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R E P O R T

together with

MINUTES of EVIDENCE and DIAGRAM

relating to the proposed

CITY RAILWAY at CANBERRA.

1916.

COMMONWEALTH OF AUSTRALIA.

PARLIAMENTARY STANDING COMMITTEE ON
PUBLIC WORKS.

REPORT,

TOGETHER WITH

MINUTES OF EVIDENCE AND A DIAGRAM

RELATING TO THE PROPOSED

CITY RAILWAY AT CANBERRA.

MEMBERS OF THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

(First Committee.)

EDWARD RILEY, Esquire, M.P., Chairman.

Senate.

Senator the Honorable John Henry Kenting,
Senator Patrick Joseph Lynch (Vice-
Chairman),*
Senator William Harrison Story.

House of Representatives.

James Edward Fenton, Esquire, M.P.,
William Fyfe Finlayson, Esquire, M.P.,
The Honorable Henry Gregory, M.P.,
Sydney Sampson, Esquire, M.P.,
William Henry Laird Smith, Esquire, M.P.*

* Ceased to be a member of the Committee on 14th November, 1915.

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

No. 59 of 24th JUNE, 1915.

14. PUBLIC WORKS COMMITTEE—REFERENCE OF CITY RAILWAY, AND DAMS, AT CANBERRA.—Mr. Archibald moved, pursuant to notice, 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, viz.:—

City Railway, and Dams for Ornamental Waters incident to the schematic plan of Canberra prepared by Mr. Griffin, and dated 20th March, 1915.

Mr. Archibald laid on the Table a Plan, and Reports.

Debate ensued.

Question—put and passed.

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

CITY RAILWAY—CANBERRA.

REPORT.

THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS, to which the House of Representatives referred for consideration and report the question of the construction of the Canberra City Railway, incident to the schematic plan of Canberra prepared by Mr. Griffin, and dated 26th March, 1915, has the honour to report as follows:—

INTRODUCTORY.

1. The Goulburn to Cooma railway line forms portion of the easterly boundary of the Federal Territory, and from a point on that line in the vicinity of the town of Queanbeyan, a branch line 4 miles 75½ chains has been constructed to Canberra, terminating at a point in the vicinity of the power house in the south-east of the city area.

2. The railway from Sydney to Melbourne passes the northerly boundary of the Federal Territory at a distance of approximately 30 miles, and under the terms of clause 9 of the agreement made the 18th October, 1909, between the Commonwealth and the State of New South Wales, and embodied in the First Schedule to the *Seat of Government Acceptance Act 1909*, it was agreed that—

“in the event of the Commonwealth constructing a railway within the Territory to its northern boundary the State shall construct a railway from a point near Yass on the Great Southern Railway to join with the said railway, and the Commonwealth and the State shall grant to each other such reciprocal running rights as may be agreed upon or as in default of agreement may be determined by arbitration over such portions of that railway as are owned by each.”

The distance from the present terminus of the Queanbeyan-Canberra railway at Canberra to the northern boundary of the Federal Territory is approximately 11 miles.

PRESENT PROPOSAL.

3. The present proposal is to construct on a ruling grade of 1 in 200 a city railway in the position set out on the schematic plan. The southern end of this railway to be linked up with the existing Queanbeyan to Canberra line, and the northern end to be eventually extended to meet the New South Wales system at the boundary of the Federal Territory.

In considering the line and obtaining estimates of cost of this and other suggested routes, a common starting point and a common finishing point have been adopted for the purposes of comparison. The starting point is about ¾ of a mile towards Queanbeyan from the terminus of the present line from that place and away from the existing line, to keep clear of the eastern lake proposal. The finishing point selected is the place at which Mr. Griffin's route and the other routes suggested would follow a common line.

From the starting point mentioned, Mr. Griffin's line would run in a northerly direction, crossing the proposed ornamental water system between the eastern lake and the eastern circular basin on an eastern embankment about a mile long and about 1,870 feet above sea level—that is 45 feet above the water level of the proposed lower lakes, and 25 feet above the water level of the proposed eastern lake.

The line then passes through a tunnel and cutting about 1,400 feet long and runs to the north-west until it approaches to within about 1,250 feet of “Vernon,” and then in a northerly direction to the proposed terminus situated about 1½ miles north of “Vernon,” a total distance of 5 miles 16¼ chains.

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4. Although no indication of the situation of the suggested stations appears on the schematic plan, Mr. Griffin stated in evidence that five station sites are proposed—the first at the south-east corner of the city, in the vicinity of the junction of the two proposed avenues; the second—the central station—just before the line enters the tunnel in the vicinity of the proposed avenue leading from Kurrajong; the third on the proposed parkway; the fourth in the vicinity of the proposed avenue leading from Vernon—the suggested “civic centre”; and the fifth at the 5-mile 16-14-chain point.

ESTIMATED COST.

5. The Engineer-in-Chief, Commonwealth Railways, estimated the cost of constructing a railway on the route laid down by Mr. Griffin at £378,972, or £72,879 per mile.

The details making up this estimate were as follows:—

Description of works—	Quantity.	Rate.	£	s.	d.
Fencing miles	5.2 ..	£160 ..	832	0	0
Cutting to bank and spoil c.yds.	491,960 ..	3/ ..	73,794	0	0
Side cutting c.yds.	nil ..	..	..	..	..
Side ditches c.yds.	2,088 ..	1/6 ..	156	12	0
All drains complete with excavation, inlets and outlets and pitching item	.. ..	..	12,500	0	0
Molonglo River bridge item	.. ..	..	58,975	0	0
Overbridges No.	21 ..	..	78,000	0	0
Underbridges No.	2 ..	..	1,200	0	0
Tunnel item	.. ..	..	75,000	0	0
Mile and grade posts No.	15 ..	6/ ..	4	10	0
Permanent way materials—					
Ballast, 3,751 c. yards per mile .. c.yds.	19,505 ..	5/ ..	4,876	5	0
Sleepers, 4,800 per mile 8' 6" x 9" x 5" .. No.	24,960 ..	6/6 ..	8,112	0	0
Rails and fastenings (80 lb.) .. miles	5.2 ..	£2,972 ..	15,454	8	0
Road laying l.yds	9,152 ..	4/ ..	1,830	8	0
			330,735	3	0
Contingencies 5%	.. ..	..	16,536	15	2
Plant and supervision (except on permanent way material) 10%	.. ..	..	31,700	1	10
Total .. .. .	.. ..	..	378,972	0	0

Mr. Griffin subsequently furnished an estimate for the same line of £197,617, or £38,003 per mile. The details making up this estimate were as follows:—

Description of works—	Quantity.	Rate.	Total.
Side cuttings c.yds.	258,297 ..	6d. ..	£6,457
Side ditches c.yds.	5,040 ..	1/6 ..	378
Drains (under different headings, including large and small culverts and pipe drains, at different prices) .. .. .	.. ..	..	1,516
Tunnel—			
Soft rock c.yds.	6,308 ..	15/ ..	4,731
Hard rock c.yds.	19,172 ..	28/6 ..	27,320
12-in. reinforced concrete lining .. c.yds.	2,950 ..	70/ ..	10,325
12 in. in portals and wings .. c.yds.	300 ..	50/ ..	750
(Total tunnel, £43,126, without taking into account the credit from quarried materials)			
Balance of earthworks, cutting, soft, and rock c.yds.	568,278 ..	1/ av.	£28,414
Deduct from total earthworks, one-half of 778,036 c. yds in causeway, charged to lakes .. ..	.. ..	..	14,879
			13,535
Forward .. .. .	.. ..	..	£65,012

	Quantity.	Rate.	Total.
Forward .. .. .	.. ..	.. ..	£65,012
Bridges—			
Overbridges, 50 feet wide, for four tracks	No. 13 ..	£3,500 ..	£45,500
“ “ 100 feet wide for four tracks	No. 4 ..	6,700 ..	26,800
Underbridges, 50 feet, for four tracks	No. 2 ..	3,500 ..	7,000
Permanent Way—			
80-lb. rails and fastenings tons	1,460 ..	£9 10s. ..	13,870
Hardwood sleepers, 8 ft. 6 in. x 9 in. x 5 in.	No. 25,000 ..	6/6 ..	8,125
Ballast, 12 inches c. yds.	22,464 ..	3/6 ..	3,932
Laying l. yds.	18,304 ..	1/9 ..	1,602
Contingencies 10%	.. ..	..	17,184
Engineering and supervision 5%	.. ..	..	8,592
Total .. .. .	.. ..	.. ..	£197,617

These estimates include no provision for station accommodation, sidings, signalling, telegraph, &c., so that it is reasonable to assume that each of the above estimates may have to be increased by approximately £150,000 to provide for such services. This would increase Mr. Bell's estimate to £528,972 and Mr. Griffin's to £347,617.

As the Committee was unable to obtain from Mr. Griffin an estimate on the lines of the costs furnished by the railway engineers, these estimates do not admit of adequate comparison for the reason that while Mr. Bell allows an amount of £58,975 for the cost of a bridge across the Molonglo, Mr. Griffin proposed to carry his line across on an embankment, charged chiefly against the lakes proposal, and consequently included nothing for a bridge. In regard to those items which are comparable, the main difference appears to be in the estimates for the—

Earthworks, where Mr. Bell is in excess to the extent of	£53,580
Tunnel, where Mr. Bell is in excess to the extent of	31,874
Drainage, where Mr. Bell is in excess to the extent of	10,984

or a total of £96,438

without taking into account the cost of the Molonglo Bridge, above referred to.

Although the difference in the cost of the earthworks and tunnel may to some extent be explained by the fact that Mr. Griffin charges portion of his earthworks against the proposed formation of the lakes, the main point of divergence is caused by the different price per cubic yard allowed for excavations.

On the weight of evidence brought to bear by Commonwealth and State engineers and private contractors as to the probable cost of earthworks at Canberra, the Committee is satisfied that it is unlikely that Mr. Griffin would be able to carry out the work under Australian conditions at the price quoted by him.

ESTIMATED REVENUE.

6. It is not possible to say what revenue is likely to be received, because that will depend entirely upon what population will be attracted to the Capital city, but there will certainly be no net revenue for a number of years.

COMMITTEE'S INVESTIGATIONS.

7. The Committee visited Canberra and inspected the country along the route of the proposed railway and other suggested alternative routes, and took evidence in Canberra, Melbourne, and Sydney, from engineers, architects, town-planners, and others, with a view to informing itself of the latest accepted principles in regard to the location of city railways, &c.

8. *Control.*—The unique position occupied by the Commonwealth Government in regard to Canberra enables it to control the development of the city in a way which has never been possible in any other city of any magnitude in the world, and the Committee realizes that strict control must be exercised if the best work is to be accomplished, for if the people are to be allowed to locate themselves wherever they please town planning is of but little value.

9. *Need for Foresight.*—Throughout its investigations the Committee has endeavoured to realize that the line under consideration is intended to be a main line of communication, and should be designed to meet not merely present requirements but to be capable of providing for an indefinite period of the future. To make the city worthy of Australia it should be kept in mind what it will become in a hundred years or more, and in the expectation that by that time it may have developed into one of the big cities of the world, the Committee has tried to anticipate what the conditions and requirements will be then, and to avoid any tendency to cater for present day needs to the detriment of future efficiency.

10. Double tracks are provided for at present, but possibly quadruple tracks may in time be necessary, and as there is at the present time plenty of land available, it is considered that ample provision should be made for both lines and stations, not only in respect of the line at present under consideration but also in respect of any other practicable route traversing the city which is likely to be availed of in future to give railway communication to the southern and western parts of the city. It has been common experience that towns frequently grow at a very rapid rate from causes which it is impossible to forecast, and for that reason, in planning for Canberra it has been considered advisable to keep in view the prospect of the city being larger than can be estimated from the present date.

11. *Bridges.*—The fact of the proposed railway being a depressed line would necessitate the construction of a bridge in every case where a road crosses the line.

In route "A" (Mr. Griffin's scheme), besides the embankment across the proposed lake system, he states that provision would be required for nineteen railway and street-crossing bridges within the 5 miles.

Mr. Bell states that in route "A", 23 bridges would be necessary. In route "A1," there would be 25 bridges; in route "B," 29 bridges; in route "B1," 32 bridges; in route "C," 23 bridges; and in route "C1," 21 bridges.

12. *Route of Railway.*—Apart from the question as to whether it is advisable to put in hand the construction of the railway at the present time, it is essential that the route of the railway should be definitely settled to permit of the location of those elements of the life of the city which depend upon or are closely related to the railways, and thus allow such works as may be considered necessary to be proceeded with.

13. A large amount of evidence was taken with a view to ascertaining whether it would be in the interests of the future capital to bring the line near the centre of the city or keep it at some distance from it. The general trend of the evidence showed that the tendency in most modern cities is to bring the railway as near as practicable to the centre of the city. The fact that in some European cities the railway is at a distance from the centre is accounted for by the explanation that those cities were built before the adoption of railways, and it would not have been possible to bring the railway near the centre without disturbing historical buildings and monuments and incurring considerable expenditure.

14. The railway at Canberra being designed to run for the most part as a depressed line with the streets crossing above the railway on their natural levels, but with no level crossings, removes a considerable amount of any objection which might be raised to the railway traversing the city. In addition to this it is probable that with the increase of population at Canberra, the practice existing in many modern cities to-day of keeping steam railways as far as possible out of the city and using electric traction within the city will be adopted.

15. *Alternative Routes.*—The western portion of the city area which is considered to be suitable for residential purposes is quite unserved by the railway system shown

on the schematic plan. It was ascertained that the intention of the designer was that this western area should be catered for in the first instance by motor vehicles, &c., and eventually by an electric tram service.

16. The Committee was informed that the three adjudicators of the Federal Capital design were all of opinion that the railway in the second premiated design was superior to that in Mr. Griffin's plan, as being so placed as to better serve the central and western portions of the city and avoid the expense of the establishment of an electric tram service. The Engineer-in-Chief, Commonwealth Railways, was therefore asked to submit estimates for the construction of a railway approaching nearer to the site proposed for Parliament House, as well as on certain suggested routes which differed from that shown by Mr. Griffin in his schematic plan.

These routes were—

- (i) that known as "A1," in which the line after crossing the embankment between the eastern lake and the eastern circular basin is diverted a little to the west to avoid the tunnel through the spur south of Mount Ainslie and joins the original line again just before reaching the "Parkway." By this deviation the length of the line would be reduced 1 to 5 miles 13 chains, and the cost to £306,155, or £59,332 per mile.
- (ii) that known as "B," which runs in a north-westerly direction from the starting point for a distance of about 2 miles, then swings around to within a distance of about 1,700 feet of Camp Hill, crosses the lake system between the eastern circular basin and the segmental basin, then runs almost parallel to the Griffin route, but about 1,200 feet nearer the lake until it reaches to within 600 feet of Vernon, when it turns to the north-west still parallel to the Griffin route, but about 200 feet further west. The length of this line is 6 miles 1 chain, and the estimated cost £386,668, or £64,337 per mile.
- (iii) that known as "B1," which follows route "B" until after crossing the lake system, when it junctions with the Griffin line in the vicinity of the parkway. The length of this line would be 5 miles 75·5 chains, and the estimated cost £397,701, or £66,963 per mile.
- (iv) that known as "C," which follows the Griffin route until after crossing the lake system, then keeps nearer the water to avoid the broken country. The length of this line would be 5 miles 22 chains, and the estimated cost £309,413, or £58,600 per mile.
- (v) that known as "C1," which follows route "C" as far as the 1½-mile point, but from that point to the 2½-mile point approaches nearer the lake system and thus avoids some cutting. The length of this line would be 5 miles 17 chains, and the estimated cost £289,709, or £55,606 per mile. It was subsequently stated in evidence that if the high embankment between the eastern basin and the proposed eastern lake were omitted, the cost of the "C1" route could be reduced to approximately £280,000, or £53,717 per mile.

COMPARISON OF ROUTES.

17. Summarized, the various routes considered were:—

Route.	Length.	Total Approximate Estimate of Cost.*	Approximate Cost per mile.	Remarks.
	m. ch.	£	£	
A	5 16·14	378,972 (a)	72,879·2 (a)	Route recommended by Mr. Griffin
		197,617 (b)	38,003 (b)	
A1	5 13	306,155 (a)	59,332·3 (a)	Deviation of portion route A suggested by Commonwealth Railways
B	6 1	386,668 (a)	64,337·4 (a)	Route suggested by Commonwealth Railways
B1	5 75·5	397,761 (a)	66,963·1 (a)	Alternative route of portion of route B
C	5 22	309,413 (a)	58,600·0 (a)	Route suggested by Commonwealth Railways
C1	5 17	289,709 (a)	55,606·3 (a)	Alternative route of portion of route C

* Method used provision for station accommodation, sidings, signals, telegraph, &c.

(a) Estimate of cost furnished by Mr. Bell.

(b) Estimate of cost furnished by Mr. Griffin.

COMMITTEE'S RECOMMENDATIONS.

18. *Grade.*—The proposed ruling grade is 1 in 200, and although it was stated in evidence that it would be possible to work suburban traffic on a much steeper grade than that, the Committee, having in view the disadvantages usually associated with unsatisfactory grades for suburban traffic, is of opinion that the grade of 1 in 200 should be adopted within the city area.

19. *Tunnel.*—The proposal to construct a lengthy tunnel through the high mount to the north of the eastern basin was a feature of Mr. Griffin's route that did not commend itself to the Committee. It was stated in evidence that it is not advisable to have a tunnel in a railway handling suburban traffic, and the Engineer-in-Chief, Commonwealth Railways, estimated the cost of such a tunnel at £75,000—a considerable sum to pay for an undesirable feature which can easily be avoided. The Committee decided therefore that the route should be altered to preclude the necessity for the existence of this tunnel.

20. *Stations.*—The question of the situation of the various stations and more particularly of the central railway station, is one to which the Committee gave much thought, as it is recognised that the experience of cities in other parts of the world has been that the main railway station has become the point of central focus in the life of the city, and has materially affected the direction of its growth. In the case of Canberra, it is probable that the railway will be a much more powerful factor in determining the growth of the town than anything else, and in fixing the position of the central railway station the Committee recommends that ample provision should be made to meet all possible future needs, and care should be taken to provide for access from all sides and avoid anything in the nature of congestion. The fact that the stations at Canberra are through stations and not terminal stations, simplifies the position.

21. The location by Mr. Griffin of his central station practically at the mouth of a tunnel was regarded by the Committee as objectionable, as well as the fact that the railway at that point would be about 30 feet below the level of the roadway, and access could be provided only at considerable expenditure.

This was one of the considerations which induced the Committee to favour a somewhat different route for the railway. The route recommended would, however, run generally parallel to that shown on the schematic plan, consequently the central and other railway stations can be located on the same axial lines as those suggested by Mr. Griffin and should lead to but little modification of his plan.

22. *Goods Stations and Marshalling Yards.*—It was represented to the Committee that the tendency in continental and British cities is to treat goods stations quite apart from passenger stations, so that whether or not it be decided to have the railway brought near the centre of the city, the general consensus of opinion is that the goods stations and marshalling yards should be kept as far from the centre of the city as practicable.

The establishment of marshalling yards is, however, an item that may very well be left for future consideration. No marshalling yards are yet in existence in the city of Brisbane, so that it is unlikely that any will be required at Canberra for many years.

It is therefore recommended that after definitely fixing upon an area, approximately one mile by half a mile, at some distance from the centre of the city as a site for the marshalling yards, the area be made available for leasing, if required, on such conditions as will enable the Commonwealth to resume possession when required without any considerable compensation for improvements, &c.

23. *Reservation.*—Experience in older countries inclines to the view that railways tend to destroy the residential value of land immediately in their vicinity, and the consequence is usually a poor type of small residence with unmistakable back yards and general unsightliness. The Committee is therefore of opinion that in all cases where the route of the railway traverses residential districts a generous strip of land should be reserved on each side of the line for plantation or recreation purposes.

24. *Route.*—After giving the matter very careful consideration, the Committee is of opinion that if settlement proceeds along the lines anticipated and the people establish themselves as thickly over the area north of the proposed ornamental waters as over the area to the south of them, then the best ultimate route for the permanent railway will be that known as "C1" suggested by the Engineer-in-Chief, Commonwealth Railways, and estimated by him to cost approximately £280,000.

25. *Temporary Surface Line.*—In the opinion of the Committee, however, there is no justification for the construction at the present time of a permanent line at a low level to pass under streets that have not yet been made and may not be made for many years, and it would be unsound from a business point of view to expend approximately £300,000 in the building of a line until there is a reasonable volume of traffic.

26. It appears to the Committee that requirements for a considerable number of years will be met by the construction of temporary surface lines capable of handling building material and light traffic, until it is decided to proceed with the construction of the permanent low level line. This would obviate the expenditure of many thousands of pounds for a number of years.

27. With this in mind the Committee obtained from the Engineer-in-Chief, Commonwealth Railways, an estimate of the cost of building a surface line of the nature indicated on route "B" from the end of the existing line for a distance of about 5 miles 14 chains. At the request of the Committee this estimate was given in three sections, as follows:—

Section 1—From the end of the existing line to a point about midway along the avenue forming the south-eastern boundary of the Government Group. Length, 1 mile 22 chains ..	£7,000
Section 2—From the end of Section 1 across the river to a point about 1,000 feet from the proposed Market Centre. Length, 1 mile 1 chain ..	15,000
Section 3—From the end of Section 2 to the 5-mile 14-chain point. Length 2 miles 71 chains	15,000
	<u>£37,000</u>

28. Mr. Griffin, in the course of his evidence, stated that he estimated the cost of the construction of a cheap line of railway right across the City from the present terminus to the northern boundary of the Territory, a distance of approximately 12 miles, at £87,000.

ECONOMY EFFECTED.

29. By the adoption of the Committee's recommendations, it is estimated that the following savings will be effected:—

(a) By building surface lines for present requirements, the interest on approximately £300,000 for a period of, say, 10 years at 5 per cent.	£150,000
(b) By the adoption of the "C1" route as against route "A," a capital cost of	100,000
Total	<u>£250,000</u>

COMMITTEE'S DECISION.

30. The decision arrived at by the Committee is shown in the following extract from its Minutes of Proceedings:—

Mr. Finlayson moved—That, while the Committee approves of the general direction of the permanent city railway as indicated by Mr. Griffin on the schematic plan, subject to a deviation to eliminate the tunnel and follow generally the route "C1" suggested by Mr. Bell, it is of opinion that there is no reason for the construction of anything but temporary surface lines until the development of the city warrants the construction of the permanent line. Seconded by Senator Keating. Carried unanimously.

Edward Riley
EDWARD RILEY,
Chairman.

Office of the Parliamentary Standing Committee on Public Works,
120 King-street,
Melbourne, 24th November, 1916.

FEDERAL CAPITAL RAILWAY.

MINUTES OF EVIDENCE.

(Taken at Melbourne.)

TUESDAY, 13TH JULY, 1916.

Present:

Mr. RILEY, Chairman;

Senator Lynch, Mr. Fenton,
Senator Story, Mr. Finlayson

Walter Burley Griffin, Federal Capital Director
of Design and Construction, sworn and examined.

1. *To the Chairman.*—I have prepared the sections for the proposed railway in the Federal Capital Territory site, and if the Committee desires, I will place the documents in as evidence. This railway comes in and out of the city at practically the same points as were determined upon previously, and in this respect it is substantially the same as Mr. Hobler's suggested route. A railway for a city is determined by its relation to the whole. It is not desirable to have a line intersecting a city any more than is necessary to reach the most important points. There were some other considerations which cannot be shown on the map, those concerning the relationship of the railway to the outlying country. For instance, it should be in a central position in regard to the whole territory which would ultimately be made available for the city site. It might naturally be expected that the level land lying to the north and east of the city site would become developed at an earlier stage than the land lying to the south-west, and that subsequent communication should be provided. To the south-west there is abrupt country which would hardly be suitable for long haul transportation. I do not think that the population will necessarily gather round Parliament House and the administrative buildings. In the beginning, the transit accommodation for this portion of the city site would be by bus later on, traction in various forms, such as trams, and finally, rapid transit, when the demands for passenger transportation had reached that stage. The Canberra terminus is not shown on the map. The concentration of city and suburbs are so related to the railway that in this scheme the railway offers no impediment to the accessibility of any point. That is to say, the railway is brought in on the radial principle. In the development of the city we must provide for an indefinite period of the future, and not merely for immediate requirements.

2. *To Senator Lynch.*—The existing terminus is in the site of one of the future suburbs, where I presume there will be a local town hall and local business places. This scheme of town planning is on the British idea, which provides for a city made up of various centres of the population, and not on the Continental scheme. The main civic centre is on the north side of the orna-

mental lake. I kept in mind the idea, when planning the city and railways, that the whole Federal area will be under one city authority, and the city therefore has been planned on the British model, which means a federation of smaller groups of people as against the Continental idea of a unified population. On the Continent the unified scheme was originally necessary for the defence of the civic population in one centre, and this idea has found expression in the modelling of continental cities; but in Great Britain, because of the isolation of the islands, there has not been the necessity for the walling in of the towns for defence purposes, and that need also does not apply to modern cities, because concentration of population for defence is now rather a source of weakness than of strength.

3. *To Mr. Finlayson.* The railway has been designed to provide the handling proper for all the innumerable industries that go to make up a modern city. This can be done most economically by the regulation and segregation of the various forces that operate in the development of a city. If we ignore that fundamental condition of town planning posterity will experience great disadvantage. We can see that with only a small population we could bring the slanting yards close to Parliament House, but that would not be convenient a long time hence, and one or the other would have to be removed. Economy dictated the placing of these activities where they are best suited to the conditions of all the people, and we have allowed ample scope for this development. We must not plan for a village—that is done where town planning is not practised—because when a village grows to a large town, enormous areas are reduced to low utility becoming slums, as they are not in their right relationship to the city in its later development. The contour shows that the line will be fairly level through the city, and that the ruling grade will be 1 in 200. There are various ways of taking the railway through the city. One is to take the railway on the ground levels. In that case all the crossings would have ultimately to be raised on bridges, or depressed in tunnels, meaning increased maintenance and construction cost. Another way is to elevate the track, which would be expensive, as the material would have to be brought in from outside and deposited along the roadway.

4. *To Mr. Fenton.* The most economical way in the city plan is to so arrange the scheme that where the railway is depressed the roads may go overhead; and elsewhere to elevate the railway to allow the roads to go underneath. By this method the earth taken out of one place may be used for embankment purposes in other places.

5. *To Mr. Finlayson.*—This is the method adopted in my plan. Where the railway is depressed the earth is removed and used on the embankment which elevates the line over the lakes,

and in other places. By this embankment we also create 24 square miles of water to be used for ornamental purposes.

6. *To Mr. Fenton.*—This scheme for the embankment is most economical from a railway point of view, and quite apart from the proposal to dam back the water in that eastern part of the city area. It is a scheme which has been worked out with my officers, of course.

7. *To Mr. Finlayson.*—The contour shows 1,855 feet at the northern entrance point of the railway into the city area; 1,886 feet at the main station point, and 1,850 feet at the southern entrance point. There are no level crossings. We propose to come to the surface at different points for the economic handling of the traffic by the laying of shunting tracks in such places as east of the park way, east of the civic centre, and at the north and south entrances, all these being places for shunting local traffic on the level. The ruling grade from the southern end to the northern entrance is 1 in 200.

8. *To the Chairman.*—The viaducts may be built of concrete, and ornamental, but that could be a matter for subsequent determination. I have not made any estimate of cost of the railway, but I have gone as far as I can by taking out the quantities of material, but until I can say what the materials are to be, I cannot indicate the cost. It will not be an expensive railway, as city railways go. We have to remember, however, that it will be a city railway, and not a country proposition. After leaving the existing terminus there will be a tunnel and cutting for a distance of 1,400 feet, passing under two main avenues of 200 feet.

9. *To Mr. Fenton.*—Except at those points where the railway will be brought to the surface there will be tunnels or cuttings or fills.

10. *To Mr. Finlayson.*—I would rather depress the railway track than elevate it, for an elevated railway bisects the whole town like a Chinese wall. In the northern part, where it is proposed to have a residential area, the railway will be below the ground level.

11. *To Mr. Fenton.*—Approaching the city from the north there will be no near view of the town for the reason that the railway will pass through an area designed for warehousemen's premises and the business quarter. The railway could not follow a higher level, because it would interfere with the accessibility of the city in regard to its industries. Even in that case of an elevated railway, there would not be any possibility of a view to the traveller, because the line would pass through a locality intended for buildings and traffic, and which must have side-track service.

12. *To Mr. Finlayson.*—The railway will come in on the ground level on the north side of the city, where there will be marshalling yards for the traffic. Then it will pass underneath the road and approach the civic centre, where there will be a track yard for shunting purposes on the level. Then it will be depressed until it reaches the parkway, and pass through a level stretch of ground to be used for trucking purposes, and into a tunnel and cutting, and come into the station below the street level in much the same way as at Flinders-street, thus allowing of the maximum accessibility to the platforms. It will then pass through on to the level and to an elevation to the south, giving the traveller a view of the whole city over the lakes, extending for over

a mile. It will cross the lakes by an embankment, and reach the last station on the south-east corner of the city area.

13. *To the Chairman.*—It would be impossible at present to give an estimate of the cost of this work until I know what will be the cost of excavating the material at the northern end. Both works should be carried out simultaneously. That is my idea of the whole arrangement.

14. *To Mr. Finlayson.*—I think the construction of a line is a necessity from all points of view, and that it should start from the existing terminus so as to provide for the transport of material.

15. *To the Chairman.*—It will be some time before the Parliamentary buildings are ready for occupancy, and it will be better for the builders' homes to be located in places where they are not likely to be disturbed later on as the city develops. It is not a hardship for workmen to walk a mile or so to work, because they must be moved about during construction operations. We cannot move into the Parliament buildings before accommodation is provided for a large number of officials.

16. *To Mr. Finlayson.*—For the purpose of establishing residential suburbs I would not recommend a deviation of the railway line any more than, perhaps, to save time in rock cutting, because the rest of the work will not take up much time. There is not a great deal of earth to be moved in the whole cutting, and it should be moved by mechanical appliances.

17. *To Mr. Fenton.*—In the early stages of the city's growth the concentration of workmen's houses in other places than those planned would not matter very much, but the workmen are not the only people to be considered. They are the advance corps, so to speak, but as population expands there might be an interference with the design. I admit it is not possible ordinarily to get workmen located in one spot, but I am considering that we will have to supply workmen immediately with all facilities such as water, sewers, light, and so on, and we cannot do that economically unless we get them into their proper place in the plan. I can quite see that where factories are established, workmen will desire to congregate round them, but I have not laid down any unalterable law with regard to their exact location. I am trying to follow the line of least resistance in the development of the city.

18. *To the Chairman.*—The south-western area of the site is intended for a high-class residential population, as the country there cuts up better into large blocks. It is desirable, of course, that this section should be as remote as possible from that part in which intense development will take place. There are no plans for steam railway communication with this portion of the city, but there will be rapid transit by means of the straight connecting thoroughfares. The nearest railway station from the south-west corner of the site will be 3 miles.

19. *To Senator Lynch.*—It is not probable that there will be development, from a residential point of view, in the area further westward, as the Yarralumla Valley will be reserved for golf, polo, race-course, and recreation clubs generally. There are fine background features, and altogether the scenic properties of the valley are admirable for recreation.

20. *To Mr. Finlayson.*—The land at Kurrajong and Red Hill would be utilized for residential purposes, and if railway communication were provided it would be by means of a loop line, but

this would depreciate residential property. It is rough country. There is a tendency for the population to concentrate on the south-eastern corner, because the railway terminus is there at present. I would rather see the terminus brought further into the city, because then we would have a concentric growth of population, the idea being not to allow any permanent settlement in the south-eastern corner of the site. It must be remembered that the Federal Government have extraordinary powers in land administration, and that land could be set aside for definite purposes. From the point of view of economy, it would be well to develop only one centre at a time. It is probable that the line from the northern end of the city will be extended to Yass, but I do not know that that would bring more through traffic than the railway from Queanbeyan. The material for the embankment between the eastern lake and the upper circular basin can be provided out of the northern railway excavations. I know sufficient earth can be obtained, because I have been through the quantity estimates, and I will furnish them to the Committee in due time. The construction of an embankment would be a serious matter if we had to transport all the material. The volume of the embankment will be 570,000 cubic yards, it will be 25 feet wide on the crest to provide for two separate sets of rails, while there will be a roadway of 33 feet on the east side, and another roadway of 50 feet on the west. Altogether I think it would be about 200 feet wide at the base. The height of the embankment would be about 1,870 feet above sea level. It has no relation to the level of the water in the eastern lake, because the railway road level is really required higher than the water level. The eastern lake is 20 feet higher than the upper circular basin, and if the railway embankment were not made as high as contemplated, there would not be enough water in the eastern lake. As it is, the eastern circular "basin" is the shallowest of all. Without the embankment there would be no lake.

21. *To the Chairman.*—The railway route from the lower end of the city to the north is approximately 5 miles.

22. *To Mr. Finlayson.*—At the civic centre there is provision for permanent railway tracks, the yard being 1,800 feet long and about 400 feet wide between the alley-ways, which are intended for tennishers and carriers and are connected with the future industrial functions of the city, the idea being that these alley-ways should be used for the heavy traffic. The station at the civic centre would not compare anywhere with Flinders-street, but I think there is altogether too much concentration at Flinders-street, and I believe the railway people agree with me that there should be other distributing points in Melbourne. The authorities, however, have brought all the lines into one single point, whereas the better system is to distribute the traffic more nearly according to the requirements of the people.

23. *To the Chairman.*—There will be five station sites in the city or Capital City area.

24. *To Senator Lynch.*—Looking at the railway from the south, it does appear to be on the fringe of the Capital City site, but we must not forget that the boundary of 4 miles square is purely an arbitrary line, and that the railway will really serve a much larger area. If we had a model to illustrate the point, the relationship of the railway road to the whole of the area could be better

seen. When I returned from America I put in a proposition for a model, which would cost about £500, but that proposition has not been honoured, though I think it is essential in order to have a clear view of the city plan in its relation to the outside country. The model in relief for the city site is not sufficient for this purpose. I never favoured the original Scrivenor route for the railway, because it bisected the city, and I wanted to have the railway brought in on the radial system. I can see no advantage whatsoever in Mr. Hobler's proposal, because it brings the railway into the residential area, and its effect will be to force businesses into places designed for residential purposes. It is true that under my proposal the civic centre appears to be bisected, but I propose to bring the line in on the radial basis, which is quite different from bisecting it. I object to bringing a railway into an area where it is not required for business purposes, and I urge that a parliamentary and administrative centre and a business centre in juxtaposition would react unfavourably on each other. It is not contemplated under my plan to establish, in the future, a general business centre on the south, but there will be local businesses purely for local needs.

25. *To Mr. Fenton.*—It is not likely that a big business man would establish himself in the south in circumstances similar to those which have produced big firms to establish themselves in, say, Prahran. There is good reason for their action in the latter case, because between Prahran and the city there is a large area of park lands, and people coming from the other side would stop at a reasonable distance to do business rather than incur the expense and bother of travelling double the distance to reach town. In the Federal Capital City there would be no parallel case to that of any business man establishing himself in any principal suburb to draw trade to his place, because in the Federal Capital City such a business man would not, I take it, be allowed, even were he inclined, to exercise his judgment by establishing a big business in a place inaccessible to the whole city.

26. *To Senator Lynch.*—Assuming that there would be a local development from a business point of view on the south-eastern corner of the city site, the railway would be near enough for all practical purposes. It would be a mile to the lower station. In the plan, Parliament House will be approached from the civic centre by a bridge across the lake. In the first instance, transit will be by bus, and as soon as traffic makes it economical, by train. The station on the lower point will accommodate the military college, and the station at the civic centre will accommodate the town population. It would not be advisable to adopt some other route, and bring the railway along the edges of the lakes. There are many examples all over the world of this being done, but it is for the purpose of transferring traffic from railway to water carriage, and in the Federal Capital area the lakes are to be reserved for the pleasure of the people, so, if the railway skirted the lakes, there would be obstruction to the view and interference with the accessibility of the ornamental waters. The scenic advantages of a railway on this route would be small compared with the disadvantage in the use of the lake by the people of this city. These lakes have been designed primarily for the benefit and pleasure of the people. The lakes and the parks are inseparable in this respect; they are intended for

the enjoyment of the people, and this enjoyment would be interfered with if the railway skirted the lake.

27. *To the Chairman.*—I think that in the development of the city, the railway which would be required for handling materials should be undertaken first. On general principles I would not advocate any more temporary work if it can be avoided, as I think there has been too much temporary work done already. The railway through the city site up to the proposed terminus may be regarded as a necessary part of the line to Yass.

28. *To Mr. Finlayson.*—If the line were taken round to the north of the first circular basin, part of the south-eastern portion of the city would be cut off from access to the basin, which is one of the features of the city, and which has been designed at heavy cost to make the city attractive. Therefore, if the line were taken in this direction, this feature of the lake system, which is an important one, would be rendered nugatory by the railway being between it and the people, because the line would have to be elevated, and it would cut off the view entirely and interfere with the real enjoyment of the people in the southern part of the city.

29. *To the Chairman.*—It is true that the same may be said of the artificial lake to the east of the embankment, but we can only create that lake by the embankment, which is, therefore, entirely justifiable.

30. *To Mr. Finlayson.*—There is no alternative route that is satisfactory to me south from the civic centre whereby the railway may be brought nearer to the population than at present. I have seen many of the designs submitted for the competition, but I do not think that any of them contains any suggestion of that nature. This line was contained in my prize design, and I have not been able to find any other plan to improve on it.

31. *To the Chairman.*—Mr. Hobbler's proposal would be obstructive to the main lines of traffic, and if it were adopted it would probably be necessary to alter the city plan. Whether that plan should be modified is another question, and I could not give an opinion on that in a minute, or a day. I would like to see what Mr. Bell has to say in explanation on this point. I consider it is possible to run the line through there, but I do not think it is desirable.

(Taken at Melbourne.)

WEDNESDAY, 14TH JULY, 1915.

Present:

Mr. RILEY, Chairman;

Senator Keatings.	Mr. Finlayson.
Senator Lynch.	Mr. Sampson.
Senator Story.	Mr. Laird Smith.
Mr. Fenton.	

Walter Burley Griffin, Federal Capital Director of Design and Construction, recalled and further examined.

32. *To the Chairman.*—In further reference to the railway, I may say that I have looked over Mr. Hobbler's plan and in connexion with it have read his report. In that report he gives costs, but, as on the plan, he shows no levels of the works, I cannot check his estimate of cost, and without a knowledge of the levels it is impossible to give any intelligent opinion upon the

scheme. A number of serious problems are affected by the levels of the railway, and I suggest that the Committee should call Mr. Hobbler, and after his evidence in connexion with the railway is in print I shall be in a position to go into the matter fully.

33. *To Mr. Finlayson.*—If the route proposed be adopted for the railway it will seriously alter the grades proposed for important streets and avenues, and it might almost be described as an underground railway. A good many things will probably require to be said with respect to the proposal when we have the facts. The plan is merely a suggestive indication, and does not show at all what the estimate of costs is based upon.

34. *To the Chairman.*—A connexion with the proposed railway giving reader access to the parliamentary buildings is already embraced in my plan, but it is assumed that it would be by electric, and not by steam traction, because steam traction would be undesirable in that part of the city. It will be understood that in the matter of grades there is scope for a very great difference between steam and electric traction.

35. *To Mr. Laird Smith.*—It would, of course, be possible to run a spur line from the proposed railway towards that part of the city in which the parliamentary buildings will be erected, but that would be expensive, since it would mean running to a dead-end, and will involve a practically useless track for a good share of the time. For the accommodation of passenger traffic involving frequent stops and starts there can be no question of the relative advantage of electric over steam traction. Where there is considerable overland haulage, various complications arise in connexion with electrical control, and the comparative advantage of electric and steam traction is very debatable. I know of only a few such cases in large metropolitan areas where electric traction has been substituted for steam traction.

36. *To Mr. Finlayson.*—With certain qualifications I should say that it would be advisable to keep the steam traffic for communication to and from the city, and to have electric traction for communication inside the city. The steam traction should be brought as close as possible to the intense industrial areas of the city and the centres of business. That is one of the distinctions I make between the residential and business portions of the city.

37. *To the Chairman.*—I believe that the construction of the railway is an urgent matter. When it is suggested that being so far from the executive centre the construction of the railway is not an urgent matter as a means of assisting in the construction of the Commonwealth buildings, I say that I believe that the railway would be of great utility to those who will be engaged in the construction of the Commonwealth buildings, and for whom accommodation must be provided. I am considering now the city of Canberra, and not merely the Capital. This involves one of the apprehensions in the minds of the Committee that I should very much like to have straightened out. I should like to have the source of that apprehension definitely stated, so that I may be able to meet the objections which may be raised. I want to say that I believe that the people will be glad enough to make the business centre where we desire to make it, irrespective of the places where they may be engaged upon construction work. It is, in my opinion, better to

put the workers to some little inconvenience in the carrying out of certain works for the city than to provide them with accommodation which might be more immediately convenient, but which would have to be removed later on. It is suggested that I am advising the establishment of residence and business centres to the north of the executive centre, and that I have provided also for residential areas to the south of that centre. But my contention is that the place of residence of the wife and family of a man employed in the construction, for instance, of Parliament House, might very well be entirely irrespective of the place where he is at work. Shops, schools, supply, accommodation and other conveniences for families of the workmen may well be provided to residents irrespective of the location of their work. The leisure occupation of the worker would have no relation to the particular job at which he was employed. It might be better provided for in one centre than in a number of centres. When it is suggested that I do not propose to provide for the residence of the people of the working class in the residential area to the south of the executive centre, I say that I do not think we should develop that region in the environments of the Capital until later on. We should not hurriedly start with the development of that area when it might be developed more effectively later on.

38. *To Mr. Fenton.*—When it is suggested that, according to my report, I have expressed myself in favour of workmen being allowed to reside on the southern residential area if they are going to carry out work at the parliamentary centre, I say that that report was on the assumption that there are insuperable obstacles in the way of carrying the railway through from Yass. I do not know what those obstacles are. It was stated that it would be many years before a railway is constructed through from Yass, and I had to grant that, previous to my being engaged in connexion with the work.

39. *To the Chairman.*—It would be economical, in the long run, and to the ultimate advantage of the Federal City, to fix one centre of gravity and let the city develop from that. We must keep the development of the city under control if we are to do ultimately the best possible work. It is true that with the construction of the line from Queanbeyan only there will be a tendency towards the settlement of population around the terminus in the Capital site, and that is why I want it removed. Some settlement has taken place near the power-house, but I should not like to consider that as permanent. The power plant is all right, but the buildings around it are not even hygienic. I should prefer the establishment of a single nucleus of settlement and the continuation of the growth of the city from that. My original plan did not fit in with the proposed line from Queanbeyan at all. If it had been the intention to carry that line by the route proposed by me that portion of the city would have been laid out quite differently. What I should prefer to do next is what I suggested some time ago. I should like to be given an opportunity to give an exposition to the Committee of the whole of the city plan showing the relationship of the streets and sections to each other, and generally the circulation system of the city. I should like to be in a position to do that in quite a general way. Taking up these proposals piece by piece, the attention of the members of the Committee is concentrated on certain details whilst my attention is concentrated upon the whole plan,

and we therefore are scarcely able to understand each other. I could arrange to make a general statement to-morrow in connexion with the whole plan.

40. *To Mr. Lynch.*—When you suggest that if we compelled settlement to be confined in the initial stages to the northern residence area there would be an outcry against people being compelled to reside at such a distance from the executive centre while there was so much land available for residence purposes in the area to the south and nearer to that centre, I say that, while that may be true, the reason for such a course of action could be explained. The people could be informed that the whole basis of town planning is to consider the matter as a whole, and so relate our functions that they will continue indefinitely in that relation. If we consider the location of functions according merely to immediate needs, we shall ultimately bring about confusion, and the difficulties we shall then have to face cannot be met without considerable expense for tearing down and removing. I believe that it would not make for economy to have two initial cities, and I think that the people at the outset may be induced to consider the matter seriously, and to agree that the way in which the city can be best developed is not a matter on which they are competent to judge. I want the city to take advantage of the southern residential site in the very best possible way for the benefit of the future, and not the immediate village of Canberra. The danger of establishing the initial city at a certain place from considerations of immediate convenience is that demands will be made for further improvements there, and a public opinion will be created in favour of continuing the development from that centre, and so everything on which the proper future development of the city depends will be thrown out of its proper place. We must do what is necessary to control the growth of the city, and prevent the creation of vested interests and a public opinion that would work against the accomplishment of our design.

41. *To Mr. Fenton.*—When I am asked why there should not be a suburb for the residences of the working men somewhere adjacent to the place at which they are employed, I would say that I do not wish to have the southern residence area, or any particular area, confined to working men's residences. It has to be remembered that if a centre of settlement is formed the people will require to have churches, theatres, and places of amusement generally provided, and we cannot justify an establishment of two centres at this stage, when that may involve expensive removal later on. If we could confine the people to one portion we could more conveniently supply them with the light, heat, and power needed, and we should not allow people to settle where they could not be properly provided with sewerage, water, and sanitary accommodation. When I suggested the modification of my plan which has been referred to, I took the view that there were insuperable obstacles in the construction of the line from Yass. I do not take that view now. I understand that the New South Wales Government are prepared to run the railway across. I do not blame any one for putting the power-house where it is. But the original plan had to be modified because the power-house was built. It was the erection of the power-house and the running of the railway in the way proposed without any regard to the original plan which necessitated the change of the plan.

(Taken at Melbourne.)

TUESDAY, 20th JULY, 1915.

Present:

Mr. RILEY, Chairman;

Senator Keating,	Mr. Finlayson,
Senator Lynch,	Mr. Gregory,
Senator Storey,	Mr. Sampson,
Mr. Fenton,	Mr. Laird Smith.

Peroy Thomas Owen, Director-General of Works, Department of Home Affairs, sworn and examined

42. To the Chairman.—If the nearest point of the railway on Mr. Griffin's plan to the Federal Parliament House buildings is 1½ miles, my opinion is that that is too far. Any plan that I know of that would bring the station nearer would modify the lay-out of the city. That is the point on which Mr. Griffin and I could not carry on some time ago. I do not know whether that has actuated the Minister. The Minister wishes to know, I believe, before he embarks on the construction of the city, what is going to be the actual cost; but, in any case, you could not start to lay out a portion of the city on the plan, especially in the south-east corner, without the route of the railway being definitely settled. The deviation of the railway, such as I had in my mind to bring it closer in, would involve a modification of portion of the plan of the lay-out of the city. When Mr. Griffin and I were collaborating about two years ago, we got to the stage where we wanted to settle where the railway access should come in. We discussed it for days, and made many sketches, and finally came to the conclusion that we had better both go to the Minister and tell him that we had come practically to an *impasse* over the railway question. Mr. Griffin could not see his way to modify the route which he proposed to bring the railway right through the heart of the town in cut and tunnel—that was a route leading directly from the south-east towards the Capitol hill. The Minister, to the best of my recollection, said, in effect, to Mr. Griffin, "Prepare your plan." The plan was prepared before Mr. Griffin went to America; and after the plan was prepared, the Board, of which I was a member, was dissolved. It seems to me that these deliberations are now taking up the matter at the point to which Mr. Griffin and I brought it two years ago, except that I understand that Mr. Griffin now thinks there is no need for an initial city, and reverts to practically the original railway route shown on his premiated plan. The railway from Queenbeyan could certainly be temporarily extended from the proposed terminus to bring in materials for building; but, so long as that temporary line was there, that particular subdivision of the city could not be laid out. What has been referred to as the Serivance route, shown on all the plans, was really a survey of railway between Yass and Canberra, and was never seriously considered for city plan. When the competition was called for, I objected to a railway route being shown, as being too much of a leader to persons preparing the plans. However, that railway route was left on, and has appeared on every plan since, because it was printed

on the contour lithographs; to get fresh plans not showing that route would mean making alterations on the lithograph plate, and reprinting the whole stock of plans.

(Taken at Melbourne.)

THURSDAY, 22nd JULY, 1915

Present:

Mr. RILEY, Chairman.

Senator Keating,	Mr. Finlayson,
Senator Lynch,	Mr. Gregory,
Senator Storey,	Mr. Sampson,
Mr. Fenton,	Mr. Laird Smith.

Thomas Hill, Engineer, Department of Home Affairs, sworn and examined.

43. To the Chairman.—In my capacity as engineer, the question of the railways and lakes in the Federal Capital has come under my notice, and I have prepared an estimate for the Director-General in relation to the earthworks and their cost. There seems to be an idea that the base, if we cross the lakes, will be 400 feet and 300 feet at the top, but I think that Mr. Griffin has said since that that was a mistake. I have here a plan which the Director-General directed me to present, and on which the estimate was based. On that plan there is a note as follows:—

This is the sketch prepared from Mr. Griffin's "schematic plan" for the purpose of the approximate initial estimate. It is now subject to considerable modification to meet the proposal given by Mr. Griffin in evidence for the low-level road on the western side. Such was not disclosed by the "schematic plan," and this branch had no other than this plan to work on.

I have brought with me the rough tracing on which the figures are based. Mr. Griffin's plan shows a double-track railway on the south-eastern portion of the plan, with a width of 200 feet between the boundary of the crescent or road. There are also projecting banks of earth there into the lake, but these and that section have not been taken into account, although there may be considerable earthwork there. There are also two roadways. The section here shows a double-track railway of 25 feet, and a roadway of 60 feet, and 40 feet on each side respectively. At the time we took the figures we assumed that the levels were practically the same; we took it that the whole of the roadway and the railway track was at the same level. The tracing also shows the levels at the roadways, as now suggested by Mr. Griffin. The first figures were prepared on the 200-foot basis at the crest; but I understand now that that is incorrect. There was nothing to help us in regard to the slopes of the bank. I have assumed here 2 to 1 slopes as being the minimum, that this material will stand. I think that the slopes should be at least 3 to 1 on the up-stream side, and 2 to 1 on the lower, for the reason that there will be considerable pressure of water on the up-stream side. I have shown the difference between 2 to 1 and 3 to 1. There is also shown here a puddle core of concrete, or of clay, which ever proves to be the cheaper proposition. Either would be quite satisfactory, except that the concrete core would be much narrower. While a reinforced core would be 4 feet wide, a clay mudfill would need to be at least 9 or 10 feet. The plan shows the borings as now taken, giving the

depth of the rock; but, before giving what the depths would be, there is some little doubt to be cleared up as to the level of the bank. For a distance of about 4,000 feet at the 1,850-ft. level, the average depth is about 55 feet. The base of the embankment would not have to go down that depth, but be shown on the ordinary surface. In preparing this estimate, I have assumed the levels as shown on Mr. Griffin's plan, but I think that, for the evidence, Mr. Griffin has since raised them somewhat. The figures taken were the 1,872-foot rail level, as shown on the northern bank of the Molonglo. For that same level we went across the Molonglo to a point on the southern bank, and from there the grade falls to a point near gravel at 1,855 feet. The next point we considered and allowed for in this estimate was the treatment of the flow of the Molonglo and the regulation of the same for two different levels of 1,845 feet and 1,825 feet. This estimate was based on the construction of a concrete wall at a point some 50 feet above the upper edge of the bridges. It will be necessary to carry that to the rock level. A width of 800 feet was allowed, with regulating gates on it, to give a variation of 5 feet, the idea being that on a flood coming down the river you would require to avoid the rising level of the upper lake and the submerging of the bank. On notice being received of a flood, the levels of the upper lake would be lowered sufficient to prevent its rising to an undue height and submerging the banks. The figure of 800 was taken from the statement of Mr. Griffin at Canberra on the Committee's previous visit. This would be the length of the bridge with regulating gates. This is also to conform to the general length of the bridges showing on the "schematic plan," and it would give ample flood discharge.

44. To Senator Lynch.—Sluicing arrangements would be made by means of pipes in the lower level of the concrete wall. The next point we considered was the bridges, and for the purposes of this estimate, we took four spans of 200 feet each, with steel girders of the bolstering type, as being a fair standard. Provision was made for a railway bridge 25 feet wide and two roadway or tramway bridges of 40 feet wide, respectively, alongside. This was thought to be the most economical standard, and it is shown on the sketch plan. The concrete wall is kept some distance upstream to allow any flood debris from the upper lake to have clearance under the bridge. This position seems to be the most suitable in order to give the maximum space under the bridges for floating trees and other debris. This section gives the width at the bottom a maximum of 254 feet, and in parts it would be 300 feet at the base. This 254 feet is based on the 2 to 1 slopes. I think the front slope could certainly be 3 to 1, and that would add another 50 feet.

45. To Mr. Finlayson.—I understand that Mr. Griffin now proposes to carry the 1,825 ft. road right across without a bridge; the lower-level road will not require any bridge, but will be part of the embankment. First of all, I do not think that it is practicable to carry this 1,825 ft. road across without a bridge, because I think the road would be in danger of being washed away. To resume the description of the plan, the small scale plan shows a proposition to fetch the roads from the lower levels, on a grade of 1 in 20 in each case, up to the bridge level, to avoid taking the level road across the Molonglo at practically water-level. This, I consider to be impracticable, because the cost would be great of raising the lower levels to the railway bridge level.

46. To Mr. Sampson.—I say that because I do not think you could cross the river safely without having bridges.

47. To Senator Keating.—I emphasize that the lower road would not be practicable also, because the low level crossing of the Molonglo would be really a ford, and liable to be scoured away. There must be some method of retaining the water if you take the 1,815-foot level first. You cannot cross at 1,845 feet without a bridge, unless you carry the embankment clean across the Molonglo. I understand that Mr. Griffin proposes a series of pipes through the embankment to deal with the flood level. However, I have no knowledge of Mr. Griffin's plan or of his evidence; I am simply giving the departmental estimate.

48. To Mr. Gregory.—The actual bottom of the gates was suggested at 1,840 feet and 5 feet high; the water would discharge over the crest. There would be a discharging crest 800 feet long and 5 feet high. This would give a mean width of, say, 6 feet, and it would take approximately 2,000,000 cubic feet a minute. That was the plan on which the estimate was prepared.

49. To Mr. Sampson.—The data as to the flood discharge is all shown on this plan.

50. To Mr. Finlayson.—The quantity of flood water with which we should have to deal is a matter of calculation, I am just now dealing with the question of discharges.

51. To Mr. Gregory.—I would like to refer to my figures to be sure as to the estimate regarding the embankment, but, apparently, I think the figures are as I have given them. I think the cost works out at 1s. 3d. per cubic yard, or £70,000. I am, however, speaking from memory, and shall let you know later, though I do not think it affects the case much.

52. To Mr. Laird Smith.—I think it would be cheaper to put in the bank straight away, with its puddle cores, than to have a trestle bridge or railway, leaving the link to be established at a subsequent date.

53. To Senator Keating.—As to how this would affect the circular basin, I may say that the back level of the 1,825 feet reaches to about the opening shown on plan where the bridge would be, and all that you would need would be to keep it up sufficiently to pass the floods and debris. You would need to keep, say, a clearance of 20 feet.

54. To Mr. Finlayson.—As to whether the proposal for an embankment is the best, I am assuming that the lakes are to be gone on with; and I think it is the best suggestion at this particular spot. The best method of carrying the railway across is an embankment with suitable bridge openings. I think there ought to be a waterproof embankment to retain the water—to prevent the escape of water from the higher level into the lower level through the underground strata above the rock. I think the most economical method of doing this is a concrete wall, with ordinary flood gates on the top of it. I take it that the flood waters that may or will come down will require a considerable number of orifices through a waterproof bank; and that water would be better treated by a crest discharge over a weir. I think a bridge opening is a practical necessity. Frankly, I have not considered whether the 800-ft. opening could not be reduced to 600 feet, but I think that it might be somewhat reduced.

55. To Senator Lynch.—I consider that the railway, under the plan proposed, would be quite safe in fact. I think the bridge openings are on the full side. I think that the discharge capacity

of an opening 800 feet by 5 feet is sufficient to handle the biggest flood that may come down.

55. *To the Chairman.*—In regard to the railways and their nearness to the administrative block, I really support the evidence of Colonel Owen. I am absolutely in accord with my chief. I think that a more economical proposition could be obtained at the crossing lower down the Molonglo River at the north-west end of the circular basin. To do this would, I think, necessitate considerable modification of Mr. Griffin's plans. When I was considering the matter some time ago the route did not seem to offer any considerable difficulty, but gave a reasonable crossing for ordinary traffic.

57. *To Mr. Fenton.*—There is an easier crossing between the eastern basin and the central basin, and it is a very practicable proposition, 58. *To Senator Keating.*—The 800-ft. opening of which I speak would represent about the distance between Melbourne Town Hall and the Equitable Building—the city blocks are a little over 600 feet. I should say that the grade of Bourke-street from Russell-street to Exhibition-street represents about 1 in 20, and the next block up to Parliament House, about 1 in 40. Opposite Messrs George and George's, in Collins-street, would be, I think, about 1 in 14.

59. *To Mr. Finlayson.*—It would be a somewhat simple matter by carrying an ordinary projection, to adapt the bridge for pedestrian traffic. The bridge of 33 feet for vehicular traffic would, with the levels shown, have to be about at least the same level as the railway bridge, and it would have to be a separate bridge. An objection has been raised to horse traffic alongside railway traffic; and if this can be avoided, it is advisable to do so. I have not given the matter of the railway traffic much consideration, but I should be inclined to put the railway on the up-stream side, and the roadway on the other side.

60. *To Senator Storey.*—As to the embankments, there is very suitable material alongside, and the estimate was based on the possibility of getting it in part from the excavations for the lake. The estimate also includes heaving, and the use of rock material on the upper side of the bank, such rock to be obtained from the tunneling through the granite on the northern side of the Molonglo.

61. *To Mr. Gregory.*—The 1s. 3d. covers the whole of the cost, and I would charge it to the railways.

62. *To Senator Storey.*—If I were told that the whole of the embankment was to be made from the spoil of the railway cuttings and tunnels, I should say that that would prove a more expensive way of making the embankment. First of all, there would have to be a bridge built or some means of access given over the river, and, secondly, you would have to get your tunnels finished in order to get this other material over to the bank. In the third place it is a long distance to bring the material, and there would be only the one method of bringing it, namely, the railway. It would be a slow process. One set of borings along the track has been finished, and the result of the second borings I expect to have this morning or to-morrow. When I receive these results I shall be able to tell exactly the material that will be available.

63. *To Mr. Sampson.*—I have traversed the route of the railways where it is proposed to make the tunnels, but I have only casually considered the possibility of a deviation to avoid the tunneling. It seems to me practicable to pass to the

west of a granite outcrop on the north side, but I have not given the matter much consideration. I should like to refer to the plans again before I answer any questions regarding the suggestion that, if we were to go between the eastern basin and the central basin, there would be no tunnel or deep cuttings.

(Taken at Melbourne.)

WEDNESDAY, 4TH AUGUST, 1916.

Present:

Mr. RILEY, Chairman;

Senator Keating,	Mr. Finlayson,
Senator Lynch,	Mr. Gregory,
Senator Storey,	Mr. Sampson,
Mr. Fenton,	Mr. Laird Smith.

John Montgomery (Coun., civil engineer, sworn and examined).

64. *To the Chairman.*—In laying out a new city I would bring the railway into the city, and not keep it outside. My experience of cities all over the world, including America, Europe, and Asia, is that it has been found necessary at great expense to bring the railways in. I can show several examples of this in the case of cities that I know, notably Antwerp, Brussels, Lyons, Chicago, and Marseilles, not to speak of London and Paris. It has been found necessary in every case, for the sake of convenience, to bring the railway stations into the town, and I should advocate this in every case where it was practicable—not perhaps right into the centre, but I would have the railway station or stations within reasonable walking distance of the main centres, if possible. In the proposed Federal City the main railway station should not be far from the group of Parliamentary and Administrative buildings. I would have it on the rise, about midway between Parliament House and the circular basin. So far as I know, there would be no engineering difficulties in bringing the railway there. It would depend to some extent on the lay-out of the city. So far as I can see, it would not interfere much with the city as laid out in Mr. Griffin's plan, to put the railway station there. The world tendency I spoke of is to have the main passenger stations, but not the goods stations, as near the centre of the city as possible. If it suited to bring the railway into the city above the ordinary level I would bring it so. I would be rather a misfortune to have to bring it in on the level, because level crossings in cities are objectionable. It would be better to have the railway elevated and the roads on the natural ground. This particular matter of Canberra is not very familiar to me now, as it is over three years since I had anything to do with it. I am speaking only from memory, as I have had no opportunity of studying the amended design. On the old plan the main railway station was to be in a tunnel. If the railway was brought further in towards the centre of the city, that is, on the western side of the circular basin, on the deviation now shown to me, suggested by Mr. Hobler, it would not be necessary to retain the line shown on the plan to the east of the circular basin.

65. *To Mr. Sampson.*—It would not be advisable to leave all that part of the city to the west of the circular basin without a railway. I would

still bring the railway round where I have indicated, even if Mount Vernon became the commercial and civic centre.

66. *To Mr. Finlayson.*—I was a member of the Adjudicating Board that determined on the competitive designs. About 130 designs were sent in, and Mr. Griffin's plan was accepted as the best by the majority of the Board, although not by me. I see that in a general way the plan now before the Committee is much the same as the original plan that gained the first prize; but there have been certain alterations, such as the underground railway station that I spoke of, and the position of Government House. I understood that I would not be asked to criticise the plan. I would not care to criticise it now, seeing that I was against its getting the prize in the first instance. For many years to come, the city can be best developed on the south-east and the south-west, and railway communication should have that as its objective, but the railway should, at the same time, be in such a position that the northern area would be developed later. I would make the railway serve both the city and Parliament House. Those working in Parliament House and in the administrative offices will naturally like to live at a convenient distance from their work. I would have the railway station within half-a-mile of Parliament House, and within, say, half-a-mile of the centre of the residential area. Before advising that the route of the railway should follow such contours through the city as would give a continuous elevated railway, I should have to look into the levels. I would not like to see the railway running through the city in a cutting or in a tunnel unless it was compulsory. I would rather have the railway crossing the roads on bridges than have the roads crossing the railway on bridges. There would be only one railway route, but a great many roads. My plan would make fewer bridges necessary, and in other ways an overhead railway would be preferable. People, when travelling by train, like to see about them. If the ground is fairly level the railway should be elevated, and not depressed. When I was in Chicago, the railway approaches from the south were being raised throughout, so as to bring all the lines above the roads. I do not know enough about the general railway system of New South Wales to be able to form an opinion as to whether the main line of communication between the Capital City and the existing railway system should be by way of Queanbeyan, or by way of Yass. I take it that there will be a railway to both places. It would be convenient to have the railway going through the city connecting Yass and Queanbeyan, or you could have spurs running in from the line.

67. *To Senator Lynch.*—In many cities the official centre is on one side of the railway station, and the business centre on the other. The business centre would be the stronger influence of the two, and it would serve the greater number of people. I do not know of any case where a railway station close to an official centre is considered objectionable. The main Central Union Depot in Washington is only a short walk from the Capitol and Parliament House, and I have never heard any objection to that. The Depot is a magnificent feature of the city. The marshalling yards are elsewhere. The Union Depot is primarily a passenger station. I would not think it unsightly to have a number of engines about the depot. They would be, for the most part, in a large shed. In the lay-out before the Committee, Parliament House and the commercial and civic

centre at Mr. Vernon could be conveniently connected later on by means of a tramway. It is only the very fine system of tramways in Washington that makes the present Union Station convenient, as the latter is about 2 miles from the White House. I think, as far as I can remember, only about 30 claims from the Congress Buildings.

68. *To Mr. Gregory.*—I would bring an overhead railway within, say, half-a-mile from the main centres of the city. I would not bring it right through the centres. Even with a system of tramways I would not care to have the railway so far out, as is shown on Mr. Griffin's plan. The western portion of the city will in any case have to be developed by tramways. As to the objection of noise from an overhead railway, I repeat that I would not bring it right through the centres. I would regard Parliament House as the political centre of the city, and looking at the design on the wall, Mr. Hobler's proposed deviation would, I think, be the best. I do not think an overhead railway on that route would destroy the scenic effect of the view looking from Mt. Vernon towards Parliament House. It would, of course, depend on the sections of the railway and the roads, and I could not express a definite opinion without seeing and studying those sections. On fairly level ground I would prefer the railway overhead rather than below. A depressed railway would mean retaining walls and tunnels, unless there were very wide areas of low-lying ground available. Double tracks, and possibly, in time, quadruple tracks, might be necessary; but, as there is plenty of ground to work on, I would leave ample room for expansion.

(Taken at Melbourne.)

WEDNESDAY, 25TH AUGUST, 1916.

Present:

Mr. RILEY, Chairman;

Senator Keating,	Mr. Finlayson,
Senator Lynch,	Mr. Gregory,
Senator Storey,	Mr. Sampson,
Mr. Fenton,	Mr. Laird Smith.

Norris Garrett Bell, Engineer-in-Chief and Acting Commissioner, Commonwealth Railways, sworn and examined.

69. *To the Chairman.*—I think that a depressed railway would be the most suitable for the Federal Capital. Level crossings are very objectionable and dangerous, and wherever possible they are done away with. I visited the Federal Capital site once, about twelve months ago. I could not express an opinion as to the cost of a depressed railway there. Everything would depend on the nature of the country, and the levels of the streets. My Department has not been called upon to make an estimate for the permanent railway towards Yass. From my experience I should say that it is the desire of railway experts, where possible, to bring a railway into the centre of a city. In several cases of large towns of which I know, railways have been brought right into the centre. I do not think that a railway would disfigure the City, and a depressed railway would be less objectionable than a line on a high level. I should prefer Mr. Hobler's proposed route for the line through the City to that proposed by Mr. Griffin, but until I had considered the levels I could not be quite sure that it could be adopted. It is necessary to consider the gradients of the

line, also the starting point, and the level of the lowest of the streets. In certain circumstances it might be necessary to depress the line so much as to injuriously affect the grades. Conditions being favorable, I should prefer to bring the railway within a reasonable distance of the centre of the City. I think that it might be brought within half a mile of the Parliamentary buildings. I understand that the Spencer-street Railway Station is a little over a mile from Parliament House, Melbourne. I can undertake to supply the Committee with an estimate of the probable cost of the line by Mr. Griffin's route, and by the route suggested by Mr. Hobler. An approximate estimate of the cost would not involve the sending of men to the Capital site. I could tell you later whether, in my opinion, it would be advisable to take the railway into the centre of the City. I can supply the Committee with an estimate of the length of time it would take to construct the permanent line to the border of the Federal Territory.

70. *To Mr. Finlayson.*—When I visited the Federal Capital Territory, I did not examine the route of the railway as proposed in Mr. Griffin's plan. I went there to inspect the line from Queanbeyan to Canberra that was built by the New South Wales Government. I know only the general lay of the country along either of the proposed routes. I have seen a section of Mr. Griffin's route, and a railway could quite easily be constructed along that route. I am not in a position to say now whether that would be the best route to adopt. I have seen no sections of the alternative route, and I have no knowledge of any surveys of any route other than that shown on Mr. Griffin's plan. Presuming that the business and the residential portions of the City were located on the northern part of the site, rather than to the south, the route proposed by Mr. Griffin for the railway would be convenient for that settlement. But I can imagine a suburban settlement to the south of people engaged in offices in the Administrative block. They will have to go to and fro to their work every day, and I can imagine eventually a suburban service provided for their convenience. People engaged in the Administrative Offices could be provided for by a rapid transit service from the station shown at the Market site on Mr. Griffin's proposed route, but that would involve a considerable increase in the time occupied by the journey. The Parliamentary buildings might not be as important as a business centre from a railway traffic point of view, but I understand that there will be a lot of traffic to the Administrative blocks in the Federal City. Parliament House, Brisbane, is about 14 miles from the Central Station. Parliament House, Sydney, is about the same distance from the station, and Parliament House, Melbourne, is about 14 miles from the Spencer-street Railway Station. When I am asked whether I would suggest the diversion from Mr. Griffin's route, proposed by Mr. Hobler, for the mere sake of serving the Parliamentary buildings, I would say that by a line by the proposed diversion would be for a purely passenger service. Goods for local consumption might be taken over the line, but eventually I think that all through goods traffic will be taken in another direction. This railway would be a purely suburban railway, and I think the closer such a line is to the main centres of population the better. I think that eventually all through goods traffic to Jervis Bay and Sydney from Yass, will go by a route to the east of Mount Ainslie. Mr. Griffin's line would leave that line

at about the site which he has suggested for marshalling yards. It will be largely a passenger line, and will not be a heavy goods line. The line could be taken between the Eastern Lake and the Eastern Basin upon an embankment as Mr. Griffin has proposed. That would be pretty costly, but it would be feasible enough. I would favour the construction of a bridge there. I do not know how the flood waters are to get away without a bridge. The cheapest, as well as the most effective way to construct the embankment would be, as Mr. Griffin proposes, to use the spoil from the cuttings on the line at Mount Russell, but I consider that it would be necessary to leave a considerable opening in the middle to allow the flood waters to get through. I have no very definite knowledge as to the quantity of water that comes down the Molonglo River, but when I was there I noticed the flood marks, and to attempt to take the flood water shown there through tunnels would probably be so costly as to be almost impracticable. I think that whatever method is adopted, an opening must be left in the middle of the embankment to cope with the flood waters. But for that I have no objection to the embankment as against the construction of an extensive bridge. I should put in a bridge only long enough to accommodate the flood waters. I have been away for ten days and unless instructions to that effect were given during my absence, the matter of the survey or construction of the Federal Capital railway has not been before my office at all.

71. *To Senator Storr.*—I understand that a city is to be built at Canberra for the Seat of Government of the Commonwealth. When the erection of the Parliamentary Buildings is commenced, I imagine that people will endeavour to settle near where the first buildings are erected unless they are compelled to go to some other part of the site. Parliament House and the Administrative Offices will be for a considerable time the real centre of the City. I do not think that Canberra will ever be a manufacturing city. I do not know that it is intended that it should be. If the railway were constructed by Mr. Griffin's route, it would be necessary to have electric trams, or other means of rapid transit, to enable people to get from the railway into what will be the centre of the City. I shall look into the question whether, by adopting Mr. Hobler's proposed diversion from Mr. Griffin's route, it will be possible to avoid level crossings without interfering materially with Mr. Griffin's design. When I was at Canberra I had no knowledge of the design, but Colonel Miller roughly indicated the proposed site for Parliament House.

72. *To Mr. Gregory.*—From the point of view of railway communication the supply of coal, water, and other necessities for a large manufacturing centre, I should not select Canberra as a suitable site for a manufacturing town. In my opinion, a depressed railway would be the most suitable line for the Federal Capital, but the adoption of such design would depend on the levels. The starting point and the finishing point, and the fact that the line would have to cross the river, have all to be considered. The level would have to be so fixed as to go below the level of the lowest street. In some places it would be necessary to go a considerable depth below the surface, and it might be necessary to tunnel in some places. The topography of the country would have to be taken into consideration. Overhead railways are both noisy

and costly, and level crossings should be avoided wherever possible. It would be necessary to consider where the streets could be best crossed by the railway, and where the largest centre of population would be. The curved line, shown as a diversion from Mr. Griffin's route, was suggested by Mr. Hobler in my absence. He went over the country, and suggested his alternative route after an inspection of the ground, and with a due regard to the avoidance of level crossings. I think that by his route the streets could be crossed by going under them. The proposed Market site, which Mr. Griffin has suggested as a suitable site for a railway station, is not, in my opinion, a suitable site for the purpose. Apart from the distance from the Parliament House site, it is not a suitable place for a railway station, because of the configuration of the ground. There is a good site for a station on the route suggested by Mr. Hobler at a distance of about three quarters of a mile from the proposed site for Parliament House.

73. *To Senator Keating.*—I never saw Mr. Griffin's proposed design, and so I cannot say whether his route for the railway is shown on the plan. There is one proposed diversion from that route which would take the line across between the Central and Eastern Basin. That is the route suggested by Mr. Hobler. There has been no survey of that route, but the sections and plans have been designed from the contours. I know of no other suggested diversion from Mr. Griffin's route with the exception of a proposal for a temporary line.

74. *To Mr. Laird Smith.*—I would much prefer to have before me the results of a flying survey or a walking survey before deciding between the two proposed routes. Without such information I could not say definitely which would be the better route to adopt. I should certainly like to have a trial survey of Mr. Hobler's route. I have already said that I have seen a section of Mr. Griffin's route, and it is a practicable route.

75. *To Mr. Sampson.*—With a railway station within half a mile of the Parliamentary buildings, I think that a tram service from the station would be unnecessary. I do not think that a tram line could be advantageously considered until there was a population at the Federal City of about 10,000. A city requires to have a fairly large population to justify the expense of an electric tram service. I have heard it stated that 40,000 is the minimum population necessary to justify the establishment of an electric tram service. I know of several towns having a population of over 20,000 where the question of the establishment of a tram system has been gone into and reported upon, and the conclusion arrived at has been that in such towns the population did not justify the undertaking. There is a good tram system at Launceston, but there is a considerable tourist traffic to be accommodated there. I have in mind Townsville, Townsville, and such places. There is a tram system at Bundage, and a tram system at Kalgoorlie, where the population is under 30,000, but it is a scattered town, and there is considerable traffic with the mines at Golden Ridge, some distance from the town. One idea in proposing the diversion of Mr. Griffin's route was to bring a station sufficiently close to the proposed site for Parliament House to avoid the necessity of establishing a tram system for some time. I should like to have no objection to confer with Mr. Griffin about his proposed route before visiting the Capital site with the members of the Public Works Committee.

76. *To Senator Lynch.*—There is no ruling grade laid down for railways within city limits, but an endeavour is made to secure as easy a grade as possible. A level line is best if the difficulty of drainage can be readily overcome. In the case of a city with a small population, the traffic could be handled with steeper grades than in the case of a city with a larger population. Where you have a large population, you would aim at getting a level line. I should not be so keen about getting a level line for the Federal Capital as I should be for a city like Sydney or Melbourne. We might make the grades steep at first, and reduce them later as the city developed. When I am told that Mr. Griffin has suggested a ruling grade of 1 in 200, I say that that is a very flat grade. It would be possible to work suburban traffic with much steeper grades than that. Mr. Griffin proposes crossing between the Eastern Lake and the Eastern Basin with a ruling gradient of 1 in 200. Mr. Hobler's proposal is to cross between the Eastern and Central Basins at a level about 10 feet lower than Mr. Griffin's route. That would not necessarily deepen the cuttings, but it would steepen the grades. The levels of the streets will fix the depths of the cuttings below the streets. It would make the avoidance of level crossings easier. It would be more difficult to avoid level crossings with a line at the higher level than with a line at the lower level, unless you were prepared to cross the streets with an elevated railway. So far as I can see there is no objection to an uncovered depressed railway in a city. The objections to level crossings are danger and delay to the public, delays to trains, and the cost of keeping a man constantly in charge open up and shutting gates at a level crossing. But the adoption of level crossings certainly makes railway construction easier and cheaper. To do away with level crossings necessarily involves heavier construction work. You have to consider the nature of the country. To get the necessary grades you may have to go below the level of the roads. In irregular country, the line might be at some places below a road, and at others above a road. I do not think that by the adoption of level crossings there would be any compensation in a reduced cost in the construction of roads afterwards. If you do away with level crossings and make an underground railway, it will be graded to suit the streets, and not the streets graded to suit the railway. I endorse Mr. Hobler's statement regarding the safety of crossing the Molonglo River at the level he adopts. There would be no danger of a breakaway of the line or a bridge work.

77. *To the Chairman.*—By going a little to the east, it might be possible to avoid the tunnel proposed on Mr. Griffin's route. I shall look into that matter.

78. *To Mr. Finlayson.*—Mr. Griffin's proposed line could carry the passenger and goods traffic very well, but when I say that another route will probably be chosen for through goods traffic, it is a question of getting better gradients. The present line has very steep grades, and these would limit the load between Yass and Jervis Bay. Between Yass and Jervis Bay there is a section of the Cooma line, which contains some very steep grades, and, as a result, the whole load would be limited by the grades on, perhaps, a mile of the line. To avoid these steep grades it is proposed to take a line east of Mount Ainslie. That might not be necessary for many years, but I think it will eventually be done.

(Taken at Sydney.)

SATURDAY, 4th SEPTEMBER, 1915.

Present:

Mr RILEY, Chairman,	
Senator Keating,	Mr Finlayson,
Senator Lynch,	Mr Gregory,
Senator Story,	Mr Sampson,
Mr Feinton,	Mr Laird Smith.

Henry Musgrave Robinson, Assistant Architect, State Government Architect's Department, New South Wales, sworn and examined.

79. *To the Chairman.*—I took part in the competition arranged in connexion with the Federal Capital design, but my plans were not successful in any way. I consider the design selected by the Departmental Board inadequate for a Capital City of the first magnitude, from the point of view of the railway service it contemplates, and I have prepared a design embodying the views I hold as to the necessities of a city of first-rate grade. In drawing up the plan which I now produce, I was influenced by the other competition designs, and I have incorporated from them whatever features I thought desirable. The railway system as shown in the adopted plan is inadequate in that it only serves the eastern portion of the city, the western portion of the city, which is suitable for building purposes, is quite unserved by the railway as projected by Mr. Griffin. I do not see any provision for the construction of branch lines either from one side of the city or the other, so that the only way of reaching what I believe will be the centre of the city, will be by an underground spur railway. Again, in Mr. Griffin's plan, what I conceive to be the central station is built entirely underground. In my view that would be a very undesirable arrangement, particularly in a new city, for the reason that all the different departments connected with the central station will naturally spread as the city grows. They will require acres of room, and I am at a loss to conceive how extension can take place if the central station is below the surface. The railway facilities shown in my plan provide for a circular railway. The main line from Yass will enter the city from the north, and leave towards Queanbeyan on the south-east. What I propose is a circular railway giving communication all round the lake, and linking up with the main line north and south. To take the main line across the lake in the centre of the city would be objectionable, whilst a railway built underneath the lake would be very expensive. In my view a circular line as suggested in my plan would serve the whole city area in a way that cannot be obtained by any other means. Wherever the railway passes through the town, I propose to construct an open cutting below the surface, and provide for the streets to run over this. If the railway were provided on the surface, its effect would be to divide the town wherever it happened to be, and houses or streets close by would be depreciated in value, because, naturally, the streets would run into a dead end. For that reason I have kept the railway below the street level at every point. A line similar to that suggested by me was incorporated in a town-planning arrangement for the City of London. The idea there was to encircle the city at a ten-mile radius, and have all the provincial lines linked up to this circular railway, so that passengers from the north, south, east, or west,

desiring to cross the city, would travel round instead of through. By this means congestion would be avoided.

In connexion with the outer-circle railway shown on my plan, I have provided for a suburban line on the east running away to Duntroon, another on the west, and another on the north-west to serve the manufacturing part of the town, the gas works, power house, and manufactories, all of which would be better placed below the dam of the lake, so as to avoid pollution by surface drainage. If these factories were placed on the south-east or north-east, a rather expensive system of surface drainage would be required in order to prevent the lake from being fouled.

I have also provided for an underground electric service forming an inner circle to stations near the departmental buildings, to link up with the main steam service. This railway would provide communication between the official area and the different city suburbs. It would also join up with the steam service in the south-east, crossing the lake at its narrowest part, and connecting also with the main line north. By means of this arrangement, residents would be able to reach the main railway at any point, without being compelled to go to the central station. I propose to place the central station south-east of the city centre. It will be a daylight station, the only underground part being where the lines run under the streets, 20 feet below the surface, though the platforms will of necessity be below the natural surface of the ground. This station will occupy a site of commanding importance, at one end of the city square, immediately opposite to the Town Hall. Such an arrangement would, in my opinion, be extremely desirable in that it would enable effective architectural results to be obtained. On the other two sides of the square I would place the Guild hall, the Art Gallery, the Library, Museums, National Theatre, &c., and I regard such an arrangement as one likely to give very great satisfaction. This central station would be about a mile from Parliament House, but I would provide another through station on the south-west, not more than half a mile from Parliament House, where members would be able to take their trains north and south. Parliament House itself would be on the Kurrajong Hill. This, in my opinion, is the most commanding site in the city area, and should be occupied by the Parliamentary buildings—the real Capitol. In that respect my arrangement of the Federal Capital resembles the lay-out of Washington, where the Capitol occupies a commanding site leading up to which is a monumental avenue. In the case of Canberra, the avenue leading up to the Capitol would be formed by the departmental buildings.

80. *To Senator Lynch.*—I do not know that the Congress buildings are situate on the highest point in the district of Columbia, but the Capitol is well elevated nevertheless. I have introduced a similar arrangement into my plan, and instead of grouping all the departmental buildings as is provided for in the adopted design, I would suggest their construction along this avenue. The adopted plan shows eighteen buildings of all sizes and shapes, intended, I presume, to be used for Government offices. Originally in the competition conditions, eight departmental buildings were asked for. I have provided for ten, and the advantage of an arrangement like that shown in my plan is that at the outset buildings sufficient to meet present requirements could be erected facing the avenue, and they could afterwards be extended

in the rear. The avenue effect would then be obtainable at an early stage of the city development. In my scheme the central station would occupy a very important position at the end of the city square, flanked, as it would be, on both sides by imposing civic buildings.

81. *To Senator Story.*—The site I suggest for the central station would be due south of the circular basin as shown on Mr. Griffin's plan. Erected there it would occupy a very advantageous position, because I think the business centre will expand towards the south-east of that site, in the direction of Queanbeyan, where the ground is level and suitable. If the business centre were to extend in other directions, it would be more or less circumscribed by Red Hill, Black Mountain, and Mt. Ainslie. The only other direction in which there is much open ground is towards the north, so that, in my opinion, the central station located where I have placed it would, in a very short time, occupy the centre of the business portion of the town. Facing the square would be the principal station buildings, then would come the platforms, and to the rear, with a frontage to another square, would be the parcels department, and the various departments connected with a railway centre.

82. *To Mr. Finlayson.*—I provide for platforms 700 feet long, glass covered, access to which would be provided by means of stairways from a bridge. In the rear of the main building would be what is known in American stations as the concourse.

83. *To Senator Lynch.*—My object in having the station sunk so deeply is to permit the streets outside to be maintained at their natural level. I take it that a roadway of 17 feet to the rails will be required, and an additional 3 feet for construction will give a total depth of 20 feet—practically 17 ft. 6 in. to the platform level. Extending in a south-easterly direction, I would put the main goods department, marshalling yards, carriage sheds, and engine-sheds, and so on, extending on the main line towards Queanbeyan.

84. *To Mr. Laird Smith.*—I have not considered the question of marshalling by gravitation. That is a matter for railway experts to consider. I take it that the marshalling yard should be adjacent to the central station, so that all the rolling stock can be kept close at hand. The goods station, as shown on my plan, is some distance away from the passenger station, and it could be removed still further away if necessary. That point is also one for the consideration of railway experts. I do not think it would be impossible to construct a spur line leading to any part of the city from the railway, as shown on Mr. Griffin's plan, though it might be necessary to re-plan some of the streets if that were done. I do not know, when modern means of locomotion are taken into account, that there is a great difference between having a station a mile or a half-mile away from any particular centre, though I do not know that it is possible to lay down any general rule as to the systems adopted in older cities for placing the main railway lines outside the centre of the city. It is not possible to generalize on that point, though I think it would be desirable to have the central station nearer than a mile to the heart of the city.

85. *To the Chairman.*—In the plan I have proposed I make the district round Kurrajong the centre of the city, as I think that in course of time this would become the natural centre, just as much as George-street might be considered to have become the centre of Sydney. I do not think there is any likelihood of the city centre

developing to the north. It is far more likely that the business centre will grow up on the south-east. The markets would be situated only a little distance from the station, and they would help in the establishment of a natural business square. I do not think that the provision of workmen's homes can be considered apart from the erection of other suburban residences. Sites suitable for suburban centres exist on both north and west.

86. *To Mr. Finlayson.*—If it were determined that the civic and business centre of the city should be on the north, I think I should move the central railway station into that district, though I would still suggest the building of a circular railway on the lines I have drawn up. I do not see any reason why there should not be a circular railway system much the same as I have suggested in a city constructed according to Mr. Griffin's plan. The arrangement of the streets might want some revision, but the same circular railway could still be carried out. I agree that in modern city development underground electricity is largely taking the place of steam in matters of internal communication, but I should be doubtful as to whether electric traction inside the city would meet all the requirements now met by an extensive steam system. The circular railway, such as I have suggested, would be a very useful feature in either case, and it could be used either for steam or electricity. In my view the centre of the city will be at the locality where there is the largest concentration of official and business population, and I think it would be an advantage to have the central station nearer than a mile to that centre, notwithstanding modern methods of conveyance. A railway running through the streets would be highly objectionable from an aesthetic standpoint. On the outer circle railway, in a south-easterly direction I have placed the sports centre, the stadium, the cricket ground, etc. with separate stations for each.

87. *To Mr. Sampson.*—I should prevent these places from being flooded by drainage. The Moonglo flood level is 1,823 feet. The arms I have set apart for the sports centre are mostly at the 1,825 feet level, though I can quite see the necessity of instituting efficient drainage. I provide another recreation ground on the north, and one for any suburb that may develop in the west, each near the railway. I suggest that the University should be on the north-east, and I propose to keep Mt. Vernon as a sort of look-out, with no buildings at all on it. I am in favour of having lakes in the natural basins as suggested by the contour plan, but I am doubtful of the wisdom of constructing the eastern lake as projected by Mr. Griffin. That is a matter for people to decide upon the question of water supply.

88. *To Senator Lynch.*—Regarding the city from the point of view shown in the plan I have prepared, I should expect development to take place chiefly south-east of the central station towards Queanbeyan. In my view the business centre will be near that point. I have not considered the possibilities of any rivalry between Queanbeyan and the Federal Capital. In my view the city will have to be allowed to develop in its own way. I do not think it will be possible to compel growth in any one particular direction. If the circular railway were constructed, I should carry out the eastern link first. That line would assist the early development of the manufacturing centre, and a point to which I

attach great importance is that the power house, the gas works, and other works should all be placed below the dam. I would carry out the western portion of the circle from the start, if that were possible, though the first line to be carried out would decidedly be that on the eastern part of the outer circle. For a city the size of Sydney I would advocate underground electric railways. Such a scheme is now contemplated under the arrangement which the New South Wales Government have entered into with Messrs. Norton, Griffiths and Co.

89. *To Mr. Stampson.*—My plan provides for an electric underground railway within the city bounded by the outer circle roadway, but I do not carry steam inside that circle. In order to link up the outer suburban areas, I have provided branches running east in the direction of Dunroon, and west. The circular line would have the effect of materially increasing the distance between any given points in the city. If a person residing in a western suburb desired to reach the east of the city, he would, under my system, travel on the circular railway to the station nearest the point he desired to reach, and then take a tram. I do not think that one line of a railway running north and south, and linking up with an electric tramway, would meet the requirements of the city so completely as a circular railway. The prohibitions are that the city will extend outwards, and the suburbs will grow up north, south, east or west of the main centre. The advantage of a circular railway would be that it would enable provision to be made for these suburbs by the establishment of branch lines. I do not think the position at Canberra can be compared with that at Melbourne, where the circular lines were found to be rather unsuitable on account of the distances involved. In Melbourne the country is more suitable for bringing passengers much nearer to the centre of the city. At Canberra I would keep the steam service further out.

90. *To Mr. Fenton.* — I did not consider the subject of railways from the engineering point of view, but from the town-planner's point of view. The scheme I have submitted is one that I consider would serve all the city interests.

91. *To Senator Lynch.* — I would avoid level crossings within the city area under any circumstances, and in order to do that I would prefer a railway running below the surface so as to permit of the streets being constructed on their natural level. If the line were constructed on the surface, or if an elevated railway were decided upon, it would have the effect of bisecting the city, whilst it would considerably mitigate against the convenience of journeying from point to point within the city itself. Land values in various parts of the city would also be considerably depreciated, whereas with a railway below the surface there need be very little depreciation. I will quote the example of the Sydney railway station as illustrating what I have in my mind. Just outside the Sydney station there are a number of small houses in small streets running quite close to the railway line, cut off from all communication with the city across the line. It is only possible to reach the city across the line by means of a wide detour. Such a state of things is at all times undesirable, and would be particularly undesirable in a new city.

(Taken at Sydney.)

MONDAY, 6th SEPTEMBER, 1915.

Present:

Mr. RILEY, Chairman;

Senator Keating, Mr. Finlayson,
Senator Lynch, Mr. Gregory,
Senator Story, Mr. Sanjivon,
Mr. Fenton, Mr. Laird Smith

Charles Compton Reade, Lecturer and Organizer
British Town Planning Association, sworn and examined.

92. *To the Chairman.*—I am lecturer and organizer to the Garden Cities and Town Planning Association of Great Britain, and I am now visiting the Commonwealth in that capacity, lecturing under the auspices of the various State Governments and local municipalities on the subject of town-planning. I have already visited every State of the Commonwealth during a stay of nearly eighteen months. I have with me a number of maps illustrating the railway systems in several important European towns. I have chosen particularly to bring under the notice of the Committee the example of Germany, because I feel that Germany offers more instructive material in regard to the effect of railways on town-planning than possibly any other modern country. The railways in Germany are State-owned, and that not being the case in England, I do not think the experience of England would have the same value to this Committee as the experience gained under a State-owned railway system, such as that in Germany. In nearly all modern towns, German and otherwise, the railways enter from different points and terminate in such a manner that, roughly speaking, the different stations are grouped in a circle round the town.

BERLIN.

May I explain the position of Berlin in this respect? Up to 1865, Berlin was a city largely circumscribed into one central portion. For the purpose of Customs, a wall was erected around the city some time before railways came there, and when the railways were introduced they were constructed on the outside of this wall, the existence of which is largely responsible for the manner in which German railway stations are grouped. All the stations come up to a dead end, but all are connected by a circular railway running round the outskirts of the city. Other examples may be quoted of where the railways run through the city.

NURNBERG.

I bring before the notice of the Committee a map of Nurnberg, where the railway runs through the town from east to west. During the Middle Ages what is now the centre of Nurnberg was surrounded by fortifications, and when the railways were constructed in the nineteenth century a line was brought in the manner I have stated through the city, which, up to that time, had not extended very far beyond the area covered by the original fortifications. The selection of this particular route is explained by the existence of a river running through the town, and following its course an easy grade was obtained for the railway all the way through. From 1870, when a period of rapid development overtook modern Germany, including Nurnberg, the original course of this railway became a source of considerable inconvenience. South of the railway the country

is flat, comparatively speaking, but the development that took place on that side is not nearly so great as that which occurred on the north, where, notwithstanding that the contour is broken and hilly, values rose and very severe congestion occurred. The fact that the railway constituted a barrier across the town, and that there were no adequate means of getting from one side of the high embankment to the other, was responsible for this, and the consequence was that until later years the development of the southern portion of Nurnberg was very seriously retarded. To-day there are six large subways through this embankment, each constructed at a cost of between £40,000 and £50,000, and I quote the example of this city as illustrative of one of the disadvantages likely to follow the construction of a railway through a city on a high level.

93. *To Senator Lynch.*—Of necessity the stations are constructed on a high level, but the practice of constructing stations in this manner is very common throughout Germany. Usually there are subway entrances, and passengers reach their various platforms by steps. Goods are sent up by lifts.

94. *To Senator Story.*—I cannot say whether all this difficulty would have been obviated if, originally, the railways and stations had been constructed below the level of the streets. The question is a difficult one to answer, because city development depends not only on the railway itself, but upon the position of the goods station, and upon many other considerations, all of which may affect the success of town-planning.

LEIPZIG.

95. *To the Chairman.*—I have here a plan showing the railways of Leipzig. Leipzig is a large industrial city with a population of about 500,000 people. The railways on the northern side of the city enter at different points, each coming to a dead-end station with goods yards adjoining, and there is also a second railway entering the city on the south, whilst an outer ring railway links up the various suburbs of the city. On the southern side there are extensive goods sidings, permanent engine houses, and so on, and in consequence of which, we have another instance of the erection of a barrier along that side of the town. The town has developed very considerably on the western side of this railway barrier, but practically the whole of the area to the east has been neglected. That again is due to the circumstance that this railway created an embankment, and although some means of communication between east and west were provided underneath the embankment, the effect of that system of railway construction was to prevent the land in that portion of the city coming into proper development, and it is only within the last four or five years—since the city itself made large land purchases, in view of the adoption of a modern town-planning scheme—that it has gone ahead. Development now has been rendered possible by the construction of more very expensive subways underneath the railway.

FRANKFORT.

I will now bring before the Committee the example of Frankfort, where a wider effect of a railway upon the development of a town may be noticed. Frankfort is another large commercial centre on the Rhine. It is one of the terminal ports on that river, and a very large traffic is carried on between Frankfort and various centres

on the Rhine. At the same time Frankfort is one of the terminal features of the great railway system of Germany which enters the town from both north and east, and a tremendous traffic is carried by the railways to be dealt with by the Rhine barges. The population of Frankfort is about 600,000 people. Originally the railway station was situated just outside the medieval town—Frankfort, like other German cities, being fortified up to a comparatively modern period—and when the fortifications were demolished a ring street was constructed, and it was decided that the railway station should be placed immediately outside that. In about the year 1885 this railway was moved further out, because it was very inconveniently placed, and the principal railway station was also constructed further away from the original town boundary with goods yards lying immediately north, whilst to the south of the railway, docks were constructed for the large traffic. As a result of the rapid commercial development that has overtaken Frankfort, particularly since the eighties, it was found that the placing of this city railway in such close juxtaposition to the river had the effect of largely restricting the amount of land available for the purposes of commercial development. Values rose rapidly, congestion followed, and the town quickly found itself in a position of considerable difficulty from the point of view of successful commercial enterprise. In about 1905 the whole situation was reviewed, and in order to do away with the unsatisfactory state of things then existing, it was decided to purchase an area of between 2,000 and 3,000 acres on the eastern side of the town. Some eight miles of new docks were constructed and linked up with the railways, the principal sidings being taken further north and east, and the whole area was purposely planned to meet possibilities of further commercial development. The original railway was altered so as to form a complete service round the town, linking up with the main system on the eastern side. The experience of Frankfort affords a striking illustration of the results of constructing railways and docks before proper consideration has been given to their probable economic effect, and their effect upon the traffic problems that are likely to occur.

COLOGNE.

A map showing the railways of Cologne illustrates more or less vividly the effect of stations upon town development, and gives an idea of the amount of land considered necessary for future traffic needs on a big State-owned system. The medieval town of Cologne was, like other towns, largely contained within a circumscribed area, which, up to 1881, was surrounded by fortifications. When these were demolished, a ring street, somewhat less than 200 feet wide, was constructed along with a number of other wide streets. One of the objects of this ring street was to relieve the congestion then existing in the narrow streets which ran across the town from east to west. That congestion was caused by the great amount of country traffic converging there, and it was hoped that the ring street would have the effect of diverting this country traffic—all which was flooded into the old narrow streets—into the wider area provided by the newer street itself. These plans, however, were upset by the existence of a railway station. When the railways were constructed the principal station was placed near the cathedral, and that particular spot became the focal point for large quantities of traffic to and fro, and instead of the contemplated

centre becoming the business centre, the area in the vicinity of the cathedral became more congested, and remains so to-day. Most of the important shops of the town were erected in the narrow streets close by, some of them only between 25 ft. and 30 ft. wide simply because this main railway station had become the point of central focus in the life of the city. Further away from the town may be noticed the large areas which this town considers necessary for its future railway extension. The original goods yards were situated nearly east of the main station adjoining the principal streets, but as that station became inadequate, new goods stations, or ranging stations, were built on the outskirts of the city, attached to each of which is a large area of land to be used for the purpose of additional sidings whenever they are required. The industrial area is fixed south of the Rhine on the leeward side of the town, so that the prevailing wind takes the smoke and odours away. Originally the tendency was for factories to be erected in the western portion of the town. That was undesirable, because the prevailing wind usually came from that direction. In fixing the new factory area the greatest consideration was given to the desirability of securing plenty of land for railway yards and goods sidings in addition to that required for the main lines. I have not gone into this particular point, or considered how it is likely to affect the future city of Canberra, but I am under the impression that the amount of land set aside for the purposes of railway development is considerably less than is considered desirable in most of the old-world towns.

MILAN.

Milan offers another instructive example of the disadvantages that follow the construction of a railway clean through a city. The existing railway passes through Milan in a south-easterly direction with the principal station at the Piazza Minna, immediately to the south of which, on the site originally set apart for commercial purposes, are extensive goods yards. The effect of that railway—again on an embankment—was to seriously impede the development of the town to the north and west of the line, and a further sequel to this placing of goods yards close to the principal station was that all the area immediately adjoining became converted into factories and other commercial buildings. All this was badly placed, having regard to the prevailing winds, whilst the district became severely congested, particularly on the area immediately south of the existing line. In order to remedy this state of affairs it is now proposed to lay apart a special area for commercial and manufacturing purposes on the southern side of the town, which will be served by a canal linked up with the existing canal crossing Italy, and the railway will be diverted around to a point adjoining the canal here. Goods sidings are provided for, and that particular area will become the future factory area of the town. At the same time a station will be erected in the same vicinity. This station will be of a temporary character, and the whole area has been planned out by the municipality in anticipation of the city's growth within the next 30 or 50 years. The point I desire to make in regard to the experience of Milan is one that I consider ought to be considered closely. In the first place the railway station was placed at a point on the north-eastern side of the town, which has passed through a series of historical grades. For the purposes of

the nineteenth century town it was not considered desirable that the railway should be further away from the city than the original site, but in constructing the new railway station the municipality selected a site virtually on the same axis as the older station, but further out, so as to cause as little disturbance as possible to the trading and commercial centre. I give it as a matter of opinion that in the planning of a new town, the example of Milan should be followed. In the first place the station might be planned from the point of view of the needs of the town within a period of 25 or 30 years, and the original arrangement should be of such a character that in case of rapid city development the station could be moved to a point, and in a manner that would cause as little hardship as possible to the original district, and at the same time give better facilities for the general convenience of the city population.

96. *To Senator Lynch.*—At the present time the central station at Milan is situated on the north-east of the town. The new station will be placed further out, and ultimately should the town continue to grow, the station will be further out still. All movement will be made in the one direction. The goods yards will be arranged round a different part of the town.

97. *To Mr. Sampson.*—There are no railway lines within the old city boundary, and the tendency is to take the station away from the heart of the city further and further as the town grows. The same tendency is shown in all large German cities.

98. *To Senator Keating.*—The city traffic is dealt with by electric trams, and in the larger cities by underground railways.

MELBOURNE.

99. *To Mr. Laird Smith.*—I think it very undesirable that the experience of Melbourne should be followed. To my mind Melbourne offers a striking illustration of the bad placing of its railway, and the effect of this bad placing upon the town. The principal railway station in Melbourne that at Flinders-street—is placed adjoining Prince's-bridge, at a point where Flinders-street and Swanston-street intersect. The railway comes in between the River Yarra and Flinders-street itself. The area there available for railway purposes is very circumscribed, and from the point of view of future extension Flinders-street occupies by no means a good position as might have been found for a central railway station in a town growing as rapidly as Melbourne. The effect of this arrangement is that that particular point of intersection has been constituted the principal focus in the life of the town. The modern railway station occupies the position that in old towns was occupied by the Town Gate. It is one of the most potent factors in forwarding the traffic of a town, and it is particularly unfortunate that the railway station and the bridge over the Yarra should have been placed in such close juxtaposition. The Prince's-bridge has to serve practically the whole of the southern portion of the town on the side of the river, and an immense traffic converges at that one point. The position is further complicated by the fact that further down the Yarra have been placed the various wharves and facilities for shipping, and as Flinders-street happens to be the one level road running from west to east, much goods traffic from the wharves, as well as that from the railway, is brought along

that lower level street in preference to the other streets that run in the same direction. So that, meeting the normal traffic across the bridge is the heavy flow of traffic along Flinders-street, and in consequence that particular spot is distinctly overcrowded simply because the railway has been so badly placed. That overcrowding would have been avoided if the railway, instead of coming along the Yarra bank, had entered the city in a more northerly direction, in the vicinity of Royal Park, and if the town had been allowed to grow down towards the river, instead of in the opposite way.

100. *To Mr. Sampson.*—In the first instance I should have placed the Melbourne railway station at a point immediately north of Latrobe-street, so that it could have been moved as became necessary with the growth of the city.

GENERAL.

101. *To Mr. Laird Smith.*—A railway station would be serving the necessary requirements of a community, having regard to modern means of locomotion, if it were placed within a mile of the centre of the city. I certainly would not place a railway station nearer than a mile to the central point of the city.

102. *To Mr. Penton.*—I know there are two bridges crossing the Yarra. The Queen's-bridge relieves the pressure from Prince's-bridge, and to some extent gets over the difficulty to which I have already alluded, but I do not think the placing of the railway station at Flinders-street is desirable in any case.

103. *To Mr. Sampson.*—I would not be in favour of the railway being brought within much nearer than a mile of the centre of a city itself, but in fixing the site for a railway station at Canberra I would arrange matters so that the station could be moved out on the same axis just as is contemplated at Milan. I do not think that I would construct a temporary railway first to the centre of the city. In the view I have just expressed, I was thinking less of a temporary railway than of a dead-end railway. Perhaps a better way of putting it would be to say that I had in mind the construction of a dead-end railway temporarily, with a view to its ultimately becoming a through railway, as in the case of Milan. In certain instances railways have not been taken into the centre of established cities because the cities were established before the railways were invented. In other instances, where railways have been constructed before the city was established, the running of a railway through the centre of the city has had a tendency to congest population and business close to the railway station. In the case of a new town like Melbourne, problems of traffic and congestion do follow the construction of a central station in the town itself, and in the case of the Federal Capital the construction of a railway a mile away from the contemplated centre of the city might influence the city's growth in a direction not originally intended unless proper precautions were taken to prevent this. I do not think there is any reason why, in the building of a new city, regulations should not be drawn up fixing the use to which any particular land should be put.

104. *To Mr. Laird Smith.*—I think the railway at Canberra will be a much more powerful factor in determining the growth of the town than anything else, but any difficulty that might arise having in view the city's future might be got over by reserving an area of land in the vicinity

of the railway station, and permitting no buildings at all to be erected upon it.

105. *To Senator Lynch.*—In my view it is not desirable that the actual railway, apart from the station, should be brought anywhere near the centre of a town if it can be kept further out. Both railway and railway station would be equally objectionable across the centre of a town.

106. *To Mr. Finlayson.*—There are many explanations of the modern tendency to keep railways outside the city areas as far as possible. There is the economic objection. Modern railways require much more room for their sidings. Many more trains are run now than was the case twenty or thirty years ago. That circumstance alone has created a tremendous demand for accommodation, and that accommodation cannot be obtained near the centre of the city. The railways, therefore, must go out to where they can get plenty of room for sidings and yards. The scheme of development decided upon in the case of the city of Milan is based on the anticipated development within the next fifty years, and the lines are being taken so far away from the centre of the city because of the desire that there shall be no repetition of the original difficulty due to the existence of a high embankment running through the city. This caused congestion on the south, and prevented development on the north. The railway has been taken out so that development may be normal in all parts. If the railway had been below the surface so that streets could have crossed the railway line at the normal level, I think the same difficulty would have occurred at Milan, because the very existence of a railway tends to draw round the goods yards all sorts of factories and other commercial buildings, and at Milan the amount of ground available for building purposes was already very limited. The growth of the city or any official restriction upon buildings on this one particular area, would have tended to still further increase land values and affect cheap production. All modern cities are looking for cheap land for industrial purposes. That can only be obtained on the outskirts where factories can get plenty of room for extension and where rents are infinitely cheaper than they would be in any central area. That is one reason why the railways are going on to the outskirts. Most towns are now being encircled with railways, and I think the possibilities in this direction at Canberra should be considered in conjunction with the preliminary plans from the point of view of the reservation of land for future developmental purposes. It is most necessary that the committee should bear in mind that ultimately a circular railway will be required at Canberra. Such a railway is requisite to the future of the Capital City. The selection of a site for a railway station in a city not yet built upon would be dependent upon the consideration of many local circumstances, and it would be very difficult for me to give a general opinion that would be of any value. A central station has to serve many purposes, in addition to those of the travelling public, and I would not care to express any opinion on the point off-hand. There is no necessity for closely associating the goods traffic with the passenger traffic. In this matter I do not speak as a railway engineer. I am merely giving a personal opinion, but my observation in European and English cities shows that the tendency is to treat goods railways quite apart from passenger railways, and goods stations quite apart from passenger stations. I can give an instance of that

in the town-planning competition recently held for the city of Dusseldorf. Dusseldorf is situated largely on the eastern bank of the Rhine with a railway coming almost due south through the city. The problem there was that they had the railway on a high embankment dividing the older portion of the city from that now growing, and because of the absence of proper means of communication the area between river and railway became extremely congested, land values rose, and various other city problems resulted. The plan which secured the first prize got it largely because of the suggestion it contained regarding railway improvements. It suggested that the goods traffic should be treated on a circumferential railway quite irrespective of the line through the city, and goods stations were placed at various points on the circumference of this railway quite irrespective of any passenger station. This is an illustration of the modern tendency to separate all questions affecting goods traffic and goods station from those of passenger traffic.

107. *To Senator Keating*—I have had no experience of the mono-rail system in this connexion. I have seen the system at work, but I cannot give any opinion of value upon it.

108. *To the Chairman*—As a general principle I would advocate the construction of an underground railway rather than an overhead railway. In answering that question I am fully aware that most railway engineers favour the overhead system because of the less cost of construction, but there is always a danger of the difficulty such as that which occurred at Leipzig, owing to the presence of high railway embankments. In Berlin the railway from Potsdam comes up in a north-easterly direction. There is a second railway from the south, and the two are crossed by the city ring railway. Development has succeeded on the western side, and also on the eastern side, but there is a tongue of land between these two railway embankments that has been almost completely withheld from development. High railway embankments running roughshod over a town, unless very careful attention has been paid to the subject of town-planning before the construction of the railway, are calculated to damage some of the best features of town-planning.

109. *To Mr. Sampson*—It is almost impossible to answer a question as to where the railway station should be placed in a new city. So much depends upon local considerations. In the evidence I have given I have not dealt with any guiding principle as affecting the construction of railways in cities already developed, for the purpose of relieving congestion. What I have endeavoured to illustrate was how the cities have been developed, and how the later growth of cities showed the tendency to take the railways further out. I do not know that anyone could lay down a definite guiding principle to govern the position of a railway in a new town. The tendency in established cities is to rely more and more upon tramways in the city itself, using the railway as a developmental and decentralizing force.

110. *To Senator Keating*—It would be impossible to lay down any general principle, but I think some advantage is to be gained in the development of a virgin city by laying down a particular scheme fixing the terminal points of its railway system, provided that the authority responsible for the location of these terminal stations is also in possession of the power of saying that cer-

tain lands shall not be built upon, and that certain other land shall be built upon. With an all-embracing power of this character, I think it would be possible to materially influence the development of a city by fixing the railway station at one point, the civic centre at another point, the shopping centre at another point, and so on. It would be possible to go a long way towards securing the most advantageous development of a new city by prescribing the routes and features of the railway system, though I do not say such a scheme would be absolutely successful.

111. *To Senator Lynch*—I would have neither railway nor station within a mile of the centre of the town. As to whether my objection would apply so strongly in the case of Canberra as in the case of an established city, I would not care to say, though I cannot admit that the city is only likely to have a population of 50,000 within the next fifty years. The experience of towns generally is that they frequently grow at a very rapid rate from causes which it is impossible to perceive, and, therefore, in planning the town of Canberra I should most certainly keep in view the prospect of the town possessing a much larger population than 50,000. My main objection to the presence of railways close to the centre of the town is that they create congestion, and affect land values, though if it were certain that the population of Canberra would be no more than 50,000 it would be possible to select a site for the central railway station at a spot where these difficulties were least likely to occur. I prefer a depressed city railway to an overhead railway. Stations below the surface are common in many parts of the world, but a sunken station, to my mind, requires to be planned just as definitely as an overhead station. The most inconvenient form of station is that at which the platforms and railways are on the same level. If the station is below the surface it is possible to get to the different platforms without inconvenience, and goods can be handled just as conveniently at such a station as at an overhead station. I most certainly would not permit level crossings in a city.

112. *To Mr. Gregory*—The settlement of all these questions does very largely depend upon the topography of the country.

113. *To Mr. Laird Smith*—In modern town-planning it is an advantage to confine the commercial centre to one place, the educational centre to another place, and so on. Classification of that sort is always an advantage, and should be applied to existing cities wherever possible.

(Taken at Sydney.)

TUESDAY, 7th SEPTEMBER, 1915.

Present:

Mr. RILEY, Chairman;

Senator Keating,	Mr. Finlayson,
Senator Lynch,	Mr. Gregory,
Senator Story,	Mr. Sampson,
Mr. Penton,	Mr. Laird Smith.

John Kirkpatrick, Architect, Sydney, sworn and examined.

114. *To the Chairman*—I have been engaged as an architect in Sydney for the last thirty-five years. Amongst the works for which I have been responsible are the Sydney Hospital, the

Mutual Life of New York Assurance Company's buildings, Sydney; Sir William Cooper's mansion at Woollahra Point; Mr. Walter Hall's house at Pot's Point, and a large number of warehouses and factories of all kinds. I am the architect for the Commonwealth Bank now being erected in Post Office Square, Sydney. I was also a member of the committee responsible for the selection of the plan for the Federal City. There were three members of this selection committee, and Mr. Griffin's design commended itself to Mr. Smith and myself as being more in the way of what was required, generally, though we did not regard the plan as altogether satisfactory in regard to all its details. It appeared to me to be the work of a young man, rather than of one who was experienced in all the technique of the work of town-planning. Many details were capable of improvement, notably in regard to the railway and water systems. But the Government did not advertise for designs showing all these details. They merely advertised for a general scheme of design, and from the point of that general scheme, we thought the plan sent in by Mr. Griffin was the best. We had to overlook a great many little essential points with which we found fault, though in the other designs many technical points were not dealt with so well as they were by Mr. Griffin.

In my opinion, the railway treatment as shown in the original design is bad. The railway should be brought down from a northerly direction more or less on the line laid down in the departmental and Mr. Griffin's amended plans, bearing to the east, and then returning back between the circular basin and the segmental basin with the railway station within half a mile of the site of Parliament House, then proceeding due south and east to link up with the Queanbeyan railway. Ultimately Canberra will become a very large city, and I think it is desirable that, even at the present time, some provision should be made for a railway to Jervis Bay. The Committee should also consider whether it would not be desirable to have a railway from Yass as well as from Queanbeyan, entering the city from the west, so that ultimately the city may be served by a railway from Jervis Bay entering from the east, another from the west in addition to that projected from the north, and a further railway south-east from Queanbeyan, all linking up with the railway that, I think, will ultimately be constructed from Melbourne running via Koscusko and the Gippsland Lakes. I would suggest that the railway should be brought nearer to the city than is shown on the design. A defect in nearly all the large cities of the world is that the railway is too far away from the centre. This is explained by the fact that the city was built before railways were invented, and great expense and trouble would now be involved in carrying the railways to the heart of the city. In New York, however, where they do things in a big way, enormous sums of money have been spent in order to bring the railways underground to the centre of the city, and enormous palaces have been built over the terminal points. I would not construct an elevated railway, I would construct a tunnel or a cutting deep enough for roads to pass over, and I would make that cutting sufficiently wide to take four tracks. I would also give the banks a slope of 20 feet or 30 feet, filling them in with rocks and ferns. Parallel to the railway on the upper level I would construct a boulevard on each side 100 feet to 150 feet wide. This could be treated like the St. Kilda-road, and would be available

for future railway extension, in case it became necessary to widen the track. I would have no level crossings. I have not had time to go thoroughly into details, but I have been into this question before, and I believe that a cutting such as I suggest could be made. A railway above the level of the houses is a disfigurement. The huge railway embankments tend to throw the whole town out of proportion. The elevated railways in New York throw all the buildings out of proportion, they are subject to all the winds that blow, and require tremendous supports. Therefore, I think that in the long run the cutting would be cheaper than the overhead railway. In this respect I do not think any notice need be taken of the absence of view. Passengers as a rule do not go into railway trains just to look through the carriage windows. I am strongly of the opinion that the main entrance line should terminate at the centre of the city. Now is the opportunity for putting the railway station in the position it ought to occupy. One hundred years hence the designers of the city will be laughed at if they put the railway away from the centre. Then the question arises as to where the city is going to grow. No one can regulate the growth of a city. Rules and regulations regarding development may be laid down only to be disregarded, but it is most likely that the city will grow in the direction that is most convenient. In any case, however, it seems to me to be a *sine qua non* that the railway should pass between the circular basin and the segmental basin to a point upon which the power house is marked in the city design, somewhat south-west of the central basin.

115. *To Senator Keating*—The railway in the second prize design is better placed than in any of the other designs. The three Commissioners were all of that opinion. In that design the track proposed is very similar to that shown in the official plan, which met with the approval of Mr. Griffin. The railway in the original design is too far away. I do not think an amended railway plan would interfere more than slightly with Mr. Griffin's design. When I suggested to Mr. Griffin that this alteration should be made his reply was that it would spoil his avenue, but it cannot be said that the construction of an underground railway has spoiled Prince's-street, Edinburgh, one of the most lovely streets in the world; yet a sunken railway runs directly underneath that street. Another good feature about the second prize design was that the manufacturing centre, which might yield fumes, was taken away to the south-west corner of the city. This manufacturing centre might be connected up with the Yass line, and subsequently this branch line might be extended to become a circular railway round the city.

116. *To Senator Story*—If the manufacturing centre were placed up north, as suggested by Mr. Griffin, the natural consequence would be a very dirty entrance to the city. If that area is set apart for manufactures, galvanized iron sheds and other sheds will be erected. Such buildings are always very unsightly, and always dirty. It would be the biggest mistake in the world to put the factories there. The manufacturing area should certainly be either on the south-west or south-east.

117. *To Mr. Finlayson*—One of the objections to the route of the line as shown in the sketch plan is that it enters into hilly country straight away, and enormous tunnels and big cuttings would be necessary. Such a railway would virtually have to cut its way through the hills. The

modern tendency is to keep steam railways as far out of the city as possible, using electric traction in place of steam within the city area. That could be done in the case of Canberra, the electric railway commencing some distance north. At the same time I should not remove the railway from the centre of the city for the sake of any disagreeableness that might be caused by steam or smoke. Half a mile is too far to remove a railway from the city centre. To a certain extent the modern tendency is for the person who has to travel a quarter of a mile or half a mile to a railway station to take a taxi, and in that respect there is very little difference between a distance of half a mile and a distance of two miles, but it must be borne in mind that railways are not built for the exclusive service of the tourist. They are built for the service of the general public, and for every one person who drives up to the railway station in a cab or taxi 10,000 people walk. The 10,000 are the people for whom the railways are built, and where convenient should be considered. No guarantee can be given that a business centre of a city will be where it is planned. Forty or fifty years ago an attempt was made in Vienna to popularise the south side of the Danube, where enormous sums of money were spent in the building of boulevards and beautiful streets, with the idea that population and popularity would follow. Instead of that the whole population, for some reason or other, moved away in quite the opposite direction, and land there can now be bought for a mere song. Some years ago an attempt was made to popularise a part of North Sydney, when a very expensive suspension bridge was erected over one of the arms of Middle Harbour. It was quite unsuccessful, and over half a million of money was thrown away. It would be better if the railway were constructed so that it would run through the industrial centre, or at least so that branch lines could be conveniently built to join on to the main line. If successful the factories will probably require branch lines of their own. In addition to the Yass Junction railway, I suggest that another railway should enter the city from the west joining with the line from Queanbeyan. As to the position of the principal passenger station, it should be borne in mind that this city is being built for a particular purpose. It is to be the capital city of Australia, and therefore it is very desirable that no cognizance should be taken of the commercial aspect in fixing the site of the railway station. The position of the railway station should be where the most important part of the city lies, and the most important part of this city will be in the vicinity of Parliament House, the Governor-General's residence, and the official buildings. That is why I lay particular stress on having the railway station placed at the spot I have indicated, about half a mile from Parliament House. I do not think there can be very serious objections to a steam railway travelling within half a mile of a city centre, if the railway is underground. If it were an overhead railway I admit it would be better 10 miles away. My recommendation regarding the detour lines running between the lakes to the south-east would be dependent upon a sunken track being possible.

118. To Mr. Fenton.—The Commissioners experienced considerable difficulty in adjudicating upon the various designs submitted. In some of the rejected designs the railway scheme was superior to that in the adopted design, though this was superior to the rest in its general lay-

out. It would be a very easy matter to substitute electricity for steam on the railway built within half a mile of Parliament House once the railway was built. I would support the construction of a circular railway within the city, though I would not go on with that work at once. I do not think it matters very much which portion of the city is first developed, so long as the main outline of the design is adhered to. The railway I have suggested running between the two lakes, and terminating within half a mile of Parliament House, can be constructed without any serious effect upon the design submitted by Mr. Griffin. At the same time I think it would be foolish to select any particular spot and say, "This shall be the civic centre," just now. Any civic centre will be of insignificant importance for the next fifty years. It would be a convenience to the actual building of Parliament House if the railway were brought to within half a mile rather than that it should remain 2 miles away. I do not think that a depressed railway would cause any disfigurement to the city, and I do not think that it would in any way affect the plan. Rather do I think it would be an improvement. The tendency in all modern cities is to have sunken railways with gardens and boulevards overhead.

119. To Mr. Lord Smith.—In recommending the construction of a railway, consideration should certainly be paid to the unity of the city, as it was in the mind of the designer, and I think Mr. Griffin's design can be well preserved by the construction of a railway as I have suggested. The railway between the two basins will improve Mr. Griffin's plan.

120. To Mr. Sampson.—If I were given sole control, with full rights over the disposal of all land, and rights to impose building conditions, I do not think it would be possible for me to control the development of the city. I have seen a city turned right round because attempts have been made to regulate its growth. If covenants are inserted in land transactions people will, as a rule, make any excuse to get away from them. I know that land at Canberra will be leased, and not sold, but the same argument applies. If only one man were to direct all the leaseholds, and for all time, it might be possible to control the city development, but where there are 500 men, each holding a different opinion, the position is different. I think it is utterly impossible for any Government, no matter how powerful it may be, or how long it has been in power, to regulate people to the extent of saying where they shall go or where they shall not go. The history of city development shows that, generally speaking, one or two men have led the rest in the matter of commercial settlement. The parliamentary centre at the new city will be its one main feature, and surrounding that will ultimately develop the civic centre, in spite of anything that may be done to establish it in any other part of the city. The civic centre shown in the north is no centre at all. It seems to have been put there simply because there is a small hill from which a long avenue has been constructed to the other side of the town. It may be nice to build a town hall there, but that will not be the centre of the city. The centre of the city will be where the population is. The suggested centre in the north is a faddy, rum-suckle centre. The actual and real civic centre will never be in the north unless Parliament House is moved there. If the commercial and

civic centres were established in the south it would be necessary to adhere to some sort of design.

121. To Senator Keating.—I think the tendency is to place the railway station as near the centre of the city as possible. I have already referred to what has been done in New York. Dresden may be quoted as another example of this, and in Berlin the railways are more or less in the centre. There are several reasons why, in older towns, the railway stations have not been built at the centre. Continental cities are for the most part old and historical cities, and there is a desire not to disturb the churches and other historical buildings and monuments, which are regarded as irremovable land marks, and for which a good deal of reverence is felt. As these land marks cannot be removed the modern railway station has been taken further out. If the land marks had been there, the railway stations would, I think, most certainly have been taken into the centre of the cities. Conditions like this cannot possibly apply to a new city, and the city railway ought to be brought into the middle of the city.

122. To Mr. Gregory.—I agree that there should be no level crossings, but that the railway should pass either above or below the street level. In the route that I have recommended I do not think that level crossings would be necessary. I think a good deal of inconvenience is nowadays caused by the noise of city tramways. A city underground railway makes much less noise than a tramway system. Tramways outside the city would be a valuable adjunct to the city railway service. I would place the goods sheds and marshalling yards outside the city. My opinion is that the factory area will develop to the west whatever may happen, and I would carry the railway there, so as to bring it in touch with the factory district. I am aware that the prevailing winds come from the west, but that would not alter my opinion as to the location of the factories. My experience of the wind is that its direction is more west to north than direct west on account of the presence of Black Mountain, which affects the currents.

123. To Senator Story.—A railway as suggested by me could be brought into the city without materially affecting Mr. Griffin's design. Rather do I think the design would be improved, but I think such a line could be incorporated in a reasonable manner. I think a depressed steam railway is less objectionable than an electric railway on the surface. I would sooner have an underground railway than a level tramway. Members journeying to Canberra from Melbourne would enter via Yass, which would probably be the main passenger entrance. Some little surveying difficulty exists, but it could be got over by tunnels. It would be objectionable to have the main entrance through the industrial part of the town. The idea of "an initial city" was suggested by myself, and I think that the tendency of settlement will be in that direction, no matter what attempts are made to force it on the other side of the river. On the opposite bank of the basin will be the residential centre. Ultimately the Governor-General's House will be there, and I think it is inevitable that the commercial centre will form itself near the "initial city." In the event of the Commonwealth Government deciding to build a factory capable of supporting a population of 5,000 people 4 miles north of Parliament House, that might have some tendency to draw population from the neighbour-

hood of Parliament House, but the tendency would not be great, and only a very few people would be affected by it. On the other hand the erection of such a factory might result in the establishment of two isolated settlements. I would not like to say that, assuming the first settlement takes place in the eastern part of the city 100 years hence, when the city has a population of, say, 150,000 people, the civic centre will or will not gravitate to the point shown on Mr. Griffin's design. Judging by the facts of history I do not think it is safe to make any assumption as to what is likely to occur in the future. At the same time it is worth remembering that in medieval times the church or the cathedral was the civic centre. Markets grew up in the same vicinity, and when the city grew larger and larger it generally happened that the civic centre remained where it was originally fixed. I think that Mr. Griffin's design could be substantially adhered to, and ultimately carried out even with the city civic centre south of the Molonglo. I have argued the point with Mr. Griffin, who, however, declined to break away from his design.

(Taken at Canberra.)

THURSDAY, 16TH SEPTEMBER, 1916.

Present:

Mr. RILEY, Chairman;	Mr. Finlayson,
Senator Keating,	Mr. Lynch,
Senator Story,	Mr. Gregory,
Mr. Fenton,	Mr. Sampson.

Norris Garrett Bell, Engineer-in-Chief and Acting Commissioner, Commonwealth Railways, sworn and examined.

124. To the Chairman.—Having seen the proposed routes for the railways, I will supply the Committee with an estimate of the cost on the route proposed by Mr. Griffin, the cost of the tunnel, the cost of the route proposed by Mr. Hobler, the cost of the departmental deviation (there would not be much difference between these two), beginning at the Queanbeyan line and finishing at the centre of the avenue running from the civic centre; an estimate of deviations joining at different points near the church; an estimate of the cost of different ways of crossing between the circular basin and the eastern lake, and an estimate of a variation of Mr. Hobler's route, skirting the lakes and joining the main line near the civic centre. I will supply, also, an estimate of the route proposed by myself, and of Mr. Griffin's suggestion of a line to junction below the church, so as not to interfere with the main avenue running from the civic centre to the proposed hotel. I will also indicate definite sites for the railway stations.

(Taken at Canberra.)

FRIDAY, 17TH SEPTEMBER, 1916.

Present:

Mr. RILEY, Chairman;	Mr. Finlayson,
Senator Keating,	Mr. Lynch,
Senator Story,	Mr. Gregory,
Mr. Fenton,	Mr. Sampson.

Walter Burley Griffin, Federal Capital Director of Design and Construction, recalled, and further examined.

125. To the Chairman.—Mr. Hobler's proposition to bring the railway near Parliament House

would decidedly affect my plan, and revolutionize my scheme of distribution. It would not affect only the one portion, although that is one of the places I do not want railways brought into. I had designed it for a high-class residential region, surrounding the public buildings, and for anything except rapid transit I would not care for a railway service, or the general accompaniments of a railway. I suppose some of my lay-out could be re-arranged if it were decided that the railway must come near Parliament House, but I cannot say that I have been able to find a satisfactory way. A railway cutting across the plan in any of the ways suggested would go through a region which I had planned for a minimum of circulation, and for purely residential streets, with social, and not business, activities dominant. To put a distribution centre in the middle of that would be to turn the thing inside out. Practically the same objections apply to the departmental deviation as to Mr. Hobler's. When discussing the matter with the Board in 1913, I indicated a line which would correspond to my circulation lines, taking it right up to Parliament House; but I have made up my mind to provide for rapid transit everywhere throughout the city by sub-surface transit. I thought that circulation route would be practicable, but I have improved on it since. The city plan is based on radial lines, with wide thoroughfares for all intercommunication, and I want all my circulation to conform as far as possible to these circulation lines. The other streets are residential or distribution streets.

120. *To Senator Keating.*—I would adopt the circulation line suggested by me previously as a last resort as a rapid transit line. It is only suitable for passenger service. I do not want a railway line with sidings and goods service in that section of the city. The nearest point of Mr. Hobler's route to Parliament House is about 800 feet. I do not suppose that Parliament House, Melbourne, is more than a quarter of a mile from the Jolimont Yards, through which hundreds of trains run per day. The proposed station would be slightly nearer to Parliament House than that, but my objection to a railway in the city is not on account of noise from sunken passenger service.

121. *To Mr. Sampson.*—To run a railway line on the deviation suggested would not take the place of the main railway suggested by me between the lakes. My suggestion was merely as a supplemental line for rapid transit. It is practicable to bring the railway as near the water as suggested to me on the north-east side of the circular basin. My objection is that it would remove the railway station from the centre of distribution, where I would prefer to have it. It is physically possible to bring the line closer to the water, and put the station closer and still preserve separate grade, but I would have to consider whether I would recommend that or not. I can give the Committee an estimate of the cost of running the railway over the embankment at a lower level, but in making the embankment I propose to use the material excavated a little further on. I am awaiting the result of three borings to ascertain the nature of the country through which the tunnel is to run.

122. *To Mr. Finlayson.*—For the sake of appearance, I would much prefer a one-level bridge between the segmental and circular basins. If the railway is taken across at a different level from the road, it will have to be taken either under or over the road where it turns. I would prefer to have a clear space of 20 feet above the water in

the middle of the arches. A two-level bridge would be a greater obstruction to the eye than a single bridge.

123. *To Senator Story.*—A railway handles freight; that is a practical distinction between a railway and a tramway. There is no more objection to an electric rapid transit railway than to an electric tramway. The important point is the period when we may expect to have a tramway or rapid transit system in the city itself. I know of a number of cities of about 10,000 population where tramway systems are in profitable operation. In Monroe, Louisiana, the municipality put in an electric tramway system with a 24¢ fare, and paid for the whole thing in seven years, and that in a very spread-out area, with a population of 5,000 whites and 5,000 blacks. It is the question in our new city whether it is cheaper to put the railway all through it or make the internal communication of the city a separate matter. Likely, in the very first stage, motor transit would be more available and cheaper, but electric tramways are profitable in a number of New Zealand cities of 10,000 population. It is the spreading out of the population that makes tramways profitable, as well as desirable for the sake of the city.

Percy Thomas Owen, Director-General of Works, Department of Home Affairs, recalled, and further examined.

130. *To the Chairman.*—If, as Mr. Griffin says, there is to be no business on the south side, why did he propose a quick transit line on that side of the plan given to Mr. Kelly? We are not proposing to make this town a Washington, especially in its initial stages. As to the double bridge or track, the Board arranged for two bridges, one carrying the railway and the other the road, on the same level, and an overhead crossing over the avenue running from the civic centre to the hotel. One thing done by the Board was to get a direct approach from the railway station to Parliament House, with a reasonable distance between the two. In a quiet region like this, smaller noises would appear much louder, whereas in a big city one would not notice at Parliament House the noise of the Jolimont Yards. The Board's proposal, bringing the railway in close to the town, with a park between the station and the ornamental water, is the best solution of the problem. We had no intention to have close settlement between the station and the water. I strove for days with Mr. Griffin to accomplish something which would meet all views, but we had to give it up. We saw Mr. Kelly with him, we were dismissed, and, to the best of my knowledge, the plan Mr. Griffin had prepared was approved, and he was told to work it out in detail. I have never seen the Minister's approval of it by minute. If Mr. Griffin proposes to get enough spoil from his excavation to make the embankment, his excavation will vastly exceed what is necessary to get the railway through. The general idea of our route was to approach the town through park and open country, and past the large Government institutions, so that visitors would see the town from the side windows as they neared it. This advantage is not offered by having the railway in a cutting.

131. *To Mr. Gregory.*—The nearest point of the departmental line to Vernon is 3,200 feet.

132. *To Mr. Sampson.*—Before I agreed that that would be impracticable, I would like to know what the business centre proposed at Vernon was going to be.

133. *To Senator Story.*—In the conditions issued to competitors it was stated that probably munitions would be made at Canberra.

134. *To Senator Lynch.*—I would carry the railway normally at the ground level, but take advantage of certain hills or ridges to give crossings for roads over the line at intervals. I would not have level crossings in the streets. The railway stations proposed by Mr. Griffin are too far away from Parliament House. The departmental route is better. I think Mr. Griffin took his deviation even nearer Parliament House than was originally proposed. Our nearest point to Parliament House was 2,500 feet. If the station is not close to Parliament House, after a generation every member will wonder why it was not done. At Delhi they are trying to get the station close to Parliament. This town will be south of the river for the next twenty years.

(Taken at Sydney.)

MONDAY, 27TH SEPTEMBER, 1916.

Present:

Mr. RILEY, Chairman;	
Senator Keating,	Mr. Finlayson,
Senator Lynch,	Mr. Gregory,
Senator Story,	Mr. Sampson,
Mr. Fenton,	Mr. Laird Smith,

John Sulman, F.R.I.B.A., Consulting Architect, and President of the Town Planning Association of New South Wales, sworn and examined.

135. *To the Chairman.*—The railway should skirt the city, and not go through it, as a general rule; but the Federal Capital requires special railway communication. Parliament itself has to sit there, and some special provision should be made to enable members and officers to catch the train on Friday evenings. A loop-line would meet this difficulty, leaving the main line to skirt the city. This might involve a little extra expense, but I think it would be justified. If I were a member of Parliament I should consider 2 miles too far. I favour the construction of the departmental deviation. I would have elevated railways, because I know what a nuisance they are in New York. A railway on the level causes great difficulty about crossings. On the whole, a depressed line is better. That is the tendency of modern railway construction, where it is considered as portion of city planning. A depressed railway would interfere with the lay-out of the city less than an elevated line or level line.

136. *To Mr. Laird Smith.*—If the departmental line goes above the surface I am strongly against it, and would prefer Mr. Griffin's route.

137. *To Mr. Finlayson.*—Perhaps the statement I made earlier regarding the desirableness of taking the railway line near Parliament House was coloured by my ideas of several years ago, when I felt rather strongly that the legislators should have as quick access to the railway as possible. The development of electric and motor transit has modified that view, and if members of Parliament are satisfied to put up with a mile and a half of electric tram or motor car travelling, I should say do not take the line into the city, except as a temporary line, just to bring in building material. Sydney Parliament House is about a mile from Redfern railway station, and I have heard no complaints about the distance. My original idea, as expressed in my pamphlet, was to have a line running in from the main railway towards Parliament House, with a car waiting

for members to be taken from there and coupled on to the train; but I am prepared now to modify that idea, although I still think it is a good one. That car might be run by electricity over the loop-line, and then attached to the train. Broadly and generally, to avoid noise and dirt and conflict with the aesthetic principles of a beautiful city, it would be wise to keep steam traction outside the city, except in the commercial centre.

138. *To Mr. Sampson.*—A visible railway running into the southern part of the city would be a disfigurement, and even a depressed railway would be, to a certain extent, detrimental. On broad, general principles, Mr. Griffin's line is the best.

139. *To Senator Story.*—It is quite possible that by the time Parliament House is established at Canberra members may get there by aeroplane. Probably the tendency would be for the first residences and businesses to be established somewhere in the neighbourhood of Parliament House and the administrative offices, where, in the building of the city, hundreds of workmen would be employed. But that tendency would have to be controlled. It would be better to provide temporary, rather than permanent, accommodation for the workmen. To make a city worthy of Australia, you must keep in view what it will become in a hundred years or more. Even if the workmen are there for as long as seven years, I would still provide temporary accommodation for them. It would be a fatal mistake to make a workmen's dwelling quarter close around the Parliamentary Buildings. I would meet the shopping needs of the workmen with temporary arrangements, which could be done away with when the great need for the presence of the large number of builders had passed. I agree with Mr. Griffin's suggestion that there should be an initial city of a temporary character situated south of the Molonglo, and in the neighbourhood of Parliament House. If manufactures are afterwards developed, the workmen's quarters will naturally surround them. It would be a pity to put any factory to the south-east, because the southern portion is the picturesque side, and does not lend itself to manufacturing activities. For manufacturing fairly level spots are necessary, but the south-east is hilly. The placing of the Small Arms Factory 4 miles to the north, might, to a certain extent, tend to create an isolated town, but I have sufficient faith in this country to believe that in the future that will not be too far to keep the factories out of the city. When I came here 30 years ago, Sydney had a population of about a quarter of a million. It has almost trebled itself in that time. I do not say that Canberra will grow as fast, because it has not the same commercial possibilities, but I believe that a century or two hence it will be one of the big cities of the world, and in building a city we must look forward at least a century. I do not know that the building workmen will suffer much inconvenience if they are entered for temporarily. When permanent works are established, provision to meet the requirements of their workmen in the way of supplies will probably have to be made locally. The manufacturing centre will become a suburban centre, with its own local trade and conveniences. Temporary accommodation would include temporary shops and temporary places of amusement. As near as possible within reason, all conveniences should be provided temporarily for the building workers. It would not be within reason to make them shop a mile and a half away on the

other side of the lakes. I would suggest a co-operative store. That is a matter which the Commissioners of the city could consider. I do not approve of the present site for the brickworks. They are just on that side of the city from which the prevailing winds blow. I should strongly recommend you to establish them elsewhere, if that is at all possible. I am sorry to hear that they are already established there, because they will be a nuisance. Development of the city will naturally take place at first more on the south side, but to confine it to that side would be a mistake. If people are allowed to do just as they please, they will probably congregate around the works that are in hand, but if that is allowed it should be only temporarily, because it would spoil the future development of a fine city. If the distance from the south-west residential suburb to the proposed business centre on the north is too great it might be necessary to make a small subordinate business centre in the south-east. But the main business centre should be on the north, at the civic centre, when Canberra is a city. That matter could be regulated by the Government when alienating the land.

140. *To Mr. Gregory.*—I presume the residences of members will be near Parliament House, so that the matter of conveyance by motor car would not be a great point. Level crossings in the city should be avoided. A very careful examination of the topography of the country through which the railway would run is necessary before a decision on the rival routes can be given. The question of how the routes will affect Mr. Griffin's general lay-out also requires careful consideration. The grade must be thought of. It should not be less than one in eighty. If Mr. Griffin says he can get a grade of one 300, that will be excellent. If he can get that without any level crossings he will give us a very good line. Park reservations all round the city would be valuable, but I am doubtful if we could get a reasonably economic line running all round the city. There is value in the suggestion to make provision for a railway in the south-western corner for use in 20 or 30 years' time. In time four lines to allow for heavy traffic might be needed.

141. *To Mr. Fenton.*—My original opinion was that it would be desirable to have a loop like Mr. Hobler's. I am still balancing. A temporary line to bring material during building operations would be a necessity. It could afterwards be converted into an electric tramway. The noise from trams is conditioned by the height of the buildings on each side. Trams do not produce the amount of noise that a train does, yet in a city like Sydney they appear to produce more.

142. *To Mr. Laird Smith.*—The plan of the city is so good that it would be a pity to do anything that would interfere with its general lay-out.

143. *To Senator Lynch.*—A permanent elevated line close to Parliament House would disfigure the city. I do not think it would do so very much if it could be kept below ground. But if we could do without it, so much the better. The railway line must go to the north, to meet manufacturing necessities and connect with the main line.

144. *To Senator Keating.*—My original idea was to bring a small spur line very close to Parliament House. If it was to carry continuous traffic I would keep it at least a quarter of a mile away. That is about the distance of Jolimont Yards from Parliament House, Melbourne. The Adelaide railway station is very close to Parliament House. The matter involves a balancing

of advantages and defects. If you can do without a railway coming right into the city, and give access in other ways, I would say "Do without it." But, if you want it, take it there, but no nearer than is absolutely necessary.

Francis Ernest Stowe, Architect and Engineer, Honorary Treasurer of New South Wales Town Planning Association, sworn and examined.

146. *To the Chairman.*—If the railway is for passenger traffic, with a terminal station, you can well and conveniently keep it out of the city. But if you are running a suburban service, it would be as well to take it through the city. The railway at Washington goes to the central station, practically in the heart of the city. The present system in Sydney is ideal, but Canberra is a place of big distances. The Sydney central station lands the traveller almost in the heart of the city, and distribution by electric tram is available from that centre. The problem at Canberra is altogether different. If the railway station is to be underground, as proposed by Mr. Griffin, it would be better to bring it nearer the Capitol, where the contours would allow it also to be placed underground. If it is to be an underground station, I would bring it nearer Parliament House and the administrative block. The sunken track is the only one that is aesthetically correct, with roadways crossing overhead. Chicago, in respect of railways, is in a very unhappy position. I presume the marshalling yards would be outside the city.

146. *To Senator Lynch.*—Of the three railway proposals, I would prefer the route going nearer the Capitol. My objection to Mr. Griffin's route is that it is too far away for a terminal station. I presume the suburban traffic will be by tramway. I would bring the railway in to accommodate the residential quarter on the south side of the lake, and to reach the hotel accommodation it should come as near the Capitol as convenient. It would not sacrifice the eastern lake if you did not take the railway across on Mr. Griffin's route. You could still have a causeway on an embankment, not so strongly built as would be required to carry a railway. The main question is that of convenience. I would not allow the question of the erosion of the eastern lake to influence me in deciding the railway route. I do not endorse Mr. Sulman's view that the railway should be kept outside the city. I am assuming that Parliament House and the Capitol will be the centre of the city, and that the hotels will be in that locality. My idea is to study the convenience of people coming to and going from the city. The business part on the north side will have to be accommodated by something other than the railway. My idea of the people who would use the central station is that they would be travellers or "casual buggers." Sooner or later electric traction will be adopted, as in New York, to bring the trains into the city. The only objection to a railway coming close to Parliament House is the smoke from the steam locomotives. The tendency in America is to bring the central station near the heart of the city. In Sydney the intention is apparently to make other central stations. The present Sydney system is one of the best I have seen. There is no objection to placing the railway station 30 feet below the natural surface, provided it is not a dead-end station.

147. *To Senator Keating.*—When we arrived at Washington we had a long way to go to reach the hotel, although the central station is practically in the centre of the city. In assuming that the hotels will be near the governmental centre, I anticipate that the relationship of the different parts of the city will be settled by the city authorities.

148. *To Senator Story.*—As the main function of the city is governmental, the convenience of members and officers of Parliament should be considered in designing the route of the railway and the position of the station; and, in view of the fact that this is to be a Capital city, the official quarter will be more important than the proposed civic and business centre. It would be undesirable to start the early business places on the north of the river, unless rapid and convenient transit was provided at once. Whether business places on the southern side of the city will interfere with the ultimate development of Mr. Griffin's plan or not will depend on the degree of their permanency. Formation of the streets will be a permanent undertaking. I am not aware that the designer of Adelaide intended that Wakefield-street should be the main business street, or that his intention was not fulfilled; but, whatever the intention, the result of the layout of Adelaide has been very good. If Canberra is allowed to develop as Adelaide has been, the business centre may grow up in a different locality from that intended by the designer; but I presume the governing authority will not allow this. That matter can be controlled by Ordinance. I cannot imagine business people tamely agreeing to a direction of the authorities to build on the north side of the river, when all the settlement was to the south, unless full and free means of communication were provided. Transit invariably determines the location and settlement of business. For a long time the shops will be merely retail. Business people will certainly want to establish their premises near the parliamentary centre; and theatres would naturally be proposed in that locality.

149. *To Mr. Laird Smith.*—One of the principal features of town planning is to construct railways in such a way as to compel business and other residents to go where the town planner likes, and not where they like; but this railway is not to be a local railway. Unless transit conveniences are provided, you cannot compel people to settle in particular localities. If business people are allowed to locate themselves wherever they choose, town planning is not of much value. The through railway line now under discussion has nothing to do with suburban transit. It should be brought in to suit what the Government propose to make the residential locality of the city; but it should not be terminated there in any circumstances. All the shunting and marshalling should be done outside the city.

150. *To Mr. Finlayson.*—The new terminal station at Washington was completed when I was there last year. The old one was removed, not for aesthetic reasons, but to get sufficient area. The Washington authorities are largely reconstructing the city to get back to something near the original plan. The railway station there is purely a terminal station. There is a difference between a terminal and a dead-end. Redfern Station, Sydney, is really both. All the stations in the Capital should be through stations, with no dead-ends. There should be other stations on the line convenient to various parts of the city. I presume the

residential hotels would be near Parliament House, as members of Parliament would not want to take hotel accommodation at the civic centre on the north side. I would locate the station as near as possible to, and not as far away as possible from, the residential part of the city.

151. *To Mr. Sampson.*—I favour the deviation rather than Mr. Griffin's route, because it gives the terminal station near the city centre instead of in the market centre. I take it that the line will be a comparatively low traffic line. Goods traffic can be diverted north-east of the lakes. Another line could be carried to the east of the eastern lake, past the Military College, and join up with the other line to the south of the eastern lake. I would advocate these two loops, and not take the railway across between the eastern lake and the circular basin. It would not be very convenient to have the station to the north of the circular basin, as proposed by Mr. Griffin. It would be worth while to save a mile in getting from the terminal station to the residential quarter. There would probably be another station at the civic centre.

(Taken at Sydney.)

SATURDAY, 2ND OCTOBER, 1915.

Present:

Mr. RILEY, Chairman,	
Senator Keating,	Mr. Finlayson,
Senator Lynch,	Mr. Gregory,
Senator Story,	Mr. Laird Smith
Mr. Fenton,	

Charles Robert Scrivenor, Director of Commonwealth Lands and Surveys, sworn and examined.

152. *To the Chairman.*—Mr. Griffin, in his design, took the railway across on a high bank, and immediately plunged it into a deep cutting with a station underground. Through the city it was proposed to keep the railway in a 12-ft. cutting, with a 5-ft. bank above it. I disagree entirely with that. The aim of the Departmental Board was to bring the railway as near the city as possible without interfering with traffic, enabling travellers to get a full view of the city as they approached it. To achieve that we kept the railway on the surface level, running it through spurs here and there to give crossing places for roads, and through two very short tunnels, or deep open cuts. On either side of the railway, as it approached the town, we left a wide reservation for parks. We did not propose an elevated railway. It crossed the river at the 1,840-ft. level. There would be required there a certain amount of bank, and the line then plunged into the hill.

153. *To Mr. Fenton.* I would have no level crossings in the city. They are an abomination. Practically the whole of the residential part of the city would be on one side of our railway. Once it crossed the river the line would keep close to it for a considerable distance. All the space between the railway and the river would be devoted to governmental purposes, such as railway shunting yards, power-house, &c., and we made ample provision for crossings and bridges without level crossings. Any loop line brought near Parliament House could easily be converted to electricity later. I object to the position of the railway station proposed by Mr. Griffin. It would be a mile and a half away from Parliament House. The loop line could be used temporarily to carry building material. Before you could begin with

Mr. Griffin's design, to have any city at all, you would have to construct the long embankment between the circular and eastern lakes for the railway, because, if you are to have a city on the other side of the river, you must get your railway to it.

(Taken at Melbourne.)

MONDAY, 16th MAY, 1916.

Present:

Mr. RILEY, Chairman;

Senator Lynch, Mr. Finlayson,
Senator Storch, Mr. Sampson,
Mr. Fenton, Mr. Laird Smith.

Norris Garrett Bell, Engineer-in-Chief and Acting Commissioner Commonwealth Railways, recalled and further examined.

154. To the Chairman.—In my letter to the Committee dated 4th February, 1916, I stated—

In reply to your letter of 24th ult. regarding Chubberr City Railway, and with reference to the extracts from my evidence before the Committee, I am dealing with these in the order in which they appear in your list.

Route proposed by Mr. Griffin.—This is shown on drawing 464, sheet No. 1, the line being in black and lettered "A." The cost of the route is approximately £378,972, and the length 5 miles 16 14 chains. The cost of the tunnel on this route is estimated at approximately £75,000.

Routes suggested for consideration by Mr. Hobler.—These routes are shown on drawing No. 464, sheet No. 2, with the corresponding longitudinal sections on drawing No. 464, sheet No. 2A. The approximate cost of the route marked B is £385,068, and the length 6 miles 1 chain, whilst the alternative route B1, which connects with Mr. Griffin's route, is estimated approximately at £397,761 for 6 miles 75.5 chains.

Cost of the Departmental deviation.—By this I understand the routes suggested for consideration by me. These routes are shown on drawing No. 464, sheet 3, with the corresponding longitudinal sections on drawing 464, sheet No. 3A. The route marked C is estimated to cost £309,413, and the length is 5 miles 22 chains, whilst the alternative route C1, which deviates a little from C, is estimated to cost £289,709 over a length of 5 miles 17 chains.

With regard to proposed estimate of the cost of different ways of crossing between the circular basin and the eastern lake, it has been shown, after examination, that practically the only reasonable crossing is that shown on the route suggested for consideration by Mr. Hobler.

Definite sites for railway stations are indicated on each of the routes. The question of avoiding level crossings has been considered when the several routes were being graded, and it has been found possible to avoid level crossings without interfering materially with Mr. Griffin's design.

I attach also to this report a table showing a comparison of estimates of the routes A, A1, B, B1, C, and C1, and in conclusion I would like to point out that none of the routes above mentioned have been actually surveyed, and are merely office locations made from a contour plan of the city site. Before committing myself finally to a definite selection of any route, it would be necessary to have railway surveys made, and the

various routes pegged and levelled. In the meantime the information given on the plans, sections and estimates is sufficient to enable the Committee to decide what amount of further information they require, and to insure that all vital matters affecting the location of the railway in relation to the design of the city may be fully discussed before incurring the expense of surveys.

The tunnel, as I have already shown, is estimated to cost £75,000, and there will be a cutting approach 25 feet deep at south end of it, so that the station site will be 25 feet below the surface level. It was proposed, I think, originally by Mr. Griffin that we could avoid the tunnel by keeping further down the hill, and that will still leave the station in a fairly deep cutting, approximately about 20 feet below the level of the avenue. I have the quantities taken out for the cuttings, and I estimate the total at 169,000 cubic yards, costing about £30,000.

155. To Mr. Sampson.—If the spoil from the cuttings could be used for the embankment over the river there would be a reduction in the estimates, but I am not sure that it would be suitable.

156. To the Chairman.—It will be possible to avoid the tunnel by taking the railway line further down the hill, but I think in that case the cost of cutting would be increased, because the station would be in an open cut, which would bring the cost of cuttings to about £36,000. As compared, however, with the scheme with the tunnel in it, this would represent a saving of about £70,000. Of the several proposals I have referred to, I prefer the route which will cut out the tunnel, for it is not advisable ever to have a tunnel in a railway, handling suburban traffic. Mr. Griffin's station site is about north-east of the circular basin, but it is not near the marshalling yards, which are further away to the north. Mr. Hobler's route, marked "B" on the plans, would deviate from Mr. Griffin's route some distance south of the circular basin, would pass between the segmental basin and the eastern circular basin, then continuing north, would run parallel to Mr. Griffin's plan for some distance before finally joining it. From a traffic point of view I do not think that there is any disadvantage in Mr. Hobler's scheme, which will take the line through the centre of the city. Along this route it is proposed to have a station south of the basin and another to the west of the basin, and close to the site of Parliament House. This station would be about 3,000 feet distant, or, in other words, it would be about as far from Parliament House as Swanston street is from the Federal Parliament House in Melbourne. The station in Mr. Griffin's plan would be about 7,400 feet, or nearly 1 mile and a half, from Parliament House. On all the routes provision has been made to have the railway line sunk below the level of the streets. This largely increases the cost, but in a city railway it is considered necessary. I approve also of Mr. Hobler's scheme because it makes available a suitable area for a station and siding opposite to the centre segmental basin. It will not be necessary to have marshalling yards at that point, but in a city railway it is advisable to have occasional sidings for the handling of goods traffic. The function of marshalling yards is to enable arrangements to be made to bring all goods trucks to the point where they are required, but, personally, I do not think that any marshalling yards will be laid down for very many years in the Capital City. There are no marshalling yards in Brisbane yet.

157. To Mr. Fenton.—Mr. Griffin's route is for a line 5 miles 16 chains long. Mr. Hobler's route is 3 miles longer. The cost of Mr. Griffin's line is £378,972, but with a deviation as suggested by the Department carrying the line along at a lower level east of the circular basin and avoiding the tunnel, the cost would be about £306,000. There is another proposal, involving a further suggested deviation from the departmental plan at this point, to make use of the embankment and take the line at a lower level and still closer to the circular basin. This would bring the estimated cost down to £289,709. The roadway would be sufficiently high to prevent damage by flood waters. All the estimates include provision for a double line of railway traffic. If I were asked which route I considered best from a railway point of view, I would favour Mr. Hobler's scheme, known as route B. How it will affect the design of the city I am not prepared to say, but I do not think it will affect the avenues, because the line will go under them in every case. This line would be about 1,500 feet from the site of the proposed bridge. In any case the markets would be rather difficult of access, and in Mr. Griffin's scheme the station site would be 30 or 40 feet below the level of the roadway. Access could, of course, be obtained to the markets at a considerable expense. The estimate in every case provides for 80-lb. rails. I could not say what material would be received, because that will depend entirely upon what population will be attracted to the Capital City, but there will certainly be no net revenue for a number of years until the population grows. The tunnel provided for is of the standard width for a double line of railway. The marshalling yards would probably be some distance out in the level country. I should think that the space required for marshalling yards should be about a mile long and half-a-mile wide, but I have not seen any provision for these yards. For the purpose of this estimate I have taken the same starting point and the same finishing point in the respective routes. Every road that crosses a railway means that a bridge must be constructed there, and the estimates furnished to the Committee include provision for these bridges. In route A (Mr. Griffin's scheme) there is to be a bridge over the Molongio River and twenty-three other railway and street crossing bridges within the 5 miles. These structures will be of steel, with concrete or brick abutments. I could not say how long it would take to build these because at present we cannot obtain steel for bridge work. In route A1 there will be twenty-five bridges, in route B twenty-nine bridges, in route B1 thirty-two bridges, in route C twenty-three bridges, and in route C1 twenty-one bridges. Some of these bridges will be very wide owing to the width of the avenues. I imagine that eventually, when the city grows to considerable dimensions, it will be surrounded by a circular railway. There is nothing in any of these schemes to prevent them being converted into a circular railway.

158. To Senator Lynch.—The steepest grade in Mr. Griffin's route is 1 in 100 on a 40-chain curve, which means about 1 in 50 on the straight. In Mr. Hobler's (B) scheme the steepest grade is 1 in 120 on a 20-chain curve, representing a ruling grade of perhaps 1 in 110. For suburban traffic this is not too steep. I imagine that some of the grades on the Melbourne suburban railways are quite as steep as this. The adoption of Mr. Hobler's route which would bring the railway across between the circular basin and the segmental basin, and would necessitate the construction of a costly bridge, but not more costly than that which would be rendered necessary by the adoption of Mr. Griffin's plan, because his route would cross the Molongio on the other side of the circular basin, and the same provision would have to be made to cope with flood waters. This bridge would be built on about the street level, just sufficiently high to clear flood waters. It could be reduced a little perhaps, but it would mean further expenditure on more cuttings further on. It would be possible to build a bridge at this point to accommodate vehicular and railway traffic, and thus obviate the necessity for two different and distinctive types of bridges. A structure like the Victoria Bridge in Brisbane could be provided, and I should imagine that this would effect a saving of £15,000 or £20,000. The railway bridge is estimated to cost £52,000, and if the proposed road bridge could be strengthened and widened to carry the railway traffic also there ought to be a saving of the amount I have stated. In a bridge like the Victoria Bridge in Brisbane, the girder running down the centre could divide the railway traffic from the road traffic. The estimates furnished in connexion with these routes and bridges make no provision for the approaches to the street crossing bridges; only the bare cost of the line and of the bridges is provided for. Level crossings should be avoided, if possible. The tendency in all big centres of population is to bring the railway as near to the centre of the city as possible. This is being done in Sydney, where it has been found that the electric tramway system is unable to cope with the heavy traffic, and in Brisbane the present central station leaves passengers nearer the heart of the city than is possible at the Roma-street station. In these schemes for the city railway, the stations have to be placed in cuttings because the line has to be sunken in order to enable the streets to cross the railway. For passenger traffic only this is not a serious disadvantage, but it is not easy to handle goods traffic at stations below the street level. The stations vary in depth from 15 to 20 feet below the roadway; one is about 27 feet.

159. To Mr. Sampson.—Though I favour Mr. Hobler's B route I do not think it will be necessary always to haul goods traffic through the centre of the city. I think that in the years to come that traffic from Yass will go at the back of Duntroon Hill and join the Queanbeyan line several miles north of Queanbeyan. The Jervis Bay line would cross the Sydney line some distance north of Queanbeyan, and the line from Yass to Jervis Bay would cross at the same place, so that neither need go through the Capital City at all eventually. However, as long as the traffic is not too great there certainly would be a tendency to use this line, which would be the shorter route. It would not be advisable, of course, always to take all heavy goods traffic through the city, and, therefore, I think eventually there would be the diversion which I speak of. It might be worth while to consider suggesting to build a light railway with level crossings along Mr. Hobler's route with the view to having it removed later on, if it were found that heavy goods traffic was developing, and constructing a line along Mr. Griffin's route, which does not go through the centre of the city. The passenger traffic could then be otherwise catered for. I do not think, however, that heavy goods traffic would take the route I have suggested. It would certainly seem a pity to go to the expenditure of £300,000 or £400,000 to build a line

like any of these proposed railways until there was some traffic. It appears to me that all that is required at present is a line that will be sufficient to handle building material and light traffic. So far as I can gather there is not a tendency to take railways out of a city and depend upon lighter forms of traction to handle the traffic. I have had some plans lately showing considerable railway extensions right through the centre of New York City. If the Eastern Lake were cut out of the Federal design a cheap surface line could be built through the city, but this would not avoid cuttings and a tunnel to reach the station site shown on Mr. Griffin's plan. The station site east of the segmental lake provided land suitable for sidings where the goods traffic could be handled. This station would be about 500 feet from the segmental basin. I think it would be possible to put in a goods siding in Mr. Hobler's plan at the station site south of the circular basin. I prefer railway traction for the handling of city traffic to buses or electric trams. In Sydney important railway extensions and alterations are proposed because of the congestion of traffic, due to the inability of the trams to handle it. Railways can handle heavier traffic more quickly than a tramway system, and I think the adoption of Mr. Hobler's route will delay the necessity for an electric tram way system in the Federal Capital City.

160. To Mr. Laird Smith.—There are places where the railway will come up to the surface level, but that cannot be avoided. In every case, however, it will be below the road level at street crossings. It is not advisable to have a tunnel at each end of a station. A grade of one in ninety is not considered heavy. The area required for the depth of the cutting in which the station is situated. I think it is necessary to have all the stations that are indicated on the plan. It is proposed to use 8 ft. 6 in. wooden sleepers in the construction of the line. Mr. Hobler's scheme will not make for an unsightly railway line because it will be below the road level. I would prefer, for the present, a surface railway for light traffic and the carriage of building material. It would be a pity, until population increases, to spend a large sum of money on a sunken railway, but it is necessary that the land required for such a railway should be set aside at the outset.

(Taken at Melbourne.)

TUESDAY, 16th MAY, 1916.

Present:

Mr. RILEY, Chairman;

Senator Lynch,	Mr. Finlayson,
Senator Story,	Mr. Sampson,
Mr. Fenton,	Mr. Laird Smith.

Norris Garrett Bell, Engineer-in-Chief and Acting Commissioner, Commonwealth Railways, recalled and further examined.

161. To Mr. Finlayson.—When last giving evidence on the Canberra city railway I referred to the necessity for a connexion between Canberra and Yass. That would bring the city into more direct communication with Melbourne, and would

reduce the length of the journey very considerably. It would eventually also be a portion of the through line to Jervis Bay. Giving more convenient access, it would assist the development of the capital, but I do not know that it would enable material for construction to be obtained more cheaply. I think it would be a great mistake to immediately construct a permanent line at a low level through and across streets that have not yet been made, and may not be made for many years. It would, in my opinion, meet all present requirements to construct a surface line not necessarily on the route adopted for the permanent line. It should be, as far as possible, parallel to the route of the permanent line, but it would be a mistake to build it on that exact route. In constructing a surface line it would be necessary to depart considerably at several places from the permanent route, as it would contour round the hills instead of going through them. It would, in my opinion, be of great advantage to have communication between Yass and Queanbeyan. It is 11 miles to the border of the Federal Territory, and the New South Wales authorities have made a survey for the remaining 26 miles. Both Mr. Hobler and I visited the site, and from a railway point of view the crossing proposed between the circular basin and the segmental basin is the best that could be chosen for crossing the river. There are engineering difficulties in the adoption of the crossing suggested by Mr. Griffin's route. They could, of course, be overcome by going to additional expense. The foundations for the bridge, for instance, would have to be fairly deep there, and the bridge would cross the river on the skew instead of on the square, which, of course, would mean increased cost. The estimate I supplied covers the making of the embankment provided for in Mr. Griffin's proposal to the width required for the railway, but not to the additional width which would be required for roadways. To adopt Mr. Griffin's route the embankment would have to be unnecessarily high, but the only way to cross the flat at that place is by an embankment with a bridge in the centre. If the eastern lake proposal were eliminated, you could get a line at a lower level at the eastern side of the circular basin, the embankment might be considerably reduced, and a large reduction in expense secured. I am in favour of keeping the line on the northern side at a lower level than is proposed by Mr. Griffin, because I think it would provide better station accommodation for the Capital, and would bring the line nearer to the centre of population. I consider the site suggested for a railway station at the market centre on the C1 route more desirable than that suggested by Mr. Griffin. The distance from the site suggested for a station on the C1 route at the market centre to the Parliament House would be a little over a mile. That would not be an unreasonable distance from Parliament House for a railway station. A proposed line on the C1 route would not be unightly or inconvenient at the place where provision is made for the establishment of gardens, and, indeed, an ornamental station building might be made quite a feature of the locality. I considered that a station at that place would serve the population of the north. The ground there is suitable for the construction of sidings. There would be room for goods-yards and goods-sheds, and there would be no difficulty in providing all the sidings necessary for passenger traffic. The cuttings would be slightly more on the C1 route than on Mr. Griffin's route, but the tunnel shown in Mr. Griffin's route is avoided on route C1. There would be 21 bridges on the C1 route, as against

23 on Mr. Griffin's route. For the purpose of my estimate I took the total length of bridging. I lumped all the bridges together and took out the cost as so much per lineal foot. That may be accepted as a fair guide of the relative cost of large and small bridges because the width does not vary very much. You must remember, however, that the estimates are very approximate. I could give you separately the cost of the bridge across the river. The cost on the C1 route would be £48,000. It would be on a lower level than the bridge provided for on Mr. Griffin's route. The cost of Mr. Hobler's proposal would be £82,000. These estimates are for steel and concrete bridges based on normal prices. It would be advisable to keep the railway bridge at the same level as that proposed for the avenue bridge, so that navigation on the lakes for pleasure purposes would not be interfered with. That might very easily be done. There would be no advantage in lowering the railway bridge, and it would not affect the cost very much to make it on the same level as the other bridge. The difference shown now might very easily be adjusted. Mr. Hobler's proposed route would probably provide convenient access to railway communication for parts of the city not served by the other proposals. I do not think that Mr. Hobler's route would serve the purposes of the circular railway which has been suggested to meet the development of the city, as I think the circular railway would be much further out from the centre than Mr. Hobler's route. Mr. Griffin suggests a steam service outside the city, and an electric service in the heart of the city. Things may develop in that way in time. Both would be convenient, and I do not think one would affect the other. My estimate of the cost of the railway on the C1 route is £280,000. By crossing the eastern end of the eastern basin at a low level the estimate might be reduced by, perhaps, £10,000, by keeping the embankment down. The line might be roughly estimated to cost about £280,000 if such an alteration were made.

162. To Senator Story.—In furnishing estimates of cost a common starting point and a common finishing point have been adopted for purposes of comparison. The starting point in the case of each of the routes prepared is three-quarters of a mile towards Queanbeyan from the terminus of the present line from that place, and away from the existing line to keep clear of the Eastern Lake proposal. The finishing point selected is the place at which Mr. Griffin's route and the other routes would follow a common line. But there is no special reason why the line by any of the routes should be immediately constructed up to the point chosen for comparison as a finishing point. They may also be regarded as parts of a through line to Yass, and we have stopped at the point indicated only because beyond that point Mr. Griffin's route and the departmental routes would be the same on the continuation of the line to Yass which follows the most suitable survey from Canberra to Yass. Unless as a part of a proposed through line to Yass, there is no reason why the city railway should at present go north of the river at all. That will not be necessary unless settlement develops north of the river, or unless a line is built through to Yass. Assuming that the first works to be undertaken in the building of the Parliament House and Commonwealth offices on the south side of the Molonglo, the taking of the railway across the Molonglo River would not be justified until settlement on the north side of the river was

started, or until it was decided to construct a direct line to Yass. The first thing to do is to provide railway communication so that material required for construction purposes may be landed close to where the work of construction is being carried out. If Parliament House and the Commonwealth offices are the only buildings of importance to be constructed, it would meet the requirements for some time to continue the existing line from Queanbeyan as a surface railway to a point convenient to the Parliament House site. The line need only be a surface line, but would have to be sufficiently strong to carry the New South Wales rolling stock. There might be fairly steep grades and sharp curves, and the line to a great extent could follow the surface. To carry the line as part of a line from Canberra to Yass straight across under the parliamentary site from the end of the first straight section shown on Mr. Hobler's route would involve a great length of tunnelling, a considerable increase of expense, and would not be convenient from a suburban traffic point of view. I think that Mr. Hobler's route gives better access for suburban traffic than the route I suggested myself. If Mr. Griffin's route were adopted in the modified form I have suggested it would still be necessary to have a bridge across the river somewhere near the point at which Mr. Hobler's route would pass it. It would not be difficult or costly to carry a surface line to a point near where the building of the city would be commenced. This would avoid the expenditure of many thousands of pounds for a number of years, and when the streets were completed and settlement advanced the surface line could be replaced by a sunk line. It would not be costly to make a line on the surface right through the city to connect with Yass, and there are no steam locomotives used to transport construction material to different parts of the city. It would be a mistake, in my opinion, to have all the additional money required for the construction of a permanent line lying idle for 20 or 30 years when a much cheaper line would serve the purpose. My estimate of cost includes the cost of bridges under all the streets, some of which might not be formed for many years to come.

163. To Mr. Fenton.—If the line were constructed on a permanent basis for steam traction, the permanent way could subsequently be inexpensively adapted to electric traction. It would involve merely the bending of the rails. I believe that there are no steam locomotives in New York at the present time. At a certain distance outside the city electric traction commences, and all trains are brought into the city by electric engines. From a business point of view, I think that the best policy to adopt to assist building operations in any part of the city would be to lay a sunk line on a strong surface line from the present Queanbeyan terminus to the place where building is being carried on. You could get the sidings off a surface line much more easily than off a sunk line. As the proposed line would not be revenue-producing for many years to come, I do not think the construction of the whole of it would be justified until the population of the Federal Capital is very largely increased. I have not examined the railway scheme shown on the second prize design, following to some extent Mr. Hobler's proposed route, and favoured by the three adjudicators on the Federal Capital design. No engineering difficulties are involved on Mr. Hobler's route, whilst by that route the actual crossing of the Molonglo would be much less expensive than by the route proposed by Mr. Griffin. There was an estimate prepared

of a surface line from the present terminus of the Queenbeyan line to a terminus at the central basin. I think the estimate was about £20,000 for a line sufficiently strong to carry the material required for heavy jobs.

164. To Mr. Sampson.—I have not considered Mr. Griffin's line as a section of a circular line. It would be a steam-line, but could be electrified when the traffic warranted it. I could supply the Committee with an estimate of the cost of a surface line by Mr. Hobler's route as compared with the cost of a permanent line by that route. I can undertake to supply such an estimate of a surface line by Mr. Hobler's route in three separate sections, finishing at the point adopted as the finishing point for the comparison of all the routes.

[Extract from letter dated 25th May, 1916, No. CR 2847, from Mr. N. G. Bell, Engineer-in-Chief and Acting Commissioner, Commonwealth Railways.]

I also forward, as desired by your Committee, plan and section showing a surface line along route "B" the estimated cost of which, dividing it into three sections, is as follows:—

Section 1, length, 1 mile 22 chains ..	£7,000
Section 2, length, 1 mile 1 chain ..	£16,000
Section 3, length, 2 miles 71 chains ..	£16,000
	<u>£39,000</u>

As an alternative, a surface line could be built along the route marked "D" but the cost would be practically the same as along the route "B," and it would entail the conveyance of building material to the Parliament House site, a greater distance than if route "B" were adopted.

(Taken at Melbourne.)

MONDAY, 13TH NOVEMBER, 1916.

Present:

Mr. RILEY, Chairman;
Senator Keating, Mr. Finlayson,
Senator Lynch, Mr. Gregory,
Senator Storry, Mr. Sampson,
Mr. Fenton, Mr. Laird Smith.
Walter Burley Griffin, Federal Capital Director of Design and Construction, sworn and examined.

165. To the Chairman.—I desire to correct the estimate in my letter of 25th August, 1916. It was prepared in my office by an officer who has had twenty-five years experience in railway engineering, and I left the matter to him, but I have since found that he included in the estimate of the cost of the railway the sum of £14,879, already charged against the lakes in the earthworks of the caseway. The length of line was also given as 4.76 miles, though I had made it 5.2 miles to agree with the Department's scheme. These corrections bring the total cost down to £197,617, and the cost per mile to £38,003. I received from the secretary the list of details which the Committee requires from me of my estimate, but I have not the information in that form. I have fuller estimates with me in another form. The Committee specify "fencing." I do not anticipate that fencing will be required. In my design of the city I am going to provide otherwise for the protection of the line, except in a few isolated cases. It will be a separate level line, and where it is on the level it must have access to the adjoining territory. My estimate, therefore, did not include "fencing." It included no "cutting to bank," because there was none. The items which the Committee ask for and which I can give are:—

	Quantity.	Rate.	Total.
Side cuttings	258,297	6d.	£ 8,457
Side ditches	5,010	1s. 6d.	378
Drains (under different headings, including large and small culverts and pipe drains, at different prices) .. .. .	..	..	1,616
Tunnel .. .. .	..	..	..
Soft rock	6,308	15s.	4,731
Hard rock	19,172	25s. 6d.	27,320
12-in. reinforced concrete lining	2,500	70s.	10,225
Do. in portals and wings	300	60s.	750
(Total tunnel, £43,126, without taking into account the credit from quarried materials.) .. .. .	..	..	..
Balance of earthworks, cutting, soft, and rock	658,278	1s. (av.)	28,414
Deduct from total earthworks one-half of 778,036 cub. yds. in caseway, charged to lakes .. .. .	..	..	14,870
			<u>13,535</u>
Bridges—			
Overbridges 50 feet wide for four tracks	No. 13	£3,500	45,500
100 feet wide for four tracks	4	23,700	29,800
Underbridges, 50 feet, for four tracks	2	45,500	9,000
Permanent way—			
80-lb. rails and fastenings	4,600	10 16s.	13,875
Handwood sleepers, 8 ft. 6 in. x 9 inches x 6 inches	No. 25,000	3s. 6d.	8,250
Ballast, 12 inches	23,464	3s. 6d.	3,032
Laying	18,304	1s. 6d.	1,602
Contingencies .. .. .	..	10%	17,164
Engineering and supervision .. .. .	..	5%	8,592
			<u>107,617</u>
SUMMARY.			
Total earthworks (less £14,870 charged to lakes) .. .. .	..	..	62,421
Concrete for tunnel .. .. .	..	..	11,075
Bridges .. .. .	..	..	70,300
Culverts and drains .. .. .	..	..	1,616
Permanent way .. .. .	..	..	27,620
			<u>171,841</u>
Contingencies (10%) .. .. .	..	..	17,184
Engineering and supervision (5%) .. .. .	..	..	8,592
			<u>197,617</u>
Total .. .. .	..	..	197,617

Rate per mile, £38,003.

That estimate is for a permanent way, double line, 5.2 miles long, complete.

166. To Mr. Sampson.—It does not include, in addition to the fencing and cutting to bank before mentioned, anything for mile and grade posts, station accommodation, signalling and telegraph apparatus, and sidings, but the earthwork for shunting space is provided. In a separate estimate I provide £21,000 for sidings, which is liberal, certainly. Not knowing the starting and finishing points of Mr. Bell's railway, I used his distance to avoid any discrepancy.

167. To the Chairman.—I cannot give you an exact comparison with Mr. Bell's estimate, because I have not been furnished with his details. My railway is planned to dispose of the earth in another part of the line. You cannot expect me to include the cost of certain earthwork twice; that is against the railway and against the lakes. Mr. Bell had referred to you by Parliament a railway on a certain estimate. I have not seen that estimate yet, and, therefore, cannot criticise it. I would want to know how much siding and what sort of stations and station buildings are to be included, and what use the stations will be put to. I cannot say that the railway for which I have given an estimate is the same as Mr. Bell has estimated for.

168. To Mr. Laird Smith.—I have taken 30 feet as the width on the top of the banks. If 25 feet was stated previously in evidence, I wish to correct that. The practice in other countries varies very much. I believe 30 feet is the standard in Victoria, and it is the Commonwealth standard also. I have allowed for the increased width in my estimate.

169. To Mr. Sampson.—The stations will be required only when the towns are there. My estimate is based on the assumption that the eastern lake will be made. If there were no eastern lake, the cost of the railway would probably be greater. If I had to provide for a railway eliminating the eastern lake I would have to re-design the route. I previously gave the Committee a price for the embankment, including two roads, a railway, and a dam, with all the necessary provision to take care of the water. All that I debited to the railway was half the earthworks taken from the railway. I charged the rest of it against the lakes. If I had no eastern lake embankment I would have to get rid of the spoil somewhere else, change the whole gradient of the line, and make other provision for disposing of the river flood waters. It would cost considerably more to take the railway across there without making the upper lake. I would have to make a bridge, or some other provision for getting across the Molonglo. I gave an estimate of £91,000 for the dam. If the lake were done away with, that sum would not pay for the three bridges comprised in the dam. The cheapest way to take the road across is to dispose with the bridge, and that means making the upper lake. I also depended on the elevation of the upper lake to give me the necessary velocity to dispose of the water. All I could save would be the earthworks of the berms on the side of the dam, which would be very slight. I have to get the railway across the Molonglo, and my scheme requires £91,000 more, which at the same time builds the lake. The £91,000 is made up of all the charges against the dam and the roadways across it, including the railroad, with the exception of the £14,879, which I have taken out of the railway estimate, as I explained above. So far as the earthworks are concerned, there is charged on the railway account £13,535, and on the lakes account £14,879. If there were no upper lake there would have to be other provision

for passing the water through, and I am not sure that that would not be more expensive. I have made no estimate of the cost of a railway eliminating the lake idea altogether. It would not be the same railway. Moreover the upper lake is the cheapest way of protecting the lower lakes. Moreover the design of the city was all based on the eastern lake, and the railway was located on that basis. The whole thing must, therefore, be taken together. I have not made up my mind whether, if the eastern lake was eliminated, I would follow the same route for the railway. It is a new problem so far as the city plan is concerned. You would save no money by postponing the eastern lake.

170. To Mr. Finlayson.—Mr. Bell's estimate of £73,794 for cuttings to bank and spoil is what I put into the dam. The total cost of the embankment would be £91,200 plus £13,535, or £104,735. That practically includes the earthworks for the railway, which is stated in that way.

Mr. Bell's estimate of £58,975 for the bridge corresponds with my provision for the discharge of flood waters in the eastern lake impounding dam. That item is "concrete work, £76,311" but Mr. Bell's Molonglo bridge is a substitute for only one portion of my embankment, which really comprises two roadways as well as a railway. Mine is a cheaper method of crossing a river considering that the railway is in a cutting. It would be difficult to estimate the figure to which my estimate would be reduced if it were decided to lay down a single track only. It would be very expensive to widen the track subsequently for a double line, because it would mean widening tunnels, bridges, and cuttings. This would cost much more than the extra cost of making the double track at once. It would also interfere greatly with the traffic and development of the city. The line, approximately 12½ miles in length, single track, from the power-station to the northern boundary of the Territory, for which I have given an estimate of £87,000, is a surface line and not a city railway. It is to be laid on the ordinary formation like the usual country railway. I would regard it as a temporary line in relation to the city, to meet the needs of such portions of the ground as there is no city upon. My estimate is arrived at without section and without survey. The survey cannot be made except in conjunction with the survey for the New South Wales portion of the line. It is based on the temporary line through the city, which I previously presented to the Committee, avoiding tunnels, following closely the permanent right-of-way but not on it, and extending that line a hypothetical distance to the territorial boundary. This line would connect with Yass. It would give the Commonwealth command of the whole route to Yass, which the State of New South Wales is obligated to build. That 12½-mile line is an alternative proposal for a city railway. My estimate of £87,000 includes sidings and operating equipment for the city railway through the northern boundary. It gives a fully equipped line for present purposes.

171. To Mr. Laird Smith.—The plan on the wall furnished by the Railway Department is not a proper profile of my original line. It is Mr. Bell's profile of my plan. Roughly, it is the same, but the grades are different. It has been made from an old edition of my section, which has since been improved. I cannot say it will make much difference in the amount of the spoil. Whereas Mr. Hobler said in the original presentation of this to Parliament and the Committee that the line he proposed would be £30,000 cheaper than

the line I proposed, in the construction of earthworks, bridges, and tunnels, Mr. Bell's own estimate is that my line is £18,000 cheaper than Mr. Hubbard's, making a difference of £48,000.

172. *To the Chairman.*—If I was asked for an estimate of a railway across the Molonglo, eliminating the eastern lake and dam, I would say that was contrary to the city plan. I understood the reference to the Committee was "railways and lakes incidental to" my plan of the city. What you ask would not be incidental to my plan of the city.

173. *To Mr. Laird Smith.*—My railway is planned from the start in conjunction with the city plan in which the two lakes were comprised.

174. *To Mr. Sampson.*—I have recommended the early, but not immediate, construction of a permanent railway. It should be preceded by a construction line in order to make it possible to get settlement at the Capital at the earliest practicable date. That permanent railway should be started not more than ten years hence, and perhaps sooner, according to the growth of the city. The upper lake will be one of the chief attractions of the Capital, and is also necessary for the control of the Molonglo River. The eastern lake and permanent railway should be postponed, and both should be built together. In the meantime, I would put a cheap line right across the city to the northern boundary for £87,000 from the present terminus to get railway connexion right to Yass, which is most important. I have already given you an alternative route for part of that alongside this right-of-way, but cutting off one portion where the heavy earthworks are intended. Any greater deviation of a temporary railway would have marked effect. A railway like that is a definite boundary in a city. It is an absolute necessity of city growth, and its location makes a great deal of difference to the growth of the city. It would also play a very important part in the economy of constructing the permanent line. Also if it were deviated, the goods distribution of the city would not be in accord with the permanent location, and it is most important to start immediately on that. Unless the railway is started on the lines designed for the permanent railway we have no guarantee that it will follow those lines.

175. *To Mr. Gregory.*—The temporary line will follow from the present terminus, close to the city boundary, the route which I laid down to the Committee when we were discussing the original site. It will cross the Molonglo on a trestle bridge or pile bridge and earthen embankments parallel with the ultimate crossing. I am not charging that in the lakes construction, though the crossing will be of ultimate value, because it will be made use of to distribute the material on the embankment, and will also coincide with the grade of one of the roads. The maximum gradient is 1 in 50. A siding to Parliament House would extend from the present power-house, which is the nearest point. Any siding would be run any way. It would be a single line with sidings. By the construction of the line to the northern boundary, a lot of our materials could be brought much more cheaply from the interior along the Harrier route. It would also give direct connexion for passenger service to meet the through trains from Melbourne and Sydney at Yass, both with the same train. Passenger traffic will matter a great deal in the next two years. So far, we have had no facilities. At present we have to land passengers many miles outside the city in the dead of the night. By that

means we could bring them into the city in daylight. The line will also open up a lot of new country, which will be tributary to the Federal Capital. £7,000 per mile is quite ample for an ordinary line. New South Wales is ready and anxious to go on with the line in their territory to connect with their main trunk line at Yass. I see no heavy expense to be incurred in crossing the river. I have allowed for bridges and culverts to cross the river, but I do not cross the Jerralombra Creek at all. We divert the creek into the river and cross the river, making only one bridge. I estimate £3,500 for that purpose. The length of the bridge will be 500 feet. Prices of steel and timber have gone up since I gave the Committee my estimate for the temporary railway. I include ballasting, culverts, and drains. It is a line of which the New South Wales Railway Department would approve to carry their rolling stock. With regard to the Central Station at the north end, after crossing the river, I am satisfied that I have an ample area of flat ground for station purposes. At that place there is to be a passenger station and not a depot. There will be a siding right into the markets from each side. There will be another depot before crossing the park way, and others further west and north for handling the goods traffic. Depots will be distributed equitably through the industrial area. There is ample room for sidings for market purposes, in my estimation.

176. *To the Chairman.*—It would take some time to give an estimate of a permanent railway across the Molonglo irrespective of the lakes, because it would mean revising the city plan in many respects. It could not be much, if any, cheaper to put a permanent railway across without the eastern lake than the present scheme including the lake. If anything it would cost more.

177. *To Mr. Sampson.*—The estimate of £197,617 for the railway, plus £91,000 for the embankment, will include a permanent railway through the city, with overhead bridges, &c. If you did away with the embankment I would have to alter the route and lower the grade, or I would have more spoil to dispose of. The spoil I have provided for is just sufficient for my embankment. Mine is the most economical line for that location. I do not know that the embankment would be much lower if it was for a railway only in that location. I have adopted 1 in 200 as the ruling gradient right through, and would not want to change it. That is a very desirable gradient in a city. If I were building a railway only I would want to make my bank as high as it is now on that route, for if I went lower down it would defeat some of the other important objects in the location of the railway line in reference to the city. I want the railway station located at a distributing point, and also a spectacular point. Putting it further away would conflict with both those ideals. I do not see any economy or desirability in postponing the construction of the eastern lake for a long time, because it would be the cheaper of the two lakes, and give the bigger water expense. I do not think there is any cheaper or more effective way of treating the eastern Molonglo flats. The question would be how to make the city habitable without the eastern lake.

178. *To the Chairman.*—There would be no saving on the railway if we did away with the eastern lake.

179. *To Mr. Sampson.*—My stations would be located as follows:—1. Eastlake, at the circular centre on the shores of the east lake. 2. Possibly a station for recreation facilities between the

lakes. 3. Station at the market centre. 4. Prospect, at the Prospect park way. 5. City station near the civic centre, and 6. Northbourne, at the 5.2 miles. There is only a section of about 15 miles where Mr. Bell's route deviates from mine, and most of my deviation conforms with earthworks that will be necessary for roads. My objections to bringing the permanent line under the lake after crossing the Molonglo until I strike the park way are—It would avoid the tunnel in name, but not in fact, because we would have more road crossings. With the tunnel we cross three roads in one act. Without it we would have to build separate bridges for each road on the skew, which would not give so good an appearance and would also destroy a number of valuable building frontages. I consider that the landscape will be improved by my scheme, including the embankment and tunnel. A tunnel constitutes less interference with the landscape than a series of bridges on the skew, and any sort of architectural attraction of a trestle bridge would be less dignified than a plain embankment, which is to be of dignified massiveness. The alteration of the route, precluding the embankment and tunnel, would detrimentally affect the city plan.

180. I still think the construction of the railway line and the construction of the eastern lake through using the spoil from the cuttings and tunnel should proceed concurrently within ten years. The eastern reservoir will take the place entirely of the proposed reservoir on the Upper Queanbeyan so far as the water supply for the lakes is concerned. We can absolutely eliminate the Queanbeyan Reservoir. There will be no necessity for it, probably for ever.

181. *To Mr. Laird Smith.*—That statement may conflict with the evidence I gave to the Committee when it was considering the advisability of constructing the Queanbeyan Dam, but that was nearly two years ago. Since then I have been going continually into the matter of the supply of water for the lakes. I may have said then that we could never have full assurance of protecting the city flats from flood waters without a weir on the Upper Molonglo, and that a dam on the Queanbeyan was better than any local expedient, and that the dam on the Queanbeyan should proceed, but at that time I had not gone into the water supply question except on the information supplied to me. A lot of water has passed under the bridge since then. In the meantime, the officers and myself have been going through the gaugings. We have also passed through a big drought, and altogether the evidence has changed my view entirely. I now recommend that the Upper Queanbeyan Reservoir should never be built.

182. *To the Chairman.*—I asked the Committee to report that that work be deferred. I protested against going ahead with it. We have taken advantage of the delay to get more data. I now say the upper lake will answer all the purposes of the Queanbeyan Reservoir.

183. *To Mr. Gregory.*—I shall not want the Queanbeyan Reservoir for the lakes at all.

184. *To Mr. Sampson.*—I can prove my statement by the particulars of flow submitted to me, and have also investigated the matter independently. I said then that the dam would not be a preventative of floods, as it would not regulate floods without a reservoir on the Molonglo. All provision for dealing with floods has been made in the design of the lakes made since then.

P.9786.—5

(Taken at Melbourne.)

WEDNESDAY, 15th NOVEMBER, 1916.

Present:

Mr RILEY, Chairman

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

Harry Vivian Francis, Assistant Engineer, Commonwealth Railways, sworn and examined.

185. *To the Chairman.* In our estimate for the high embankment between the eastern lake and the eastern basin, as well as the estimate for the suggested alternative route, we were tied down by Mr Griffin's sections which included heavy cuttings and banks, in order to preserve the continuity of the city plan, and so as not to interfere with the streets. We did not make any survey or grading of the sections at all. We simply took the plan which Mr Griffin supplied to us and made an estimate of the quantities which that plan entailed. Members of the Committee might remember that Mr Griffin called attention to the fact, as he described it, that the plan before the Committee was not a duplicate of his plan. He was in error in saying that, because it is an exact duplicate. We hold the plan from which we made the duplicate. We obtained it from Mr. Griffin, and I have it here with me. We are not in a position to produce sections like those which he handed to us for an estimate. That plan contains faults in the grading which a railway man would not carry out. For instance, in the cutting at 3 miles 67 chains there is a distinct "sag" which would prevent water getting away; a similar fault is found at 0 miles 26 chains.

186. *To Mr. Sampson.*—The first-mentioned fault would be in the locality of the circular street, and the other at about the site of a proposed station, the location of which would be faulty unless the side of the cutting were taken off on the fall to allow of drainage. As at present shown on the plan drainage is impossible. We would not have graded the section that way at all. We accepted Mr. Griffin's grading and our price for earthworks, tunnel, and so on, is based on the actual works that would have to be undertaken to produce the line.

187. *To the Chairman.*—We could prepare an estimate for a railway on an improved section, adopting the same location, but it would mean level crossings, which railway people all the world object to because of the danger. The Victorian Railway authorities would give a great deal to be able to get rid of level crossings, and in order to avoid them in the Capital City railway a lot of heavy work is necessary. If the sites for the stations were changed that would not make much difference, because the streets determine the level of the line. We must have at least 14 ft. 6 in. or 15 feet between the rail level and the under side of a bridge, and that means a lot of cutting to allow of a clear passage for trains. I have seen Mr. Griffin's estimate, which differs from the departmental figures. The latter estimate was furnished to the Secretary for Home Affairs, with an intimation from Mr. Bell that "in estimating the cost for the two roads I have considered them purely as railway propositions." In our estimate we had to deal with cuttings and banks as a railway job pure and simple, and we were faced with the fact that Mr Griffin required an 800-foot waterway for the

passage of water from basin to basin, so we furnished an estimate for an 800-foot bridge on the Molongie River after having diverted the Jerrabomberra Creek into the river. It must be an ornamental bridge, and our estimate for it is £58,976. The high cost is due to the fact that the borings made showed that we would have to go down 40 feet for foundations, so necessarily the bridge would be expensive. We have to provide that area of waterway to guard against flood waters. Mr. Griffin naturally scores there because he provides no bridge; he claims that the embankment is part of the other Federal Capital work. I find that on earthworks, cutting to bank, and still, would cost £73,224, the rate allowed being 3s. per yard. It is difficult for a railway man to understand Mr. Griffin's figures, and still harder to understand the prices which he supplies. I heard him say yesterday that his estimate included 258,237 cubic yards of side cutting at 6d., and he finished up by saying that the balance of earthwork was 558,273 cubic yards, his total earthworks being 826,575 cubic yards. Our total earthworks are practically the same as his, 882,520 cubic yards. Mr. Griffin puts down side cuttings at 6d., and the balance of the earthworks at 1s. I do not want to question his ideas of earthworks' costs, but I am extremely doubtful about the possibility of getting any class of earthwork done in Canberra for 6d. per cubic yard. The bank shown in the cross section of his embankment means a tremendous amount of trimming which alone will cost a considerable sum per yard, and he cannot possibly finish the berms and slopes on those sections for that amount. Further, I understand an investigation Mr. Hobler made at Canberra, and from the ordinary description on the plan, that nearly all of those cuttings will be in rock of some form or other, so Mr. Griffin will probably find that 40 per cent. of his estimate of 6d. will disappear in explosives alone. In his own estimate he shows that there must be a considerable amount of rock by the proportion he allows for it in the tunnel, the greater part of which is described by him as hard rock, yet he proposes to handle side cuttings for 6d. and other works, so far as I can see, for 1s. That is impossible. I have made some investigations into the cost of earthworks, and I have found that the universally adopted idea as to the cheapest form is the steam shovel, locomotive and cars. To handle soil only, and excluding any shooting or difficulty in getting material away, I doubt if it would be possible, under the eight-hours system in Australia, and with the rates of pay in force at Canberra, to move earth under 1s. 1d. as against Mr. Griffin's estimate of 6d. I base that opinion upon the view held by Gillette, a recognised authority on costing throughout the world, and I provide for all costs, including enginemen, train-drivers, firemen, and all concerned. There is no allowance in Mr. Griffin's estimate for batteries of cuttings, or for trimming banks, and when explosives and supervision come in, the cost must be materially increased. Mr. Hobler was of opinion that 3s. per cubic yard was a fair price for such work as could be seen on the ground and I certainly think the estimates supplied are reasonable for the earthworks.

188. To Mr. Sampson.—The estimate of 3s. includes excavating, filling, tipping, trimming, and finishing off the batter to a vertical face. It is probable that the proportion of hard rock; this could not be determined unless shafts were sunk, and we were not able to give anything more than an approximate estimate in this case. In Victoria

and New South Wales, if work of this kind is to be done on the hutty-gang system, the man is taken to where trial shafts have been sunk in the cutting, perhaps in two or three places, and he tenders on the information thus obtained; but we did not have that information in this case, and had to base our figures on surface knowledge only. Our estimate, therefore, may be under the mark. Knowledge would be necessary as to the percentage of rock in the first place, and locality of the work in the second, before one could say what would be a reasonable amount to charge extra for rock cutting as against earth work. We are paying 6s. 6d. for hard rock in the Northern Territory, and I have paid 2s. 6d. on the Wonthaggi line for hard rock work, but in the latter case there was a percentage of top earth which could be ploughed. Perhaps two-thirds or more of the depth there was in rock, and at 2s. 6d. it is possible for a man to make good wages. Another point has also to be considered. People who are accustomed to mining know that the cost of the work depends to some extent on the lay of the strata. If it is cut on there will be very little breaking, and explosive costs will be high; whereas if it runs across the direction of work each shot will be effective, and the cost of explosives comparatively light. On the Emtai Bay railway we took out rock at a cost of 1s. 6d. a yard. In our estimate we allowed for the average distance of transport on Mr. Griffin's section. It is rather difficult to say what proportion of rock has been allowed for. I can only say that our estimate was made by a man who has been accustomed to look over such ground, who has done hundreds of such cuttings in his time, and in this case was able to say, from the general nature of the strata, "I think this stuff will be worth about 3s."

189. To Mr. Fenton.—I am aware that Mr. Griffin allowed for a certain amount of stone work in the tunnel. His estimate for the tunnel includes 6,308 cubic yards of soft rock and 19,172 cubic yards of hard rock, so according to his figures, about 75 per cent. will be in hard rock. I cannot understand how he estimates for only 25,000 yards of excavation in that work, because that is only 50 per cent. of the amount required for a double line tunnel of the length shown on his section. In our estimate we show about 42,580 cubic yards in the tunnel as against Mr. Griffin's 25,480 cubic yards. The total price is not very much affected, because he takes a higher price for some of his excavations than we do.

190. To the Chairman.—If it were decided not to construct the dam I think the railway banks could be lowered. Judging from the contours I should think it would be possible to move Mr. Griffin's line very considerably, but Mr. Griffin will say, of course, that it is part of his schematic plan that the railway should be where it is shown, and that the scheme should not be interfered with. That objection by Mr. Griffin confines us in our location of the railway to the particular sections furnished by Mr. Griffin and we have only estimated on what has been asked for, we were not asked to say what would be the best location for the railway. I want to make that point clear. We could, I think, submit an alternative section showing an easier work than Mr. Griffin's line, but it is almost certain that he would raise the objection which he voiced yesterday, that it would destroy frontages and upset the plan altogether. The departmental estimate was submitted by Mr. Triller and we stand by that. I had an opportunity of discussing it before the engineer-in-chief became unwell, and I know he intended to come before the Committee to explain it himself.

191. To Mr. Sampson.—In the departmental estimate for the embankment our figures were based purely on a double track railway without reference to anything in connexion with the plan. The quantities will show that they provide simply for a 30-ft. formation of double track railway and no more. We have no figures for the cost of the embankment because it is made up from filling. Actually such earthwork costs are made up under the items of explosives, getting and filling, leading, tipping, trimming, and batters. In this case we have 100,000 cubic yards of cutting to spare. That brings me back to the statement that they are Mr. Griffin's sections, and not ours at all. The engineer-in-chief would have preferred to have a survey made, so that we could give something definite, but at present we have to base our figures on the sections shown on the contour, and we were tied down by Mr. Griffin's requirements.

192. To the Chairman.—It would probably take about a month to make a survey of that railway. I think we could alter the sections and avoid the grading, but we would probably foul some of the streets. It seems to me that in order to get out a section for a cheaper line of railway we would have to get a direction from the Committee to ignore the actual lay-out of that particular part of the city, and not worry about the streets. If that were done I think the railway would be cheapened very considerably.

193. To Mr. Sampson.—We could cheapen the line by taking it at a lower grade and avoiding the tunnel, which would save nearly £60,000.

194. To the Chairman.—As an engineer I should say that the proper policy for all city railways is to have the terminal station as near as possible to the centre of the city, even if it has to be brought underground. This is the engineering practice in America, and I think Sydney affords the best example of a city with its terminal station in the wrong place. In my opinion Mr. Hobler's line, described as "B" on the plan, has a distinct advantage over Mr. Griffin's line, marked "A," though it also includes a number of cuttings. All bridges over streets and avenues make it necessary to depress the line. The earthworks are lighter in Mr. Hobler's line, but the cost is greater because the line is longer.

195. To Mr. Sampson.—I do not see any great difficulty in carrying goods traffic through the city at present, but I think we should provide for the future, and therefore it would be advisable to have a fairly large area reserved for marshalling yards and a goods depot. I would prefer a railway to go through the heart of a city, and assuming the Canberra eventually becomes comparable to some of the big cities in Australia it would be wise to make provision for goods traffic. A tramway system radiating from the principal railway station means dual travelling for passengers. I would prefer a line that would bring passengers from all parts of Australia as nearly as possible into the heart of the city. That is the tendency nowadays in all railway undertakings. I am not familiar with the lay-out of the city, but it would appear from the plan that passengers for the civic centre would have to be provided for by the tramway system linking up with the railway station. One wants, if possible, to realize the developments of the future, and undoubtedly, in view of that fact, it would not be wise to depend always entirely upon one line. We have that difficulty illustrated in Melbourne, and also in Sydney, but it appears to me that for a small city one line of railway would suffice, though we could never figure on that.

196. To Mr. Gregory.—If ordinary engineering wisdom is exercised sufficient land should be reserved for future possibilities. Unfortunately this has not been done in regard to other cities in the Commonwealth, and during the past few years an infinite amount of trouble and expenditure has been incurred in order to bring railway requirements up to existing needs.

197. To Mr. Fenton. Not a great deal of difficulty is experienced in converting a steam railway to electric traction, and undoubtedly when traffic warrants it that course is preferable because of the reduction in cost. I see very little difficulty in substituting electric traction for steam in the capital city at some future date. Electric traction makes for cleanliness and economy because only the power necessary to run the trains is used.

198. To Mr. Gregory.—Our estimate for the railway has not been based upon the assumption that it will be carried across the river where the water is standing at the 1,845-ft. level, and that is a point that may cause some trouble to Mr. Griffin's route at the commencement of the line and needs consideration. If he has water at 1,445 feet in the eastern lake, as shown on his plan, and commences the line at 1,840-ft. formation level, he would have to carry the protecting cut-off wall shown on the cross section "N" and the other cross sections along to the starting point to save his own line, as far as I can see from the map and the contours. We based our bridge on a flood level of 1,830 feet, and that is below his lake level, and we provide an 800 feet opening between basin and basin. I am inclined to think that he will have trouble at the commencement of his line unless the bank protection which he has shown is extended to protect the railway. I think it is quite possible that his plans have been based on the assumption that the water level will be at 1,845 feet, but Mr. Helli and Mr. Hobler have said that they simply viewed the matter as a railway proposition and without reference to the lakes. Whether they know that and ignored it or not I could not say. The top of the bridge will be approximately 30 feet above flood level, but that is due to the long grading running up to the tunnel. The Chairman raised the question of reducing the grading, and the height of the embankment which I say cannot be done. We did no grading. We simply took Mr. Griffin's plan and estimated on that. If we could cut out the eastern lake I think we could produce a cheaper line on the western side of Mr. Griffin's route, provided we were allowed to do so, because we could reduce the embankment and cut out the tunnel; but the question as to the layout of the city to be considered before the railway? It has always appeared to the Commonwealth railway officials that railway considerations have come last. I have always had the idea that Mr. Hobler's suggestion for route "B" was a good one provided it had to start and finish somewhere near the points indicated by Mr. Griffin. While land is cheap it would be wise to extend the line to the southern and western portions of the city to provide for future railway extensions, but I do not know of any survey to test the feasibility of bringing the line around that way, with the exception of that made by Mr. Marshall, who made a trial survey from Molongie River out to the Federal boundary to join New South Wales line. In view of the fact that so far little progress has been made in the development of the city, the most sensible thing to do at present would be to connect the railway at Queanbeyan with an economical line, provided, of course, the necessary reservations were made for the future. In our estimates no provision has been made for station

accommodation, sidings, or rolling-stock. It would depend upon the number and character of the buildings by how much the present estimate would be exceeded. The earthworks, bridge, and tunnel account for about 60 per cent. of the cost of the line in our estimate. If provision were made for draining those portions of the cuttings to which I referred it would mean that a large amount of material would have to be moved. The ordinary railway formation does not provide for anything but the mitre drains on either side of the line, and deep drainage would mean a greater width of formation. At the particular places I have mentioned there will be 2 or 3 feet of water at times. For instance, on "C" route at 3 miles 67 chains, the water would have to rise from the "sag" until it flowed out at the mouth of the cutting. The grade there is 1 in 200, so that in 7 chains or so there would be a depth of 4 ft 6 in of water. That is to say, the water would have

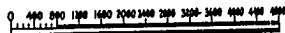
to rise 4 ft. 6 in. in the cutting before it would begin to flow out, and until it dried up again there would always be that depth of water in the lowest part of the cutting after rain. I do not know how Mr. Griffin proposes to drain those cuttings. It could be done, of course, at considerable expense, by removing the batter on the side, in order to take the water away, but that would be an expensive operation. In our estimate we allow £12,500, or £2,500 per mile, for drainage work, while Mr. Griffin provides only £1,516 for the whole length. Usually in railway work water courses are put under the banks, but in this case a number of the water courses cross the cuttings, and will require special treatment to lead the water down the batter, under the line, and out through a lengthy drain on to the other side.

199. *To Mr. Sampson.*—Roughly speaking, our estimate for earthworks, rails, ballasting, and permanent way, but excluding the bridge over the Molonglo and any overhead bridges, is £220,000

CANBERRA CITY RAILWAY

DIAGRAM SHOWING VARIOUS ROUTES PROPOSED.

— SCALE. —



1600 Feet to an Inch.

COMPARISON OF ROUTES.

17. Summarized, the various routes considered were:—

Route	Length m. ch.	Total Approximate Estimate of Cost. ^a £	Approximate Cost per mile. £	Remarks
A	5 10 ¹⁴	376,972 (a)	72,579.2 (a)	Route recommended by Mr. Griffin
A1	5 13	197,617 (a)	38,003 (b)	Deviation of portion route A suggested by Commonwealth Railways
B	6 1	356,668 (a)	61,337.4 (a)	Route suggested by Commonwealth Railways
B1	5 70 ⁵	327,761 (a)	65,953.1 (a)	Alternative route of portion of route B
C	5 22	309,415 (a)	68,600.9 (a)	Route suggested by Commonwealth Railways
C1	5 17	289,709 (a)	56,606.3 (a)	Alternative route of portion of route C

^a Excluding provision for station accommodation, sidings, signalling, telegraph, &c.
^(a) Estimate of cost furnished by Mr. Griffin.
^(b) Estimate of cost furnished by Mr. Griffin.

