinion, however, as to there being enough room for the training of aviators. I should think that there is not enough room for that. In most training places they have very considerable free areas. The wires might certainly be a source of danger to aviators who were only learning their work. Most of the training schools are placed where there are large areas quite free from obstructions of any kind. The saving of £6,000 by the installation of the alternating instead of the direct current system, which has been spoken of, would probably be in copper. I consider that the alternating current system costs less to maintain than the direct current system, including the generating station. A system to cover a small area could be designed without transformers. Such a system would be applicable to the area under review. A man with a knowledge of the alternating current system could quickly obtain a knowledge of the direct current system. The alternating current system is more difficult to understand than the direct current system. It would not take a man long to pick up a knowledge of the direct current system. The placing of wires underground is adopted by power supply engineers only for æsthetic reasons, so as to prevent the disfigurement of streets in thickly-populated areas, where to take a considerable number of services off poles would cause unsightliness. There is about the same amount of undergrounding of wires in Sydney as in Melbourne. In both places, the central business portions are undergrounded. From the point of view of practical working, the overhead system is the easier. An overhead wire gives a better service than an underground wire, because, if over loaded, it can radiate off the heat. But there is not the same opportunity for radiation from an underground wire which is insulated. Therefore, in case of emergency, an underground wire cannot be charged as heavily as an overhead wire. From the practical point of view, the overhead wire gives the better service.

291. *To Senator Henderson.*—The Melbourne and Sydney systems of undergrounding are similar. In the principal thoroughfares the cables are drawn into ducts. A trench is cut, and in this the ducts are laid. At certain places there are what we call man-holes, and at each of these there is a cable joint. The cable is drawn in from one man-hole to the next, and jointed up. The undergrounding of power wires has no connexion whatever with the undergrounding of telephone wires in tunnels.

292. *To Mr. Sampson.*—The direct current system was the first to be discovered and developed, but about twenty-five years ago the alternating current system commenced to be generally adopted. In Melbourne they generate alternating current and convert it. The direct current system is often found in use in the centre of cities, because it was the first system, and was brought into use in places where the electric supply system was likely to earn the largest and quickest return. Then, again, it was for a long time the only system suitable for elevators. It is only within the last five or six years that alternating current elevators have been used successfully. The alternating current system has been the usual system to install during the past fifteen years. In America the alternating system has been in use longer than in British countries.

(*Taken at Sydney.*)

MONDAY, 18TH FEBRUARY, 1918.

PRESENT:

Mr. Gregory, Chairman.

Senator Henderson	Mr. Mathews
Senator Needham	Mr. Sampson
Senator Newland	Mr. Sinclair
Mr. Mahony	Mr. Laird Smith.

Thomas McDougal Mundle, Electrical Engineer, Commonwealth Naval Dockyard, Cockatoo Island, sworn and examined.

293. *To the Chairman.*—I served my time with Messrs. Crompton and Co., of Chelmsford, England, where I was associated with Admiralty work. On the completion of my time, I was transferred to the London office, and was there engaged for another two years, where I also did a considerable amount of Admiralty work. From London I came to Australia under contract as engineering manager for J. A. Newton and Company, with whom I remained for two years. I then went back to England, and joined the firm of Messrs. Siemens Brothers and Company, and, after being in London for two years, went to their eastern office, in the Malay States, where I remained for another year. I then came back to Australia, and was with Messrs. Noyes Bros. for about six months, and about five and a half years ago I joined the Cockatoo Island Dockyard. At that time the dockyard was under the control of the New South Wales Government. Practically all my experience, as an electrical engineer, has been closely associated with Admiralty work. In the Malay States I occupied the position of manager at Kulua Lumpa for Messrs. Siemens and Company. While with Messrs. Crompton and Company and Siemens Bros., in England, I was directly associated with the lay-out and installation of power station plants, including some of the dockyards. I have had special experience, entitling me to advise in regard to electrical methods to be adopted in connexion with naval bases or dockyards, as I am fully acquainted with this class of work at the Admiralty dockyards at Rosyth, Malta, Devonport, Sheerness, and Chatham, as well as many other English private dockyards. I am acquainted with the nature of the plant proposed for the Flinders Naval Base, and made a special trip to Melbourne recently in order to look into matters with which, up till then, I was not fully acquainted, so I am

now thoroughly conversant with all that is required at the Flinders Base. Power is required there, not only for the workshops, but also for charging submarines, and for lighting, and I have no hesitation in saying that the only proposition for the Base is the direct current system. If it is proposed to adopt the alternating current system, it can only be in addition to a direct current supply, in order to meet special naval requirements, of which most shore engineers do not appear to be fully cognisant. In my judgment, not less than 85 per cent. of the power at Flinders Naval Base must be direct current, thus leaving only 15 per cent. of the power which could be utilized under the alternating current system. For dockyard work it would be exceedingly undesirable to have the voltage higher than is considered safe for shore purposes, because all the men are practically standing or walking on steel plates and ships' decks, and the slightest leakage of power might result in serious consequences. Therefore, I would say that if it is proposed to introduce alternating current as a proposition for the Base, it should not go above 415 volts, which is the usual supply for shore purposes. The amount of copper required for a three-wire direct current system, as proposed at the Flinders Naval Base, and the three-wire alternating current system for the same voltage would be exactly the same, and if it were decided to install the alternating current system, it would be necessary to provide for an expensive converting plant, in order to convert the 85 per cent. of power required for naval purposes to the direct current system. I do not know whether those who have already given evidence concerning this matter realize what is required in the charging of a submarine battery. The plant suggested is for 750 kilowatts, and I am perfectly safe in saying that on many occasions at least 500 kilowatts might be required for charging submarine batteries. That in itself practically fixes the size of the power plant, which might appear to be excessive to those not acquainted with naval requirements. Apart from the charging of submarines, there is also the question of lighting naval vessels, including destroyers, which would be lying alongside the wharfs, and for which continuous current would be required up to about 100 kilowatts. Then, also, it must not be forgotten that the work-shops must be supplied with power, and there a large number of motors are required for special purposes, and a large percentage will be variable speed motors. I am not going to say that you cannot use alternating current for variable speed motors, but I do say that that system is most unsatisfactory for dockyard requirements, and that the equipment is not yet commercially on the market, because it costs nearly three times as much as the direct current equipment for variable speed motors. It is generally recognised that where work-shops require a large number of variable speed motors, including crane motors, direct current offers by far the cheapest proposition, both as regards initial cost and maintenance charges. At Walsh Island, where the alternating current is taken from the railways, the authorities had to put in a special plant to convert the power to direct current for crane services, &c. The mixture of alternating current and direct current is regarded as a most undesirable power plant proposition. With alternating current at Flinders Base, it would be necessary to put in a converting plant on the transmission line to Stony Point, and, even taking into consideration a reduction in the cost of cable, this would be more than counterbalanced by the cost of the converting plant and wages for a man in attendance, building, &c. There would be a continual maintenance charge against the system, whereas with the direct current proposition, although there would be slightly heavier copper wire required, the deterioration and maintenance charges would be practically nil. To convert from alternating current to direct current, it is necessary to have a rotary converter consisting of one motor and one generator—alternating current, therefore, will cost so much more. For ordinary work-shops with line shafting, no speed variation, and where motors are running continually, the proposition would undoubtedly be alternating current; but naval work-shops are of an altogether different type. At Cockatoo Island Dockyard, for instance, out of 5,500 horse-power in motors, I have not more than 100 horse-power on line shafting. The allocation of power in a dockyard may be summarized as follows:—(*a*) Continually running, constant speed motors in work-shops under cover, and operating line shafting, machine tools, &c., 5 per cent.; (*b*) continually running, constant speed motors in the yard, not under cover, operating punching and shearing machines, drilling machines, drills, rolls, &c., 7½ per cent.; (*c*) continuously running, variable speed motors in work-shops, under cover, 20 per cent.; (*d*) continuously running, variable speed motors in the yard, not under proper cover, 15 per cent.; (*e*) motors for special purposes, such as dock pumping, turbine balancing, &c., which are in intermittent service, only 15 per cent.; (*f*) crane and lift motors, under cover, in work-shops, 7½ per cent.; (*g*) crane and lift motors in the yard, not under proper cover, 5 per cent.; (*h*) supplying vessels with shore power, 10 per cent.; (*i*) charging submarine batteries, 15 per cent. It is probable that these figures would not be understood by shore engineers, because it is difficult for them to realize the special requirements of naval work, which demand so many variable speed motors, and—taking Cockatoo Island as an example—only require 12½ per cent. of the power for constant speed motors. At Cockatoo Island Dockyard we have the direct current system in its entirety. The average electrical engineer, accustomed to shore conditions, would, no doubt, advocate alternating current, arguing, probably, that direct current is out of fashion; but I would point out that one of the largest engineering works of recent erection in Australia is the Newcastle Steel Works, where they have gone in for direct current throughout, and I might remark that, in regard to their requirements, that establishment approaches more nearly than any other in Australia to a naval dockyard. Another technical point which, in its relation to the Flinders Base, has, I think, been overlooked, is the question of the power factor, which has to be taken into account with the alternating current proposition. This power factor does not come into consideration with the direct current system. With a large number of motors running intermittently, difficulty is occasioned by fluctuation of the load, and under alternating current the power factor will drop. Normally the power factor should not be less than 85 per cent., but with the exceedingly uncertain and fluctuating load in a dockyard the power

factor might drop very much below this figure, and an appreciable difference in the efficiency of the plant would result.

294. *To Mr. Sampson.*—In a shore establishment such as the Sydney City Council electric light works, if they were getting anything below 85 per cent. power factor, they would think things were getting pretty bad; but in a dockyard it would be possible, with alternating current, to get down to an almost unworkable power factor. In the City Council establishment, heavy motors running continuously would tend to keep the power factor up; but in a naval dockyard the position would be entirely different. Even with a low voltage direct current, such as we have at Cockatoo Island, leakages become frequent, and with the alternating current system this would be a very serious matter indeed, because with motors in the open, and without proper covering, men working on metal plates stand a fair risk of shock. I am solidly in favour of the direct current proposition for Admiralty work. There is not, so far as I know, a dockyard under Admiralty administration—I am referring, of course, to Admiralty yards before the war, because I do not know exactly what has taken place in regard to private yards taken over during the war by the Admiralty—that is not on the direct current, three-wire system, taking voltages at 480 to 240, which is identical with the proposition for Flinders Naval Base. At Singapore dockyard, which is a private yard, the alternating current system has been installed; but no machine tools of any consequence are in use there, and no submarine batteries have to be charged, the power being merely required for the docks and lighting, for which alternating current is an excellent proposition. I have not gone into the question of comparative cost between the two systems, but I would be pleased to do so if the Committee desired the information. I understand that it has been suggested a saving of £6,000 would be effected at Flinders Base by the introduction of alternating current. This saving, if effected, would, however, in my opinion, be counterbalanced by an increased cost for a converter plant to meet the needs of naval requirements. I should say that the only saving in the one system over the other would be, to a limited extent, in regard to the amount of copper. Speaking of the element of danger in work-shops through using alternating current as against direct current, it may be taken as a broad principle that 220 volts continuous current is as dangerous as 110 volts alternating current—that is to say, the latter is about twice as dangerous as the former. I have not as high a voltage at Cockatoo as is proposed at Flinders, the voltage at Cockatoo being 240 as against 480 proposed for Flinders Base; and even with that voltage we have had not less than a dozen accidents through men getting hold of the wires, but practically none have proved fatal, whereas there is not the slightest doubt that, had the system been alternating current, the men would have stood a very good chance of being killed. Newcastle steel works is on the direct current system, and they also have direct current for the variable speed crane motors at Walsh Island. There was an advantage about taking alternating current at Walsh Island, because at the time it was impossible to get power plant of their own, and they took the supply from the railways on the alternating current system. There is not the slightest doubt that, in the power-house itself, alternating current would be cheaper to install, especially if it were required at higher voltages, but if alternating current were installed throughout, and there were a large number of variable speed motors, the cost would be prohibitive, and considerably outweigh any saving that might be effected in the way of copper, because it would be necessary to put in converters to meet the special needs of the establishment.

295. *To the Chairman.*—There is a slight saving in the maintenance cost of an alternating current motor over a continuous current motor due to the absence of a commutator in the alternating current machine. I will look into the statement that a saving of £6,000 would be effected by the installation of the alternating current system at Flinders Naval Base for lighting purposes alone. It seems to me to be an enormous figure, and out of all proportion; but, without knowing the alternating current voltage proposed for the Base, it would be impossible to check the figures. I have not touched upon the question of policy at all in the lay-out. That, of course, is a factor for consideration, as it is proposed to train men for naval requirements at this Base. There is, however, exceedingly little alternating current used by the Admiralty, and with one exception, throughout the whole of the service, it is all direct current. It is only within the last few months that alternating current has been introduced at all on naval ships, and that only in a minor degree. I would unquestionably advise that the cables at Flinders Base be placed underground, because I suppose that the cost of maintenance of overhead cables is from 60 to 70 per cent. greater. A mud surface, as at Flinders, is not ideal for underground conduits, but I think that when road construction is under way, satisfactory provision may be made alongside the road for the undergrounding of the cables.

296. *To Senator Newland.*—We are not using any alternating current at all at Cockatoo Island. As 85 per cent. of our requirements is direct current, it is, of course, far cheaper to have that system installed than to convert 85 per cent. of alternating current to direct current. When I went to Cockatoo Island five years ago, there were already £50,000 worth of electrical apparatus installed, and which we could not afford to scrap. Had I been starting afresh, I would have retained direct current for all purposes, with possibly an increase in the pressure. The voltage at Cockatoo has not been cut down. It was predetermined by the amount of machinery installed at the date of my appointment. I suppose our lighting requirements at Cockatoo Island are three times greater than will be required at the Flinders Naval Base, and yet with provision for 3,000 kilowatts in the power station, my lighting load, when in full swing, is not more than 100 kilowatts. In ordinary working hours this load is not felt at all; but at night time we use a special set for lighting purposes. It is the smallest item of the whole load. Our lighting system is much larger than that proposed for Flinders. I would have a ring main as on board ship running around the whole area at Flinders, so that, in the event of any breaks, it would always be possible to supply lighting and power, as the supply to the ring main would be from different points. A direct current proposition would require more copper, but at Flinders Base the distance for lighting purposes is not excessive, and I am satisfied that if the alternating current system is adopted, with the

necessary converting plant, the extra cost will more than counterbalance any saving in copper, this question, in relation to the whole proposition being rather a secondary consideration, in my opinion. Besides, a converting plant requires care and attendance. The tramways, who have to carry power long distances, naturally generate alternating current, and at the various outlying places convert to continuous current, which all require attendance and involve heavy maintenance cost. The increased cost of a converter plant would not be justified at Flinders Naval Base, because the bulk of the plant required would be direct current. It is absolutely necessary to use direct current for submarine charges. We did this class of work at Cockatoo Island when the *AE1* and *AE2* were in commission. Cockatoo has a lower voltage than is proposed at Flinders Base, and, therefore, we had to put in special plant to charge the submarines. It is likely that at Flinders Base the plant will require to deal with, say, six submarines, calling for power possibly greater than is proposed at present. When I referred to the possible leakage of power in motors not under cover in dockyards, where high voltage is being used, I did not refer so much to leakage from the cables as from the machinery in use. Once cables are laid underground they are not likely to give much trouble, but in the case of motors, especially those not under cover, there is always a possibility of damage, and thus leakage of power. When cables are laid underground, under proper conditions, as in a solid concrete bed, the job should be a permanent one, and the cables require little future attention; but in the event of any trouble occurring, we have apparatus for determining within a foot or two where any break or leakage may have occurred. We have had no trouble like that at Cockatoo Island, and some of our cables have been in service for four or five years. In the case of overhead cables, however, there is always the possibility of damage, as well as a certain deterioration, due to the weather conditions, and a loss of power through fracture of insulators; and, although the undergrounding of cables is much more expensive, there are special considerations in a naval base which justify that course. At Cockatoo Island I did not care to put the cables into conduits, because there is so much shifting of heavy machinery that the pipes were likely to be damaged, so the cables were laid in concrete. In cases where the ground is not likely to give any trouble, I would suggest that the cables be placed in conduits. This course could be followed at Flinders Base. In all Admiralty dockyards of recent construction, the authorities have adopted the direct current system, at 480-240 volts, the only exception, as I have already said, that I know of where alternating current was adopted is at Singapore, and this is not an Admiralty yard, but provides only for docking ships for cleaning purposes, and very minor repairs.

297. *To Senator Needham.*—The direct current system is absolutely necessary for charging submarines. For the purpose of training lads in the use of alternating current for Admiralty work, I would suggest the adoption of the alternating current apparatus which the Admiralty use. Alternating current is adopted only for minor work, such as the firing of gun circuits, and the special Admiralty apparatus for this purpose would be quite a small plant. Generally speaking, they would not get much instruction of Admiralty requirements from an ordinary alternating current plant, because, as I have stated, the only use to which alternating current is put on board ship is for the firing of gun circuits and other special apparatus.

298. *To Mr. Laird Smith.*—For submarine charging, there is not the slightest difference in the general principle of the accumulator as compared with that ordinarily in use. Power can be converted back to direct current, but, as I have stated already, we employ a direct current plant for charging submarines, because the power required for this purpose is a very big item. The method of charging a submarine is identical with that of charging an ordinary battery—it is a matter of voltage. If current were converted from alternating current to direct current, there would be no difficulty whatever in charging a submarine battery. It is a question of size of plant and cost. For the charging of two submarines a battery-room considerably larger than that in which the Committee are sitting would be required. I am aware that in Sydney electrical people are converting from alternating current to direct current, in order to charge secondary batteries, but the process is more expensive than the laying down of a direct current plant for such work as would be required at a submarine base. A transformer would do for electric lighting. There might be a slight loss in transmission of power on the direct current system over a mile and three-quarters for lighting purposes, but it would depend entirely upon the load. A 20-volts drop could be allowed. I agree that some transformers that have been used for twelve or fourteen years require very little attention, and that, for a shore-going proposition, three-phase motors are cheaper and less troublesome to look after, also that alternating current is preferable to direct current in the majority of cases. The whole thing hinges upon the question whether the motors are to be constant speed or variable speed. I have fitted up many shore factories on the alternating current system, but I say that direct current is far cheaper, and certainly is preferable in cases where there is a larger proportion of variable speed motors in use. The average shore factory has line shafting, with constant speed motors, and for them the alternating current is the ideal proposition. I am fully alive to the advantages of the alternating current for general purposes. The cost of a commutator for variable speed alternating current motors is another point to be taken into consideration. One must be alive to the fact that this equipment exists, but I could not find a single firm in Sydney who could quote me for one. They are not commercially on the market yet, and if they were, I do not think that they would be taken up seriously. This proposition is a possibility, but at present it is very much in the air. Practically all the motors we use at Cockatoo Island are variable speed machines, including lathes, boring plant, drilling and milling machines, and so on. Out in the yard practically every other motor is operating a crane. On the whole of Cockatoo Island I do not think we have half-a-dozen lengths of shafting. The motors at Cockatoo Island are

mostly 110-volt motors; but I have recently been introducing 240-volt machines. So long as the horse-power is there, the pressure required for these motors is immaterial as regards alternating current or direct current. It is purely a question of policy, and not taking alternating current too high. Alternating current is preferable for long distance work, because it can be generated at a higher voltage than direct current. You cannot take direct current at much more than 500 volts. Our motors in the yard at Cockatoo Island are protected as much as possible from the weather, and, in order to avoid trouble, I leave the shunt coils alive during damp weather, so that any moisture that might settle on them would not affect their efficiency. An earth on a machine need not necessarily ruin it, but it might mean a very bad shock for the man in charge of it, but 110 volts would not necessarily put a man out of action. I have felt 480 volts myself, though I had every ideal condition for withstanding the shock. I say that nothing is gained by putting in an alternating current system when, for the bulk of the power, direct current is required. You might as well put in a direct current of the same voltage, and so reduce the risk by half. There is a safe limit at which men may work for dockyard purposes under both alternating current and direct current. There is not the slightest doubt that a far larger number of the deaths in the United Kingdom and Australia are due to the alternating current system than to the continuous. I have had previous experience with plants similar to the one proposed for Flinders Base for electric light and power purposes, and I have handled plants which carry the lighting a greater distance than is proposed at Flinders. The distance is practically nothing. The Sydney power stations have to consider the question of carrying it 15 miles. In undergrounding a cable I would not put electric light lead-covered cable in the ground direct, because of the danger of deterioration and leakage. An armoured cable would be different. It is possible for submarines to charge their own batteries at sea, and provision in dockyards for this service is only necessary when the submarine engines are being overhauled. It is then most essential to have a plant available for charging the batteries. When a submarine is on the surface, it is engaged in charging its batteries, but when it is submerged it must run on its motors, because it cannot get rid of the gases from the engines. Dockyard work is different from that carried on in an ordinary factory, in that there is very little repetition work. Variable speed motors do not alter their speed without adjustment, unless, of course, there is not sufficient power in the power station and the voltage drops. Constant speed motors are cheaper in initial cost than variable speed, but they cost the same to install, and we must not lose sight of the fact that, in an establishment like the Cockatoo Island Dockyard, we have only 12½ per cent. constant speed motors in the whole of the place, so it would not be advisable to install an alternating current plant for the whole establishment.

299. *To Mr. Sampson.*—I think it is possible that a condition might arise at Flinders Naval Base when several submarines under repair would require the whole power of the station plant; but I have not the slightest doubt that, when the scheme is completed, the naval authorities will also increase the size of the power station. After considering all the possible requirements of Flinders Base power plant, I say it should be direct current. I estimate that 100 kilowatts will be the extent of the power required for lighting. It would be possible, with an alternating current system at Flinders Base, to install in the power station a rotary converter with a step-up or step-down transformer for lighting purposes, but this would not be an economical proposition. There is no advantage in putting in the alternating current system at the Base proper, because, with converters, this would mean a duplication of the whole of the wiring system. It is generally recognised that the lighting wires, which are used at night time, become power lines in the day time. Any loss in transmission of lighting to the residences would depend upon the size of the copper used; but it would not be more than 3½ to 4 per cent., which, on 50 kilowatts in a station of 750 kilowatts, is not much. Alternating current is generated at a higher pressure, and that is the reason it is more dangerous.

300. *To Senator Henderson.*—I base my advocacy of the direct current over the alternating current system upon the circumstances and the utilization of power. I have not read Admiral Clarkson's evidence.

301. *To Mr. Mathews.*—I should say that electrical engineers accustomed to shore work are confident of the superiority of the alternating current system as the proposition for Flinders Naval Base because they do not know anything about actual naval requirements. If I were put in charge of a shore station, I would not hesitate myself to put in alternating current, but dockyards require a very much higher percentage of variable speed motors than an ordinary shore establishment, and if alternating current is adopted, converting plants must be put in. Everything depends upon the ultimate utilization of the power itself. It is quite wrong to assume that a naval dockyard and a private shore concern are identical in their purposes. In almost every factory in Sydney or elsewhere there is a large amount of line shafting, whereas at Cockatoo Island, and in other naval dockyards, there is very little line shafting in operation. I may mention that a transformer is distinct from a converter. It is used purely for the purpose of converting alternating current from one voltage to another. You can take 100 volts alternating current, and, by the use of the transformer, convert it to 1,000 volts or 10,000 volts. That is what would be called a step-up transformer. A step-down transformer would perform exactly the same operation, only in the reverse direction. Literally speaking, a transformer is identical with a medical coil, with which most people are fairly familiar. You can convert or transform from any voltage you like up or down, without loss of voltage; but there may be a loss of efficiency, which is rather a fine distinction. Suppose you want to convert 100 alternating current to 500 direct current. In that case you would have the 100 alternating current motor directly coupled to a 500-volt direct current generator, and drive the generator with the motor instead of by the engine. There would be from 10 to 15 per cent. loss of efficiency due, say, to friction in the bearings of the rotary converter, in converting alternating current to direct current. I believe some American ships are running the alternating current plant, but all the lighting is done by direct current on ships of war. If I had to design the lay-out of Flinders Base I

would underground the cables, because the work would then be finished with, and I consider this is the proper system for a dockyard.

302. *To Mr. Sinclair.*—The fact that 85 per cent. of the power is required for variable speed motors determines, in my opinion, the system to be adopted for a naval base. Unless underground cables are misused their life is unlimited; but what invariably happens is that cables eventually get overloaded, and the overheating of the rubber insulation causes deterioration of the copper.

303. *To the Chairman.*—There would be no objection, in order to meet special circumstances at Flinders Base, to having the wires partly underground and partly overhead.

(*Taken at Sydney.*)

TUESDAY, 19TH FEBRUARY, 1918.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

Julian James King Salter, Member of the Royal Corps of Naval Constructors, Member of the Institution of Naval Architects, General Manager of the Commonwealth Naval Dockyard, Cockatoo Island, sworn and examined.

304. *To the Chairman.*—I understand that Admiral Clarkson desires to have workshops at Flinders Base built of steel and iron, and that, on account of the high cost of these materials, owing to the war, the Home Affairs Department recommends a brick building with steel stanchions. Personally, as one who has had considerable experience in dockyard work, I have no objection to the nature of a building—whether it is steel and iron or brick, so long as there is sufficient provision for overhead travellers where required. Owing to the high cost of steel at the present time, I am proposing to Mr. Settle's Department that some new workshops which I want should be built with timber.

305. *To Mr. Laird Smith.*—I have not been consulted about the workshops for Flinders Naval Base at all, but I have visited the locality.

306. *To the Chairman.*—Possibly there is something in Admiral Clarkson's argument that if a brick building is erected alterations to meet future needs will be more difficult and expensive than if the building were of brick and iron; but I should say that if it is only to be temporary, perhaps a combination of brick and steel will be more suitable. For a permanent structure, I have no objection to a brick building at all. As a matter of fact, many of the main machine shops at Home are brick buildings, and it is in a country like Australia where, hitherto, galvanized iron has been cheaper than brick, that buildings of that nature have been generally adopted. From my point of view, a brick building is much cooler and better for the men. Undoubtedly it is necessary to provide plenty of head room for the handling of submarine and destroyer boilers. At Cockatoo Island the height of the boiler shop buildings is in the neighbourhood of 35 feet to the gantry rails.

307. *To Mr. Mathews.*—I would prefer that all electric cables should be placed underground, even though the cost be greater than overhead wires. I may add that I made that provision in my scheme for the Henderson Naval Base.

308. *To Mr. Sampson.*—I am informed that two main workshops of 179 by 65 feet and 179 by 55 feet are proposed. It would depend entirely on the number of ratings and the number of vessels to be handled, whether one building would be sufficient or not at first. I dare say that, to start with, one building would be sufficient if portion of it were used as a boiler shop and the ordinary work of repairing carried out in the other portion.

309. *To Mr. Laird Smith.*—If reasonable data were available as to the number of vessels likely to visit the port for the next fifteen or twenty years, it would be possible to arrive at a definite conclusion as to the size of the workshops required.

310. *To Mr. Sampson.*—Owing to the state of the war, I should say it is quite impossible for the Navy Department to say what number of submarines or destroyers would require attention at that Base in the immediate future.

311. *To Senator Needham.*—For a small Base I would have no objection to a boiler shop and repairing shop being under the same roof as the machine shop, but if the place grew to any dimensions I would certainly separate the establishments.

312. *To Mr. Mahony.*—In the design of a naval workshops it is necessary to keep in mind the dimensions of the boilers likely to be handled, and the weights required to be lifted by cranes on the overhead travellers. I do not think the objection raised by Mr. Murdoch, that with brick pillars the height of the building would have to be reduced by 10 feet, is necessarily fatal to a brick design, because, at Cockatoo Island, we have brick buildings 35 feet high, and 15-ton cranes with a 60-ft. span, and Mr. Swan, I understand, could take the walls up another 10 feet if necessary, making them the same height as is proposed for Flinders Base. I think it is only a question of cost and design. Brick walls could be buttressed outside of the building. I do not think it is essential to have steel stanchions.

(*Taken at Sydney.*)

WEDNESDAY, 20TH FEBRUARY, 1918.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

William Robert Swan, Superintending Civil Engineer for New South Wales, Naval Works Branch, Department of Works and Railways, sworn and examined.

313. *To Mr. Sinclair.*—With regard to the proposed workshops at Flinders Base, where the Department of Home Affairs recommends the construction of a brick building, I should say that it is purely a question of putting sufficient material in to withstand the stress caused by heavy loads on overhead cranes, and I shall be pleased to supply at a later date some further particulars of experience which I have had with brick buildings of this nature.

(*Taken at Melbourne.*)

WEDNESDAY, 27TH FEBRUARY, 1918.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

Thomas Hill, Engineer, Department of Works and Railways, recalled and further examined.

314. *To the Chairman.*—The estimate of £840 for removing the existing gymnasium building from Williamstown, £428 for removing the stokers' school, and £285 for removing a signal tower, was made by Mr. Jeffrey, and included all charges for removal, freight, and re-erection. The estimate of £1,500 for the recreation ground was prepared by Mr. Jeffrey and myself. In the absence of any definite information, we tried to imagine the possible requirements for that class of work for the financial year. We had no definition from the Navy of the probable actual requirements, so we imagined a set of conditions that might possibly arise, and provided for it. It does not mean, of course, that the money would be expended. Before the proposition was carried out, proper plans and specifications would be prepared in conjunction with the Navy Department, and the Minister's approval obtained for a proper scheme. The three tennis courts, bowling green, and croquet lawn could be left out. The estimate was prepared quickly, and we had no idea of the actual location. I see no reason, as a matter of urgency, for going on with that work. The estimate of £5,000 for permanent fixtures and fittings has been brought personally under Mr. Settle's attention, and it was undertaken that a list of requirements would be prepared, which would take some time. Pending that, we made provision for a sum to meet requisitions as they were submitted, or requirements as they were made known. We were anxious to get on with that work, as it made very good work for the joiners' shop, in conjunction with the rest of the joinery, enabling us to work the shop to the fullest advantage, if we could ascertain the requirements. These permanent fixtures and fittings represent lockers, clothing cupboards, tables, forms, and all the other furniture to enable the officers and seamen to occupy the place when they arrive. It was arranged for an inventory to be taken at Williamstown, where there is a certain amount of furniture, and that any further requirements should be submitted and dealt with. This sum was placed on the estimate to meet possible expenditure. It was intended to cover mess tables, chairs, and floor covering, but I think I am safe in saying that it did not include billiard tables. The item of £700 for fencing includes labour. With regard to the item of £1,700 for laying out grounds and general cleaning up, there is, first of all, a fair amount of work to be done between the barrack buildings and the kitchens. There are also the making of approaches, levelling up, grassing, and sloping around the buildings. Practically there is hardly a building there to which any of that finishing work has been done yet. We had in our minds the fact that there was a good deal of work to be done around the seamen's blocks and between the kitchens. The item of £3,345 for general excavations applies to existing and new buildings. At that time a certain site for the hospital was proposed, which would need a considerable amount of excavation, and other buildings were proposed also, so Mr. Jeffrey and myself estimated, roughly, a sum to be provided for the purpose. It was also intended to adjust the costing of certain excavation that has already been done, and included in the costing charge. If our figures show an unexplained balance of £529, that will probably be accounted for by sums put in for contingencies. We had to split the figures up into eight different items, and in doing so it is possible that we added a little extra for contingencies to one or two of them.

315. *To Mr. Mathews.*—After preliminary consideration of the site it was resolved to put in fencing of a light character, and encourage the growth of hedges afterwards between the buildings. The idea was to use light cyclone fencing, and grow cypress or ti-tree hedges, and ultimately to have practically no fences. Of course there are a large number of buildings which would account for the apparently large quantity of fencing. We assumed that the hedges would take some years to grow, and the fencing would be more in the nature of a protection for them while they were growing.

316. *To the Chairman.*—I have prepared a statement showing the comparative costs of installation and annual running costs of four different systems of heating for the Base, based on an ultimately completed installation for 2,368 men, to supply energy or heat for heating the buildings, supplying hot water, and cooking. Under scheme "A," as submitted by the Department, we propose a central boiler house, providing steam supply for heating of buildings, hot water, supply for baths, and steam cooking. The initial cost is £30,422, the annual cost £4,462, and the cost per man per week 8.7d. For the same scheme I have prepared the comparative figures for 762 men, showing initial cost £16,720, annual cost £2,302, and the cost per man per week 1s. 2d. In table "B" we provide for separate hot water boiler, installations for heating of buildings, and hot water supply to baths, and separate steam boilers for cooking. This shows initial cost £17,611, annual cost £6,521, and cost per man per week 12.7d. In table "C" the figures are given for open fireplaces for heating of buildings, separate hot water boilers for hot water supply to baths, and separate steam boilers for cooking. The initial cost is £16,027, the annual cost £7,260, and the cost per man per week 14.15d. Under scheme "D," electrical heating of buildings, electrical cooking, and electrical heaters for hot water supply to baths would involve an initial cost of £100,000, including the necessary power-house; the annual cost would be £29,493, and the cost per man per week 4s. 9½d. Of the same scheme for 762 men the initial cost would be £54,370, the annual cost £12,255, and the cost per man per week 6s. 8d. Attached are the data on which all these schemes have been based. The cost, £100,000, of installation of an electrical system was based on a power-house of about 2,500 kilowatt capacity. The estimate of annual cost bears out Mr. Smith's evidence that electrical heating would cost about ten times what the ordinary hot-water system would cost per man per week. In the one case the coal is used to heat the water and pass it direct into the building, whereas in the electrical scheme you lose 90 per cent. of the value of your coal right away by having to employ a steam engine. The temporary hospital can be

supplied by an extension of the scheme as proposed without any addition to the diameter of the piping. That is one of the advantages of putting in a high pressure boiler. You can extend the system by increasing the pressure in the boiler by a few lbs., varying with the distance to which the system has to be extended. If the temporary hospital is placed alongside the barracks, all that is required is a slight extension of the piping and a few lbs. extra pressure in the boiler. The needs of the hospital were thought of in preparing the scheme. The position of the hospital was not decided on, to my recollection, in October last, when these estimates were prepared. The scheme is based on an installation for 2,368 men, but did not at the time it was prepared include the hospital, because the hospital was proposed to be at Crib Point. Mr. Vincent in his evidence noted the "omission from the estimate of a large water tank in the roof." That tank is of timber, lead-lined, and was built in the previous year in conjunction with the roof. It was difficult to get in after the roof was put on, and as we needed a hot water tank there we put it there out of last year's estimate, so that it has already been dealt with under previous approvals. He also spoke of the hot water reticulation having been put in with the basins and baths in the seamen's blocks. That might, perhaps, have been included in these figures, but, as the work had been done, and we were dealing only with the figures of work proposed to be done, it was not included in the estimate. It represented about £600 actually expended on the hot water fittings. It is also rather difficult to say where that would stop. We might have to include a good deal of the cold water fittings and the mains, but where there are general fittings in a block of lavatories or baths like that the actual taps, &c., are regarded as part of the installation of those fittings, independent of where the water comes from. Those fittings were put in the year before, and had been paid for, and so were not included in this estimate. Mr. Vincent refers also to the placing of the pipe lines in the seamen's barracks as wrong and uneconomical, and submits an alternative scheme of the H type, using exactly the same unit cost for the pipe. I have taken out a scheme for the H type, as suggested by Mr. Vincent, and have taken £50 off our labour item of £850, as there is a little less pipe to be laid in his proposal, and find that the actual saving is £150, spread over seven blocks. That system of distribution was considered along with others when the design was prepared. It was open to the objection that the return pipe had to be carried under the floor, whereas in our system the return pipe is on the ceiling. Our experience of putting hot water pipes under floors has made us avoid it, unless we are absolutely forced by circumstances to do it, or a large economy can be seen by it. If anything goes wrong, you have to take up your boarding, disturb the inmates, and get in between the joists. Mr. Vincent's system is both inconvenient and unsuitable for the design, and is not warranted by the small difference in the cost. Our piping is visible and quickly accessible. If a troublesome leak developed under Mr. Vincent's scheme we might easily lose the small saving made in the initial cost. In Mr. Vincent's radiator circuit he gets a maximum distance of 300 feet as against our 390 feet, but our scheme is designed for a temperature of about 190 degrees Fahr. at one end of the system, and 170 degrees at the other, so that the maximum loss throughout the whole transmission is only about 20 degrees. The small difference in the distance as suggested by Mr. Vincent would not represent above 2 or 3 degrees of Fahr., and the slightest variation in the temperature would get over that. Even on the coldest day the temperature in the furthest radiator will not be below 150 degrees, or a variation of only 40 degrees; that is, from 190 to 150 degrees. That is a condition which will rarely occur, and generally the variation will be only 20 degrees, so that the thermal advantage of the slight shortening suggested by Mr. Vincent is negligible. On the other hand, the whole of the circuits under our design have an equal frictional resistance all round. We have a certain sized pipe leaving the radiator on the top floor, and as the pipe progresses feeding the different circuits it is being constantly reduced in diameter. Then as it gathers in the return flow on the lower floor it is constantly increasing in diameter. We have, therefore, a uniform diameter for the upper and lower rings, and gain the advantages of an equal flow and equal supply of heat to every radiator in the place. Mr. Vincent is quite wrong, therefore, in suggesting that there will be any sluggishness in the flow from the bottom ring to the ceiling on the return. He must have imagined that we had a common return pipe passing through the lower radiator and up again, instead of which all the radiators are fed from above. The water drops down through the three radiators before it returns to the top ring. It is gathered in, returned, and reheated, and returned to the top again. The flow through the three radiators is governed by the difference in temperature between the calorifier and the return pipe. On our plan, as displayed on the wall, we start with a temperature of 188 degrees, and we reckon that the lowest temperature will be 155 degrees. On that thermal capacity these pipes are computed. It has been stated in evidence that "any proposal to install two Babcock and Wilcox boilers for the purpose of heating is ridiculous." The capacity of boilers nowadays is not stated in horse-power, but generally in evaporative units. The boilers proposed for the Base were of 1,790 square feet heating surface each, having an evaporative capacity of about 5,400 lbs. of steam per hour each. Our estimate of cost was £1,338 per boiler, £350 for the automatic stoker, £232 for the superheater, and £330 for the economizers. That made the total which we simply stated in our estimate as "boilers, £4,500"; but the actual boilers would represent only £2,676. One witness said he would use a pressure of 60 lb. of steam to the square inch, and multitubular boilers. The equivalent multitubular boiler would be 18 feet long by about 6 ft. 6 in. in diameter, and a boilermaker, the other day, told me that he would not like to supply one of that size under £1,200. The advantage in cost of that type, therefore, would be only about £150. Either type can be made in the Commonwealth. When Mr. Dixon drew up the estimate he had to base it on the probability of the boiler being made by Hawke and Company, of Kapunda, South Australia, who had represented that they were making high pressure boilers in the Commonwealth, and ought to receive consideration. The cost of £1,200 that I mentioned just now for the multitubular boiler would include brickwork and setting in. When buying the actual article we would have had to consider whether it was to be Australian-made, but the intention at the time was to endeavour to give Hawke and Company a chance

to make the type of boiler mentioned in our estimate. Some of that type have been made here, and put together. The boilers for the Small Arms Factory were made at Cockatoo Dock, and Thompson's, of Castlemaine, have been considering the matter lately, but Hawke and Company are actually building them. Our design was to use steam at 100 lbs. to the square inch. Mr. Vincent's proposal to use steam at 60 lbs. to the square inch would add one-third to the diameter of the main supply pipes and increase the radiation loss by 20 per cent., so that in winter we would be adding quite a ton of coal to our radiation loss. Another witness suggested that steam at 15 lbs. would be sufficient, but that would require doubling the diameter of the pipe and increasing the capacity four times. Using steam at high pressure is an economical proposition. For the Babcock and Wilcox boiler we take the evaporative capacity at 8 lbs. of water to 1 lb. of coal. With the multitubular boiler it would be 7 lbs. of water to 1 lb. of coal, which means that one-eighth of your coal has disappeared. By using a high pressure boiler of the type we suggest our actual economy on coal consumption would represent from 15 to 20 per cent. That would represent nearly a ton of coal on a consumption of 4 tons per day in the winter, and this can be gained by an extra expenditure of £150 on the boiler, and an additional £912 in initial expenditure on the stoker, superheater, and economizer. There is also the advantage that if we wish to extend the supply of heat anywhere in the Base we would not have to increase the size of the supply pipe. All that would be necessary would be to increase the pressure in the boiler. By adding another 10 or 15 lbs. to the pressure you could send your supply 100 feet further without any addition to the main water system. That is a point which should be stressed when you have a growing establishment to deal with. The figures I have given for costs of boiler, stoker, superheater, &c., were quoted to us by Babcock and Wilcox last October. When Mr. Dixon said that the boiler would cost £2,250, he included all those accessories. The multitubular boiler of the ordinary colonial type does not lend itself very readily to the addition of appliances of that kind, particularly so far as mechanical stoking is concerned.

On the question of underground *versus* overhead cables for the electrification scheme for the Base, one witness stated that there would be no difficulty in putting the ordinary lead-covered cables underground without any protection in the shape of redgum boxes or bitumen, and that he had seen this done at Toorak. I made inquiries from the company and elsewhere, and cannot find the slightest evidence of any cable carrying electric current, lead-covered and paper insulated, having been laid underground except in redgum boxes, and with bitumen around it. To do so would be to run a great risk of electrolysis, particularly in wet ground, and a great deal of the ground at the Base is damp. We will have about 30,000 feet of cable at the Base, costing about £10,000, and the cost of providing redgum boxes and bitumen to protect it against electrolysis and damages of all kinds would be only about £1,500. If the cable was laid without protection it could not be lifted up and replaced in boxes, and made reasonably tight without running the risk of flattening or otherwise injuring the lead covering. The only cables I have been able to find that have been laid in Melbourne without enclosing in redgum boxes and bitumen are the Victorian Railways high tension cables lately installed. These are specially armoured, as well as lead covered. There is also a warning board of 9 by 2 inch timber placed over them to prevent any one digging down on them. There is also a small piece of armoured cable laid in Chapel-street, Prahran, but that is only between the power-house and the distributing stations. It is not cut or disconnected between certain main stations, whereas the ordinary lead-covered cable can have a decent joint made cheaply and economically at pretty well any point along its route. The armoured cable would be a very expensive matter for work such as we want, and would not be a good type of cable for us when put down. If there was any idea of using the Base for an aviation school I would protect the aviators against the danger from electrical shock from overhead wires by caging the wires. Of course they would still exist as a mechanical obstruction. I should recommend overhead wires inside the main area of the Base, but it is possible that the portion from the guard-house to the station itself would be better undergrounded. Wherever the buildings exist I should overhead the wires. The Department has laid a good deal of lead-covered cable in redgum boxes with bitumen. One witness said that faults are easily discovered, but our experience is that faults under ground take a long time to locate. Departmentally our experience is that wherever we can avoid undergrounding we do so. In overhead wiring, faults can be easily located and got at. If the objection about aviation is not insuperable, I strongly recommend overhead wiring. At the cordite factory at Maribyrnong we have put in a second system on the overhead plan, although the first system was undergrounded under the best possible conditions. The underground system there has given us trouble, and we have laid 1½ miles of overhead to cut it out. The cost of erecting poles must be considered in estimating an overhead system. The No. 2 system of underground cables at the Base was estimated, in the first place, to cost £18,000, which was afterwards increased to £19,000, as against £16,200 for the overhead. If the cost of redgum boxes and bitumen was cut out, it would only bring the cost of the underground system down to £17,500. I would prefer to deal with the telephones, electric clocks, and fire alarms on separate wirings. I would not attempt to lay those wires in the same box with the ordinary electric cable.

On the question of the type of pipe to be used for the sewerage main, in that part where the pipe line has to cross a depression, the marked advantage at the present time would be on the side of the concrete pipe. Cement is now approximately 11s. 6d. a cask, whereas the cast-iron pipe is about £13 or £14 a ton. When first considering that proposition we were buying cast-iron pipes at £8 a ton, and cement was somewhat dearer than it is now, so that at that period the cost of the two pipes would be about even. I am taking the cast-iron pipe at 12 feet long and the reinforced concrete pipe at 6 feet long for the diameter proposed. The present prices approximately for these pipes would be as 10s. for cast-iron to 5s. for reinforced concrete per running foot. On the other hand, the concrete pipes would want more trestling. On a length of 1,600 feet the market advantage at present would be about £200 in favour of the reinforced concrete. On the other hand, for the carrying of sewage the concrete is not so good a job. It is an easy matter to caulk a leak in a lead joint in a cast-iron pipe. There will

be some little liability to leakages on trestling of that length for some time to come, on account of the movement of the timber. A cement joint is not so easily repaired, and cement pipes are more liable to damage by accident. Still, with the present high price of cast-iron I would be inclined to take the risk and substitute concrete pipes. There is practically no internal pressure in this case, but there is some risk of exterior injury, and it is easier to injure a concrete than a cast-iron pipe. There is also half the number of joints in cast-iron piping. As an engineer, I prefer the cast-iron pipe for the purpose, and it makes a better engineering job. I still adhere to my previous evidence that the cost of cast-iron pipes is about £13 10s. per ton.

I read Mr. Jeffrey's evidence, taken at Flinders, and the statement he sent to the Committee with regard to the work done by the men there, particularly by the bricklayers. I also saw Mr. Murdoch's computation of the cost of the cottages at the Base at £14 8s. 6d. per rod for labour. I am satisfied with the work done down there in the past under day labour, under the conditions which then prevailed. It might be done for less or more than £14 per rod, according to the state of the labour market. Under the conditions down there, I am satisfied to carry it out at £15 a rod, but I believe that you could get the brickwork done at a better price now, because there is more labour offering, and bricks have not advanced in price. The price of £26 or £27 a rod for brickwork and material on those particular buildings at the Base is reasonable. I do not think you would get it any cheaper under contract, because those figures include all costs. I have seen a schedule where the cost of brickwork is put down at so much a rod, but when you include all the other items the price is increased by quite £4 a rod. I saw a case recently, in an actual contract with the Department, where the cost was increased from £21 to £25 per rod. Mr. Jeffrey's figures include everything connected with the brickwork. The first estimate of the cost of the cottages was £111,000. I saw it stated the other day at £179,000 but probably the first estimate was based on Melbourne prices, and took no account of the allowance of 2s. a day payable at the Base. The present estimate should be close, and there should be no reason to anticipate further increases. For a bricklayer to lay only 220 bricks a day may be very good work if he is on special work, otherwise not. A decent average on work like that at the Base should be from 450 to 500 bricks a day.

317. *To Mr. Sampson.*—I would prefer to regard the question of day labour *versus* contract as a matter of policy, and not one on which I should state my individual preference.

318. *To Mr. Mathews.*—I explained to the Chairman where Mr. Vincent is in error in anticipating sluggishness in the hot water system. We have put an exactly similar system in the postal building at the bottom of Bourke-street, and it is working well. The expense of joining up the electric circuits, as suggested by one witness, would not be justified by any probable outcome. I have noticed a tendency to crack in stone and cement pipes laid and jointed with cement, but I do not think that that is always due to faults in the pipes or cement used. It is generally due to external injury. The present methods of joining cement pipes are quite satisfactory for the purposes for which they are used.

My experience is that more supervision is required on day labour than on contract, because we have to take the place of the contractor as well as of the architect. The supervision could be well supplied by leading hands. Naturally we require more men on the supervising staff under day labour, but there is less supervision than on contract. You can get more value from a clerk of works on day labour than on contract. The clerk of works should not be required on a contract. The contractor employs all the necessary supervision, and a clerk of works is, or should be, superfluous if the contractors did their work thoroughly. All the supervision we had at the Base was one clerk of works and a few tradesmen foremen. A contractor would probably have employed more, and paid a little more for them. All the overhead charges are included in the cost of the buildings per rod. They are not abnormal, but they are exceptionally high at present, with so few men employed. The storeman and storekeeper have to be employed in any case, but when we are in full going order the overhead charges represent about 11 per cent., including 3 per cent. for handling goods in and out of store. We cannot reduce the overhead charges in proportion to the reduction in the number of men employed.

319. *To Senator Newland.*—I have had experience of Australian-made multitubular boilers, and have also seen some of Hawke and Company's boilers in working order on the Murray. I saw no reason why they should not be used by us; but we have also had a number of ordinary colonial type multitubular boilers, built for us under contract, working for years. It is not intended to import boilers for the heating work at the Base. When the estimate was prepared the Assistant Mechanical Engineer consulted me as to the type of boiler, and it was then distinctly in our minds to get Hawke and Company to make for us, so long as we could recommend their price to the Minister. Mechanical stokers could be made locally, but, generally, any one going in for all these special appliances gets the Babcock and Wilcox type of boiler, and obtains the whole outfit complete. The whole set-out of that plant is more suitable, as it has been thought out and developed. We understood at first that the Navy Department had no objection to the introduction of mechanical stokers. While we knew they intended to train stokers in the main power-house, we did not think they would want to use the heating system for that purpose. A heating system is better with mechanical stoking, as it can be more readily left for a time. To instal men would increase the cost of stoking, and would mean a less efficient coal consumption. With regard to the pipes for the hot water, I am wondering if Mr. Vincent assumed that in every case the whole of the flow went through each radiator. As a matter of fact, we start off with a 2½-in. pipe, but only a small proportion of the water in that pipe goes through the first radiator. The pipe then diminishes in diameter until it reaches the final radiator with a full supply. Only one-ninth of the whole of the water the pipe is carrying goes through the radiator, but in the meantime the other heated water is passing on to the other radiators. This makes an even supply, and you get the heat quickly. Mr. Vincent's statement that there is loss of heat is perhaps correct, but the amount lost through the extra length of pipe is so small as to be negligible.

With reference to the electric cables, it would be more expensive to put them in an open conduit. The next best alternative is the solid "draw in"

system, with conduits divided into compartments. This is estimated to cost £28,000, as against £19,000. If we used a pipe for No. 2 scheme instead of redgum boxes and bitumen, it would add another £3,000 to the cost, and then would not be so good a job. It would be possible, with a conduit divided into compartments, to underground the telephone, clock, and fire alarm wires in the same scheme, but it would be much better to have them separate, because otherwise you would have to break off from the main track in places to get into the buildings with the telephone and other wires, which would not be so easy if you were using an earthenware pipe. We have taken the fullest advantage of the poles, wherever possible, for our telephone and other wires, but the moment those wires are put underground that advantage ceases. If the electric power cable was underground, there would still be overhead wires at the Base, and these would still constitute a mechanical obstruction to aviators.

(Taken at Melbourne.)

THURSDAY, 28TH FEBRUARY, 1918.

Present:

Mr. GREGORY, Chairman;

Senator Henderson,	Mr. Mathews,
Senator Needham,	Mr. Sampson,
Senator Newland,	Mr. Sinclair,
Mr. Mahony,	Mr. Laird Smith.

Thomas Hill, Engineer, Department of Works and Railways, recalled and further examined.

320. *To Mr. Sinclair.*—I cannot at present recollect the original cost of the gymnasium at Williamstown, although I built it, I think, in 1910. I find from the plan that it is a building of 130 feet by 40 feet, and is like a drill hall, but with a special floor and special fittings for the purposes of a gymnasium. I think it cost twice as much to build it as it would cost to remove it, especially at the present time when timber and iron are so dear and so difficult to obtain. I consider it a good idea to remove the building to put it to the use proposed for it. It is practically a drill hall, but with special fittings and equipment, and specially strengthened to take swinging bars and other appliances of that sort required for a gymnasium. The flooring in the Williamstown building was put in for the special purpose of a gymnasium, and is not the same as the flooring of an ordinary drill hall. In the case of the building at Duntroon we have actually got the flooring on springs. The flooring of this building is not on springs, but it was specially constructed for the purpose of a gymnasium. Your suggestion, with respect to the building, is worthy of consideration, but, on the other hand, I understand that its removal is required for ship-building purposes. I recollect that when fixing the site it was implied that the building might be removed should the Railways Commissioners require to extend their accommodation for the export of wool and wheat. The building is erected at the end of the block at present occupied nearest to the railway track, and, to the best of my recollection, there was an understanding that it would be removed at some future time, which then was not thought to be far distant. It would be of no use where it now is, as the employees of the dockyard do not need a gymnasium. It was built for a special purpose, and I think it might be removed to the Naval Depôt to serve that purpose again. My recollection is that the increased estimate for the armourer's workshop is due to the increased cost of the amended proposal. With respect to the electric wiring Mr. Mundle suggests the adoption of what he calls a ring main. His idea, apparently, is that in the case of a break at any point the current could be supplied from the power house from another direction while repairs were being made. Where a fault has to be repaired only a certain portion of the wiring can be in use while the repairs are being effected. For instance, if there were a break at point 9 on the plan, without a ring main while it was being repaired, the wires from point 9 to point 175 would be dead, but with a ring main the current could be supplied between point 9 and point 175 from another direction. Unless the ring main could be provided at very small expense, I should not recommend it. I can quote the case of a single main at the Cordite Factory, and we have had only a few hours' stoppage on that over many years, which has entailed no inconvenience in the working, though that is a single main extending over some miles. Referring to the hot-water system I have said that I think a return main under the floor would be unavoidable with the H system. I think that Mr. Vincent has said so. I do not see how you could pick up the radiators otherwise. That is not my principal objection to the H system. I do not think it is as good as our own design. There would not be much difference in the cost, and I think you would get a better circulation with our system. As to the claim that, under the H system, the loss of heat would be less because of the circulation over a shorter area, I cannot make the loss of heat under our system more than 2 or 3 degrees at the furthest radiator, a loss which I regard as negligible. With regard to the workshops and the boiler house and power house combined, the matter of the concrete stanchions carrying the frame was dealt with in evidence given by Mr. Murdoch. One proposal was for reinforced concrete piers instead of steel. I think the use of reinforced concrete should be considered, as the proportion of steel required would be reduced to 2 per cent. by using thin rods instead of big steel girders. You would use only one-fiftieth part of the steel required if the other principle were adopted. You would need to use only what are described as commercial rods for reinforcing, and these can readily be obtained on the market. With respect to the clearance required above the traveller, the point raised, if I recollect rightly, was as to the size of the boiler or engine to be lifted from one place to another. Provision is made for a clearance of 31 feet underneath the traveller. That would give 16 feet above the base of the traveller, and that is not too much head room for working a crane of that capacity. It is a matter for consideration whether the head above the traveller could not be reduced. I cannot, for the moment, recollect the reason for the adoption of the cantilever principle for the roof. The amended section using the timber principal gives 42 feet from the floor as against 46 feet with the steel principal. The height of the wall with the steel principal is some 4 feet greater than with the wooden principal. The question you raise might be looked into. I consider a clearance of 42 feet essential over the

whole width of the building. The operator of the traveller is sometimes suspended from it, but sometimes works overhead. As to the material of which the buildings should be constructed, I may say that bricks have recently advanced considerably in price, whilst the prices of the other materials have not been increased correspondingly. Bricks are now quoted at from 46s. to 50s., and are hard to get. I think that, perhaps, it would be best to adopt the steel principal, but if you go in for reinforced concrete piers in place of steel I consider that the rest of the building should be in concrete. That construction would not lend itself so readily to extension as would brick or steel and iron. There would be no difficulty in making extensions if the buildings were constructed of brick. The system of lighting provided for seems to me very good. I think there will be ample light in the building as shown by the plan. I like overhead lighting best of all. I have had no actual experience of men working in shops lighted through the walls as proposed here. If it could have been provided for, a saw-tooth roof, giving lighting from overhead, would have been preferable. That plan is being adopted in later designs for the arsenal and factories.

321. *To Mr. Mathews.*—It is not adopted for a building of the height of the one under consideration, but for 14-feet wall plates.

322. *To Mr. Sinclair.*—I do not regard the provision for windows in these buildings as likely to weaken the walls. The piers will carry the weight, and the windows will be constructed in what are really only filling in partition walls.

323. *To Senator Needham.*—Wherever it can be provided, and is not objectionable from any other cause, I prefer overhead wiring for power and lighting to undergrounding the wires every time.

324. *To Mr. Laird Smith.*—I indorse what Mr. Harold Smith said as regards the estimate for installation. It was carefully taken out and based upon known conditions. We are doing other work, and have all the data now on which to make such estimates. I stand by the estimate given. I am satisfied that the adoption of the alternating current will make the saving he estimates under the conditions set forth by him. I have noticed that the installation at Geelong Woollen Mills has been carried out under the a.c. principle. We are adopting the same principle in connexion with the acetate of lime factory, as being best applicable to the case. We are now satisfied that alternating current motors meet the conditions required. At one time we confined ourselves wholly to direct-current motors. The whole of the recent development has been on a.c. lines, whereas the d.c. principle has made no advance for some years. I am satisfied that the machines in the workshops can be worked successfully with an a.c. current. I notice that Mr. Mundle, in his evidence in speaking of the cost of variable speed motors, said that they would cost three times as much, and he could not get a quote for them in Sydney. We rung up this morning and were told that we could be supplied with an alternating motor for variable speeds at exactly the same price as a direct current, and that they had one in stock. We have used the a.c. current at Canberra, and it has given satisfaction there. There is no difficulty in charging accumulators with the a.c. system, but you would have a loss of 15 per cent. to 20 per cent. In the case of appliances, placed as they will be here close to the power house, the advantage of the high-tension current would be less. The Babcock and Wilcox boiler responds more quickly to the fuel than does the multitubular boiler. That was a consideration in proposing that type of boiler.

325. *To the Chairman.*—It would be possible to provide for warrant officers' cottages at a cost of from £850 to £900 by altering the class of construction proposed and reducing the accommodation. So far as our Department is concerned, this was a matter of policy. We were told that certain accommodation was required, and we made provision for it.

Printed and Published for the GOVERNMENT of the COMMONWEALTH of AUSTRALIA by ALBERT J. MULLETT, Government Printer for the State of Victoria.