1923-24.

THE PARLIAMENT OF THE COMMONWEALTH OF AUSTRALIA.

PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

REPORT

TOGETHER WITH

MINUTES OF EVIDENCE

RELATING TO THE PROPOSED ESTABLISHMENT OF

AUTOMATIC TELEPHONE EXCHANGE, ELSTERNWICK, VICTORIA.

Presented pursuant to Statute; ordered to be printed, 19th August, 1924.

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MEMBERS OF THE PARLIAMENTARY STANDING COMMITTEE ON PUBLIC WORKS.

(Fourth Committee.)

The Honorable HENRY GREGORY, M.P., Chairman.

Senate.	*House of Representatives.*
Senator John Barnes.†	Arthur Blakeley, Esq., M.P.
Senator Hattil Spencer Foll.‡	Robert Cook, Esq., M.P.
Senator Patrick Joseph Lynch.†	David Sydney Jackson, Esq., M.P.
Senator John Newland.‡	George Hugh Mackay, Esq., M.P.
Senator William Plain.*	James Mathews, Esq., M.P.
Senator Matthew Reid.†	

* Ceased to be a member of the Senate, 30th June, 1923. † Appointed 5th July, 1923. ‡ Resigned 28th June, 1923.

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EXTRACT FROM VOTES AND PROCEEDINGS OF THE HOUSE OF REPRESENTATIVES, No. 80, OF 4TH JULY, 1924.

4. PUBLIC WORKS COMMITTEE—REFERENCE OF WORK—AUTOMATIC TELEPHONE EXCHANGE, ELSTERNWICK.—Mr. Stewart (Minister for Works and Railways) moved, pursuant to notice, That, in accordance with the provisions of the *Commonwealth Public Works Committee Act* 1913–21, the following work be referred to the Parliamentary Standing Committee on Public Works for its investigation and report thereon, viz. :—Establishment of an Automatic Telephone Exchange at Elsternwick, Victoria.

Mr. Stewart having laid on the Table plans, &c., in connexion with the proposed work—

Question—put and passed.

LIST OF WITNESSES.

ELSTERNWICK AUTOMATIC TELEPHONE EXCHANGE.

REPORT.

The Parliamentary Standing Committee on Public Works, to which the House of Representatives referred, for investigation and report, the question of the proposed establishment of an automatic telephone exchange at Elsternwick, Victoria, has the honour to report as follows :—

INTRODUCTORY.

1. Elsternwick is one of the populous suburbs of Melbourne, and is now telephonically served from the Windsor, Malvern, and Brighton exchanges. It is represented that the cost of line plant required to connect subscribers in the district to these exchanges is unduly great, and economy in this respect can be secured by opening a new exchange in the telephonic centre of the area.

PRESENT PROPOSAL.

2. The proposal submitted is to erect a telephone exchange building on a site which has been recently acquired by the Commonwealth at the corner of Selwyn and Davis-streets, Elsternwick, and to install therein an automatic telephone switching system having an initial capacity of 5,700 subscribers' lines, and an ultimate capacity of approximately 9,500 subscribers' lines. It is proposed that the initial equipment shall be capable of extension to the ultimate capacity named, thereby affording sufficient accommodation for the anticipated development in the Elsternwick exchange area.

ESTIMATED COST.

3. The estimated immediate cost of the proposal as submitted to the Committee is as follows :—

	£
Site	1,000
Building	7,900
Air-conditioning, heating, ventilating, vacuum cleaning, and air compression plant	4,000
Exchange equipment, including that necessary at other exchanges (approximately £19,000)	124,950
Sub-station equipment	5,083
Line plant (conduits, cables and open lines)	24,922
Cut-over	220
	168,075

COMMITTEE'S INVESTIGATIONS AND RECOMMENDATIONS.

4. The Committee visited the site at Elsternwick and examined the plans of the building proposed to be erected there. In addition, an inspection was made of the air-conditioning plant at the Collingwood Automatic Telephone Exchange, and inquiry made as to the necessity for these plants and the practice followed in regard to their installation in other parts of the world. Evidence was obtained from the Secretary, Postmaster-General's Department, the telephone engineers and works officers, and also from Australian representatives of British and American automatic telephone companies.

5. As several proposals for the installation of automatic telephone exchanges have been referred to the Committee and it is probable that a further number will be referred during the year, the Committee deemed it wise while considering this project to make somewhat extensive inquiries in regard to automatic telephones generally which may be considered as applicable to similar investigations to be made this year.

Building.

6. The plans submitted to the Committee indicated a one-story structure with brick walls, and floor and ceiling of concrete. It is proposed to have the battery room 10 feet high and the switch room 16 feet 4½ inches high, and a flat concrete roof with a galvanized iron roof over it.

7. Between the side of the switch room and the adjoining property it is proposed to introduce the battery room, the air-conditioning room, the boiler and fuel room, a dining-room for the staff, a store-room and lavatory, and a line-room.

8. After carefully considering the matter, the Committee is of opinion that to improve the appearance of the building and assist in regulating the internal temperature, tiles should be substituted for the proposed galvanized iron roof.

9. In the matter of automatic telephone exchanges generally, the Committee, having in mind the value of the plant installed therein and the inconvenience to the public which would result from the destruction of the equipment, considers that everything possible should be done to minimize the risk of fire. To this end it suggests that in all cases the switch-rooms of the buildings should be of brick, or reinforced concrete, with concrete floors and ceilings and tiled roofs. It is also considered that for the purpose of preventing the entrance of dust and facilitating the regulation of the temperature in the switch-rooms, all entrances to the switch-rooms should be through a porch or vestibule fitted with double sets of doors.

Advantages of Automatic System.

10. During the course of its inquiry, the Committee learned that many advantages are claimed for the automatic as against the manually operated telephone system; the principal being speed of operation, secrecy of service, greater economy, automatic registration of calls, and increased efficiency. The Committee is satisfied from personal observation, from the evidence of the experts of the Postmaster-General's Department, and from the testimony of commercial men who use the automatic telephone to a considerable extent, that the system is efficient and a distinct improvement on the manually operated system.

11. Evidence was obtained that in the larger cities of Great Britain and America steps are being taken to develop multi-office telephone networks almost entirely on an automatic basis, and the Committee is quite in accord with the idea of proceeding by progressive steps to the early achievement of a complete automatic telephone system for the principal cities of the Commonwealth.

12. In the meantime, it is considered that the senior telephone officials should be instructed to continue to keep themselves abreast of the latest telephonic developments in other parts of the world, so that any necessary improvements can be worked into the Commonwealth system with the least avoidable delay.

Air-conditioning Plant.

13. The Committee paid special attention to the fact that in connexion with this exchange it is the intention to install an air-conditioning plant estimated to cost £4,000.

14. This plant, designed to eliminate dust and regulate the temperature and humidity of the air in the switch-room, is said to be necessitated by the fact that the manufacturers of automatic switching equipment do not guarantee reliability unless the atmosphere of the switch-room is kept free from dust, and the relative humidity is not allowed to exceed 70 per cent.

15. Evidence placed before the Committee showed that a deposit of dust or moisture on the more delicate parts of the mechanism materially interferes with the efficiency of the service rendered to the public, and causes deterioration of the plant, and convinced members of the necessity of installing a complete air-conditioning plant.

16. The cost of the plants so far erected appears to the Committee to be high, and it is hoped that every effort will be made to bring down the cost of each new installation.

Method of Tendering.

17. The Committee made inquiries as to the method of tendering for automatic telephone equipment followed in the Postmaster-General's Department, and is satisfied that an endeavour is being made to ensure that the Commonwealth shall have the widest choice of automatic equipment available. Every assistance is given to contractors who desire to tender, the creation of a monoply by any particular firm is being avoided, and the material is being obtained at prices which compare favorably with those being paid in other parts of the world.

18. The technical officers responsible for the selection and installation of this equipment appear to be fully alive to their responsibilities and to the requirements of the service.

Difficulty of Obtaining Telephones.

19. It is common knowledge that in the majority of cases a more or less lengthy period lapses after application is made for a telephone before service is given. The responsible officials state that an effort is being successfully made to reduce the period of waiting, but they admit that if they canvassed for business the Department would be overwhelmed.

20. Suggestions have been made that partly on account of the impossibility of obtaining materials and partly on account of the reluctance to expend money during, and immediately after, the War, the telephone service has been allowed to get a long way behind normal development, and difficulty is now being experienced in overtaking arrears. Besides being a necessary convenience of modern life, all the information placed before the Committee goes to show that in the majority of instances the telephone is a paying business proposition from the Departmental point of view. It is therefore considered that every effort should be made to meet all public demands for telephone service wherever it can be done without ultimate loss to the Commonwealth.

21. It was represented to the Committee that there is at present, and likely to be for some years, a world-wide demand for automatic telephone equipment which will result in a lengthy period elapsing before Australian orders can be fulfilled. It would therefore avoid delay and disappointment if development could be anticipated, and authority obtained for the purchase of material a reasonable time ahead of actual requirements.

Manufacture of Parts in Australia.

22. Some consideration was given to the possibility of manufacturing automatic telephone equipment in Australia, in view of the statement made that overseas manufacturers are unable to cope with the heavy demands now being made upon them. The evidence obtained by the Committee was not encouraging in regard to the whole of the equipment, but the Committee feels that considerable assistance might be given and time saved if at least some parts could be manufactured locally, and recommends that this aspect of the matter be carefully considered.

Financial Aspect.

23. It was stated in evidence that the total annual charges for the proposed automatic system as at 30th June, 1926, are estimated at £26,945
and five years later at .. .. 29,688.
The estimated revenue at 30th June, 1926 is set down at 44,216
and five years later at .. .. 63,008.
The assets thrown spare if the automatic equipment is installed on 30th June, 1926, are estimated to have a recoverable value of £60,361.

COMMITTEE'S RECOMMENDATION.

24. Under these circumstances, the Committee has no hesitation in recommending that the proposed installation of an automatic telephone exchange at Elsternwick as recommended by the Department be put in hand as early as possible.

H. GREGORY,
Chairman.

Office of the Parliamentary Standing Committee on Public Works,
Parliament House, Melbourne, 30th July, 1924.

MINUTES OF EVIDENCE.

(Taken at Melbourne.)

SATURDAY, 5TH JULY, 1924.

Present:

Mr. GREGORY, Chairman;

Senator Barnes	Mr. Jackson
Senator Lynch	Mr. Mackay
Senator Reid	Mr. Mathews.
Mr. Cook	

John Murray Crawford, Chief Electrical Engineer, Postmaster-General's Department, sworn and examined.

1. *To the Chairman.*—The proposal before the Committee is to erect a telephone exchange building on a site which has recently been acquired by the Commonwealth, at the corner of Selwyn and Davis-streets, Elsternwick, and to install therein an automatic telephone switching system having an initial capacity of 5,700 subscribers' lines, and an ultimate capacity of approximately 9,500 subscribers' lines. It is proposed that the initial equipment shall be capable of extension to the ultimate capacity named, thereby affording sufficient accommodation for the anticipated development in the Elsternwick Exchange area. The reasons for the proposal are as follow:—Elsternwick is one of the populous suburbs of Melbourne, and is now served telephonically from the Windsor, Malvern and Brighton Exchanges. The cost of line plant required to connect subscribers in the district to those exchanges is unduly great, and economy in this respect can be secured by opening an exchange in the telephonic centre of the area. The net value of the line plant required to serve the area, if the exchange be opened in 1926, will be approximately £85,000; but if the opening of the exchange be deferred, and we continue to connect subscribers to the adjacent exchanges, the value of the line plant required to give service to the subscribers in the area would be approximately £123,000. In a multi-exchange network such as that of the Melbourne metropolitan area, the exchange should be automatic, and, so far as sub-station equipment is concerned, this will make no change in the apparatus of the subscribers now connected to Malvern and Brighton exchanges, which are already automatic exchanges. The estimated immediate cost of the work is:—

	£
Site	1,000
Building	7,900
Air conditioning, heating, ventilating, vacuum cleaning, and air compression plant	4,000
Exchange equipment, including that necessary at other exchanges (approximately £19,000) ...	124,950
Sub-station equipment	5,083
Line plant (conduits, cables and open lines)	24,922
Cut-over	220
Total	£168,075

The approximate annual revenue derived, and the annual revenue it is estimated will be obtained on the date of opening, viz., 30th June, 1926, and with five years' development, is shown hereunder:—

Number of lines connected April, 1922.	Annual Revenue Received for Year ended April, 1922.	Estimated Number of Subscribers' Lines, 30.6.26.	Estimated Annual Revenue 30.6.26.	Estimated Number of Subscribers' Lines, 30.6.31.	Estimated Annual Revenue, 30.6.31.
2,030	£22,440	4,000	£44,216	5,700	£63,008

It is proposed that the building shall be of reinforced concrete, of simple design, and built on the latest fire-resisting principles. The immediate installation in the exchange is for an equipment of 5,700 lines, but it is proposed that the building be designed sufficiently large to accommodate on one floor an equipment having a capacity of approximately 9,500 lines. The financial aspect is set out in the following table:—

FINANCIAL ASPECT.

	30.6.26.	Five years after cut-over.
	£	£
1. Capital cost—New	168,075 ..	176,159
2. Capital cost—New and *in situ* ..	241,839 ..	256,000
3. Annual working expenses of proposed system	6,983 ..	8,656
4. Total annual charges for proposed system	26,945 ..	29,688
5. Annual revenue	44,216 ..	63,008
6. Assets recoverable or thrown spare if new exchange is installed—		
(i) Book value	64,005 ..	..
(ii) Recoverable value	60,631 ..	..
(iii) Cost of recovery	1,380 ..	..
7. Amount by which revenue exceeds annual charges	17,271 ..	33,320

The difference between sub-items (*i*) and (*ii*) in Item 6, i.e., £3,374, is an amount which, if the assets are recovered, will need to be written off in the departmental accounts. It represents the proportion of the capital outlay which is irrecoverable, and includes depreciation due to wear and tear, and labour in installation. I have with me the following certification of revenue from the proposed exchange:—

(*a*) ANNUAL RECEIPTS.

Revenue.

Exchange.	Average number subscriber's lines.	Average annual revenue received for three years ending 30th June, 1920.	Revenue per subscriber's line.
		£	£
Windsor	4,583	44,014	9·604
Brighton	1,529	12,761	8·346
Malvern	2,901	24,886	8·578
Average revenue per sub. line in Elsternwick area			8·843

Allowing for an increase of 25 per cent. in the telephone rates, as introduced in October, 1920, the revenue per subscriber's line in the Elsternwick area would be approximately £11,054.

[As this is an average taken over a period of three years, the estimated revenue is based on this figure in preference to the figures shown below.]

(*b*) This figure is considered to be typical of the revenue received per line, as for the year 1922-23 (after the increased rates had been operating for a reasonable time) the revenue was as follows:—

Exchange.	Average number subscriber's lines connected.	Revenue received 1922-23.	Revenue per subscriber's line.
		£	£
Windsor	5,970	71,376	11·956
Brighton	1,990	20,770	10·437
Malvern	4,160	45,318	10·893
Average revenue per sub. line in Elsternwick area			11·095

I certify that the revenue shown above is in accordance with the records kept in this office.

W. JEFFREY,
Acting Accountant.

30 May, 1924.

The site for the exchange is at the corner of Selwyn and Davis-streets, Elsternwick. It has been approved by the department as suitable for the development of the district. The new area will be carved out of the areas now served by the Brighton, Malvern, and Windsor Exchanges, and the number of subscribers to be transferred at the date of cut-over will be—From Brighton, 1,800; from Windsor, 1,480; and from Malvern, 720. The erection of the new exchange will increase the facilities in the other exchanges—for instance, 1,800 lines will be available for ordinary development in Brighton. The position in Brighton is such that it depends on the transfer of the subscribers to Elsternwick. The spare places on the switchboards of the three exchanges will be very rapidly filled up. The population of the Elsternwick area is about 40,693. Last year the increase in lines in the metropolitan area was 17 per cent., the figures being 39,163 at the beginning of the year and 45,976 at the end of the year. The department can supply figures showing that the estimates submitted to this Committee in previous years, in regard to cost of installations and probable revenue, have worked out fairly accurately. In fact, they have always been on the conservative side. Collingwood Exchange has been working for about two years. I can supply the Committee with last year's details of that exchange. When we call for tenders for equipment we advertise in the *Gazette*, and send a copy of the advertisement to all manufacturers of automatic apparatus. As the specifications and drawings are costly to produce, we make each firm that wishes to tender pay a fee of, I think, £3 3s. for a copy of them. This charge is made so that the copies will be supplied only to bona fide tenderers, and the fee is returnable upon the submission of a tender. We call for the total price of the installation of an exchange by the department or by the tenderer. If the departmental price is higher than the installing company's price, the company does the work, but there has not yet been a case in which the departmental price has been higher than that of any tendering company, because the companies would have to bring men from England or America to do the work, which it would not pay them to do. In addition to the price of the equipment, the tenderers must also state the amount of Customs duties they would be called upon to pay. Thus we know the amount with which they load their tenders. We also ask them to submit tenders for each specific section of a plant, for instance, switches, connectors, frames, machines, and so on—all the items that go to make up an automatic exchange. That is to say, they are asked to submit a schedule of prices for each exchange. In accordance with the usual Commonwealth practice, tenderers have to deposit, I think it is, 5 per cent. for the first £1,000 and 2½ per cent. for each subsequent £1,000. Our chief concern in installing an automatic exchange is to make one plant dove-tail into another. We must also see that every tenderer gives the same grade of service; that is to say, that there shall be approximately only a certain minimum number of lost calls when transmitting. One tenderer might put in too little of one particular type of apparatus in order to cut down his price. Tenderers must state precisely the grade of service they guarantee. We have to check the apparatus they propose to supply with the figures they give in respect to their grade of service. We supply the would-be tenderers with all data as to traffic, floor space, building plant, &c.—all the information necessary to enable them to submit complete and accurate tenders. We would not accept a tender lodged with the High Commissioner in London. We may consider an extension of the time for tendering for a few weeks. In fact we have done so in one or two cases, but the extension applies to all tenderers. The firms from which we are now receiving tenders for automatic exchanges are:—Siemens Bros., the Western Electric, the Automatic Telephone Company, Chicago, the Automatic Telephone Manufacturing Company, Liverpool, the British General Electric, and the Relay Automatic. All of these firms have their representatives in Australia.

2. *To Mr. Mathews.*—Equipment costs are now higher than we hope they normally will be. They are higher than when we first established automatic exchanges. The figures I have given are based on a cost of £17 10s. a line. The cost of the Geelong equipment was below £12 a line, but Geelong is a single office network. Melbourne is a much more difficult and costly problem. The cost per line generally increases in a multi-office network. I think the present high cost is due to an increase in manufacturing costs. If sworn statements are obtained from the companies they will show that the prices they charge us compare very favourably with those charged to the British Telephone Department. In Great Britain they are proceeding with the establishment of automatic exchanges, but they are not as far advanced as we are in Australia. They had more up-to-date manual equipment than we had before automatics came into use. We had a number of magneto exchanges which would have had to be replaced by manual or automatic exchanges. When we adopted the automatic system Britain did not have anything like the obsolete apparatus that Australia had at the time. For that reason probably Australia is relatively ahead of Britain in the amount of its automatic experience. It is admitted by all telephone administrations that the automatic is the system of the future. As good a service can be given by the manual as by the automatic, but the annual cost of the latter is much less than that of the former. Errors are being reduced in the automatic system. They were largely due, as every administration found, to post war conditions, but they are now being overcome. We also suffered from lack of junction accommodation, a difficulty which is being gradually removed. There are difficulties connected with every machine system, but they are not really troublesome. They merely want looking into now and then. Generally speaking, there are no more troubles connected with the automatic than there are with the manual system. At the beginning we were very short of junction lines, but even now, when that difficulty has been overcome, there are occasional troubles. The public are gradually becoming more accustomed to the use of the automatic system. There are few complaints about overcharges. In some instances the equipment registers calls when it is not being operated by subscribers, but, I think, the percentage is an irreducible minimum, such as is inevitable with all machine systems.

3. *To Senator Lynch.*—The automatic system has definitely superseded the manual for multiple office networks. The public prefer it because there are no delays in exchange connexion. Ultimately it will prove to be less costly to operate than any other system. We estimate that in 1931 subscribers will be using the tele-

phone in the Elsternwick area to precisely the same extent as subscribers in the Windsor, Brighton, and Malvern areas were using it in 1922, so that, with the same charge of 1¼d. per call, the revenue per line will be £11.07—as it was in 1922. Our estimate is really conservative, because it follows that the more possible outlets there are for calls, the more calls there will be. For instance, the calling rate on a country exchange is about 1.8, but in the city area it may be 22 or 25. The bigger the system the more value it is to the public, and the more calls are made. However, we have not taken advantage of that fact in our calculations. We prefer to base our figures on the conservative rather than on the liberal side. We show that from June 1926 to June 1931, the capital cost of the exchange will increase by 5 per cent., whereas in the same period the working expenses will increase by 25 per cent. The reason for that is that, in establishing an automatic exchange, we put in sufficient primary equipment to take care of five years' growth. It does not pay us to put in less than that. All we have to do then, as the growth comes in, is to add very little to our capital cost. In the meantime, however, working expenses will considerably increase—more mechanics will be needed when the number of subscribers increases. The capital expenditure in the five years' following the first period must increase. The moment it is necessary to put in new lines over and above the number for which equipment has originally been provided, the capital cost of an exchange goes up practically in the same ratio as shown in the figures, viz., £17 10s. per line, assuming, of course, that in the meantime prices have not been reduced. The reason why there is a very small difference between the capital cost at the opening of the exchange and five years later is that, after the initial equipment for five years has been installed, there will only be a little subscribers' sub-station apparatus to be added. At Elsternwick we are providing for 9,700 lines, but there will only be 4,500 lines when the exchange is opened. The increased provision will be effected without considerably increasing the capital cost of the exchange. If we put in equipment for 4,000 lines only, and then proceeded to put in equipment for a further 500 lines, it would be necessary to alter the whole of our internal trunking. It pays us to put in sufficient equipment for five years' growth to begin with, and in an automatic exchange it is particularly economical to do so. If there are 200 subscribers for whom cable provision has to be made, it does not pay the department to run out a cable with 200 pairs only in it because next week another cable may have to be run out to make provision for a few additional subscribers. The economic period of a cable is seven years. We estimate the number of subscribers we will probably have in the next seven years, and run our cables to meet that economic development. At Elsternwick we are proposing to build for a twenty years' period. We would not build for 4,000 subscribers only. In the figures I have submitted provision is made for working expenses, interest on capital cost, depreciation, and all overhead charges. We estimate the life of the plant at twenty years, and then a residual value of 20 per cent., which means an annual depreciation of 4 per cent. on the apparatus. When the limit of 9,700 subscribers is reached we shall probably build another exchange. There comes a time when it pays to carve a new area out of an existing area. As the number of lines increases it pays us to reduce their length, and the cost of the new equipment is an off-set against the external plant. In twenty years, assuming our figures are correct, it may pay us to put in another exchange carved out of the Elsternwick, Windsor, and Brighton areas. There is no difficulty in dovetailing an automatic system into a manual system. Obviously a single system is cheaper than a dual or treble type system. In Sydney we have a quintuple system. Usually the public classify the systems as either manual or automatic. However, we have no difficulty in dovetailing the various systems. We are doing it every day. I have no doubt that in thickly populated areas the automatic will ultimately supplant the manual system. The British Post Office is now undertaking a study of London in order to install the automatic system. The Bell company is undertaking a similar study of New York for the same purpose. Both London and New York are big areas in connection with which no experiments can be risked. They must be carefully mapped out before the authorities commit themselves to one system or the other, but the fact that these administrations are taking steps to prepare for the installation of the automatic shows that for closely populated areas the future system will be the automatic. The net value of the line plant required to serve the Elsternwick area, if the exchange be opened in 1926, will be approximately £85,000, but if the opening of the exchange be deferred, and we continue to connect subscribers to the adjacent exchanges, the value of the line plant required to give service to the subscribers in the area would be approximately £123,000. I have already explained about the length of the lines that would be required to serve the area. It is not economic to defer connecting subscribers, but we have not the plant to connect them. If the new exchange is provided at once it will save the difference between £85,000 and £123,000.

4. *To Mr. Mackay.*—The assets recoverable will be recovered from Malvern, Brighton, and Windsor, or they will be what we term "thrown spare." Past estimates of assets recoverable have been realized. Take the case of Brighton. With the opening of the new exchange there will be 1,800 lines thrown spare in Brighton, of a value of about £12 or £15 a line. The actual floor space occupied in the three existing exchanges and thrown spare for use in those exchanges is valued at—Windsor £1,163, Brighton £22,910, Malvern £648. The total value of site and building accommodation thus thrown spare will be £4,721. The value of exchange equipment thrown spare will be £38,360, made up as follows:—1,800 lines at Brighton, £21,600; 1,480 lines at Windsor, £7,400; and 720 lines at Malvern, £9,360. The total value of sub-station equipment thrown spare will be £2,974 8s. 3d., and the store value thrown spare will be £2,139 8s. The cost of recovering apparatus for 1,522 stations, at 3s. 6d. per station, will be £266 7s. If these figures are totalled they will give the amount quoted in the summary I have submitted to the Committee. Assuming that equipment has a life of fifteen years, ten of which have expired, we value it at one-third of its value. The building of an exchange at Elsternwick will render unnecessary additions at Windsor, Brighton, and Malvern. If the Elsternwick exchange is not built it will be necessary to make additions to those plants or hold up subscribers. No advantage would be gained by asking for tenders for the Unley, Northcote, and Elsternwick exchanges in one tender. They must be dealt with as separate items. As a matter of fact tenderers have the opportunity to tender for the three plants. They can tender for one or for the lot. We hope that they will tender for the lot, because competition may lower prices. Their tenders must be based on delivery in Melbourne. As well as the amount of Customs duty they are asked to show what freight they will be likely to pay. I understand that there is a regulation prohibiting more than twopence being charged for a call if the person has a public telephone on the premises.

5. *To Mr. Cook.*—A certain amount of equipment will be necessary at other exchanges when the Elsternwick exchange is built. The value of this equipment will be approximately £19,000. From each exchange junction lines run to other exchanges, and the value of these being a considerable item, we debit to Elsternwick the actual cost of the equipment we must place in the Central, Brighton, Windsor, or Malvern exchanges. That is to say, the actual capital cost of the Elsternwick equipment will be £105,000 at Elsternwick and £19,000 in other exchanges. The block of land at the corner of Davis-street and Selwyn-street is 63 feet by 166 feet, which will be sufficiently large for twenty

years' growth. Our estimate in regard to the number of lines and annual revenue is largely approximate, but we have taken every care to see that it is accurate. It is based on figures we have actually paid for each line on the last accepted tenders. There are five competing firms, but one may submit two tenders. One firm is American. The others are British. German firms have never tendered for automatic equipment for Australia.

6. *To Senator Reid.*—The Brighton, Malvern, and Windsor exchanges are now loaded to their full capacity. We have had the utmost difficulty in connecting subscribers at Brighton, and unless the Elsternwick exchange is provided the Brighton public will not be properly served. Unfortunately there is a large number of applicants awaiting lines at Brighton, but we are now connecting them, and I am hoping that we can hold the fort until the new exchange is opened. There may be a delay of six months, but I am hopeful that a special arrangement will enable us to obviate that. The delay has been due to the non-delivery of equipment. As soon as that equipment arrived I put on extra men and pushed on with the work at lightning speed. Prices in Australia compare favourably with tenders accepted by the British authorities. I have been informed by the Automatic Telephone Company that they are actually charging higher prices in America than those at which they are tendering for Australia's supply. We are not being fleeced. Our trouble is the periods of delivery. There is such a tremendous call on these companies for automatic apparatus. We are not having the difficulties with the use of the automatic that we had about twelve months ago. The public are becoming more accustomed to its use, and our service is improved in quality, due to more junctions and better internal trunking. I think that the public are more satisfied with the automatic than they were with the manual system.

7. *To the Chairman.*—The extra cost of the air conditioning plant is due to the fact that the exchange will be a big one; furthermore, the humidity readings at Malvern show the necessity for such a plant. With three readings each day at Malvern the humidity reached the following points in the months mentioned:—June, 83 per cent.; July, 84 per cent., August, 73 per cent.; September, 73 per cent.; November, 76 per cent.; December, 86 per cent. These figures show that the humidity is above the 70 per cent. for which the contractors have to make provision. I do not think that the automatic system has been affected by the electric installation on the suburban railway lines. We have had trouble with trunk lines, but none of the lines running out from the Elsternwick Exchange will run parallel with the railway for any distance. In any case they will all be lead-covered cables. It will probably be necessary to earth them.

8. *To Senator Lynch.*—The depreciation charge covers all classes of depreciation. In twenty years' time the people in the Elsternwick area will have paid for the total cost of the equipment of the exchange by means of the depreciation charge, because we allow in our balance-sheets year by year a depreciation charge to cover the cost of the installation. For the installation of telephone conveniences in the capital cities no subsidy is required from the Federal Treasury. As a matter of fact the system largely helps the Treasury because there is a very fair profit.

(Taken at Melbourne.)

TUESDAY, 8TH JULY, 1924.

Present:

Mr. GREGORY, Chairman;

Senator Barnes	Mr. Jackson
Senator Lynch	Mr. Mackay
Senator Reid	Mr. Mathews.
Mr. Cook	

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

9. *To the Chairman.*—I submit the following statement, of estimated cost of heating, ventilating, vacuum cleaning, air conditioning, electric lighting, and power plant for the proposed automatic telephone exchange at Elsternwick:—

Electric light, and power and light mains ...	£600
Ventilation, fan, ductwork, registers	700
Refrigerating plant	1,600
Air conditioning and washing	525
Heating	550
Compressed air cleaning	300
Vacuum cleaning	325
Battery room extraction	100
	£4,700

We are now installing air-conditioning plants in over 30 exchanges. Our experience of the working of automatic exchanges shows that these plants are essential for certain localities, and I strongly urge this equipment for the proposed exchanges at Northcote and Elsternwick. If the manufacturer of the equipment could eliminate trouble due to moisture a considerable proportion of the proposed expenditure would still be necessary to ensure absolute cleanliness in an automatic exchange. I am not sure that any of the items, with the exception, perhaps, of £1,700 for the refrigerating plant, could be dispensed with at the proposed automatic exchange at Canberra. I do not think that any of the items can be materially reduced. Mr. Lewis, our chief mechanical engineer, when giving evidence in connexion with the South Melbourne Exchange, estimated the expenditure for that exchange at £4,050. Necessarily our estimates of cost must vary according to the character of the building. Most of the items are for standard equipment. It is very difficult to eliminate all dust from automatic exchanges, and I think it advisable to provide what are known as air locks and to require the staff to don some style of protective clothing. They should, in fact, treat the interior of an automatic exchange like a laboratory or a powder magazine, and be required to change their boots and clothing before they enter the exchange proper. I do not think the estimate for the refrigerating plant is excessive. There is considerable competition for all plant and equipment required, and the total amount for the heating, ventilating, vacuum cleaning, air conditioning, electric light and power is small in comparison with the total value of the plant. As a matter of fact, the expenditure is a valuable asset to ensure the efficiency of the plant itself.

10. *To Senator Lynch.*—The plants now being installed have been evolved as the result of some years of experience. The item £600, for electric light and power and light mains, includes internal wiring in the building. An air lock would enable us to still further reduce the dust contents in an exchange. Several months ago we carried out certain experiments with sheets of foolscap which were placed in certain portions of an automatic exchange. We found that there was very little deposition of dust. Owing to the operation of an air-conditioning plant no dust can enter an automatic exchange building through any of the apertures, but it may be introduced on the boots or clothes of the mechanics. Therefore I suggest an air lock or a separate room in which mechanics could change their attire, and thus absolutely prevent the introduction of any dust. The cost would probably be not more than £150 or £200.

11. *To Mr. Mackay.*—To minimize the dust problem we have laid good quality cork linoleum on the concrete floors of all our exchanges.

12. *To Senator Reid.*—The item £325 for vacuum cleaning includes the internal fittings throughout the exchange building, enabling vacuum cleaners to be coupled up at different points and ensuring by means of exhaust fans the thorough extraction of dust from the mechanism.

13. *To Mr. Cook.*—We treat all our contracts as Commonwealth work, and therefore secure keen competition for all plant and equipment required, tenders being received from Sydney, Melbourne and Adelaide. Owing to the fact that no two competing firms have exactly the same system for the arrangement of their gear, and their general lay-out, occasionally we have to make certain modifications in connexion with the duct work, registers, fans and ventilation. The whole of the plant, with the exception of the motors, is Australian made.

14. *To Mr. Mathews.*—Large electric motors are being made by individual firms in Australia, but not on a commercial scale. Commercially very good five kilowatt motors are now obtainable in Australia at a reasonable price.

(Taken at Melbourne..)

WEDNESDAY, 9TH JULY, 1924.

Present:

Mr. GREGORY, Chairman;

Senator Barnes	Mr. Jackson
Senator Lynch	Mr. Mackay
Senator Reid	Mr. Mathews.
Mr. Cook	

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

15. *To the Chairman.*—The site obtained for an automatic telephone exchange at Elsternwick is very suitable, except that we shall have to build on the whole of it. We can get natural lighting for the exchange on four sides, while skylights will have to be provided for the accessory accommodation. The same remarks as to construction apply to Elsternwick as to Northcote. The site has a frontage of 165 feet to Davis-street, and 63 feet to Selwyn-street. It is a one-story building, on the corner of those two streets. Between the side of the switch room and the adjoining property we propose to introduce the battery room, the air-conditioning room, the boiler and fuel room, a dining room for the staff, a store room, a lavatory, and a line room. These are considered by the Postmaster-General's Department to be sufficient, but they are not on such a large scale as those provided at Northcote. The battery room is 10 feet high, and the switch room 16 ft. 4½ in. high. Along the neighbouring wall there will be a parapet 1 ft. 9 in. above the flat concrete roof. The walls will be of brick, and the floor and ceiling of concrete. It is proposed to have a flat concrete roof, and an iron roof over it. The entrance to the switch room will be from Selwyn-street. The door provided at the back is for the handling of large equipment. The air-conditioning room will open into a vestibule between it and the switch room. Between the switch room and the outside air there ought always to be at least two doors. In this case a door could reasonably be placed across the verandah. In Switzerland, Austria, and other cold countries the bed-rooms in the hotels often have two doors. In Vienna even two sets of windows are sometimes used. The object is to provide an air lock. The idea might perhaps be adopted as a general principle. Double doors could easily be provided at Collingwood exchange at an expenditure of perhaps £20. I have no objection to substituting a tile roof for the proposed iron roof. As the air-conditioning pipe will run along the building, I suggest that the windows should be lowered 15 inches, and made correspondingly wider. The design of the building is suitable for its purpose. The estimated cost is £6,966.

16. *To Mr. Jackson.*—The estimate works out at 11½d. per cubic foot. We have not constructed a building at as low a cubic rate as that in the last eight years. The cost at Northcote will be 1s. 2d. I do not believe that a building has been erected in Melbourne at that price during the last seven or eight years. It is not feasible to make the appearance of the front of the building uniform. One could not erect a wall for no other purpose than appearance.

17. *To the Chairman.*—I could not at the moment give the latest quotation for cement. I do not think that we have any difficulty in obtaining supplies, but the demand is, I believe, slightly in excess of the supply. I shall advise the Committee if any change is to be made in the design of the Elsternwick building. I shall, however, alter it in the direction suggested by bringing the windows lower down.

(Taken at Melbourne.)

THURSDAY, 10TH JULY, 1924.

Present:

Mr. GREGORY, Chairman;

Senator Barnes	Mr. Cook
Senator Lynch	Mr. Jackson
Senator Reid	Mr. Mackay
Mr. Blakeley	Mr. Mathews.

Arthur A. Burch, Director and General Manager, Automatic Telephones Limited, sworn and examined.

18. *To the Chairman.*—The automatic telephone exchange has many advantages over the manual system. Chief among those advantages are greater secrecy, reduction in maintenance costs, more efficient service, instantaneous disconnexions, while the meters register only on the answering of the call by the called subscriber. Manual exchanges are still utilized to a considerable extent in the United States of America, as the cost of installation is probably only 50 or 60 per cent. of that of automatic exchanges. The cost of maintenance in the case of automatic exchanges is, however, from 60 to 65 per cent. less than in the case of manual exchanges. By maintenance, I mean the actual cost of service. I wish to emphasize the point that the automatic exchange is just as efficient at one hour as another, whereas the efficiency of the manual system depends largely on the force of operators on duty. So far as my experience goes, automatic telephone services in Australia compare very favorably with similar systems in other parts of the world, but I think that the manual systems of the United States of America are slightly better than in Sydney. A great deal depends upon the size of the city to be served. Mr. Hesketh, the late Chief Electrical Engineer, was also of that opinion. I believe in a commercially-owned plant. The cost of installing automatic telephones is, of course, affected by the Customs tariff and by the shipping freights. Apart from those charges, however, the cost of an automatic plant here is identical with that of a similar plant in England or the United States of America. Our price in Australia is the American selling price, plus charges. The percentage of added cost due to the tariff is about 11 per cent. The limit in the number of subscribers who can be efficiently served by an automatic exchange has not yet been reached, but I would put it down at about 10,000 subscribers to one floor. Although it may be correct that in New York there is one exchange with three floors of 10,000 subscribers each, that might be a combination of automatic and manual telephones. It is only within the last five years or so that automatic telephones have been installed in New York. The size of the building required for an automatic exchange depends on the area to be served and the possible developments in that area. If the area to be served is so congested that it is possible to estimate fairly accurately the number of subscribers to be served, the engineering staff should be able to plan a building to meet the requirements. It is, however, not always possible to estimate in advance the development of a district from a telephone point of view. The question whether it is better to erect several exchanges in congested districts, within moderate distances of one

another, rather than confine the business to one exchange, depends largely on construction costs, and whether those costs for separate units are out of proportion to the cost of one building only. Telephone business is most peculiar, as experience has shown that the more it is expanded, the higher is the cost per unit. That is to say, the cost per unit for a city of 1,000,000 people is greater than for a city with 50,000 inhabitants. The proportion of subscribers to the population is probably greater in the United States of America than in Australia, the reason being that in America the demand for telephones is met more rapidly. I believe that the demand exists in Australia, but in the United States of America the telephone companies solicit business to a greater extent than in Australia. Hitherto, in the United States of America two or more companies have sometimes operated in one city, but that is now being discontinued, and the companies are consolidating. So long as telephone rates and charges can be governed, it is better to have one company operating in one district. In the United States of America, both flat rates and meter rates are charged. In nearly every state the rates are fixed by the Railroad Commission. A board was constituted to control the railways before the telephone came into the field, and, instead of constituting another board to deal with telephones, the existing board was given control. The board fixes the price. and its consent must be first obtained before a company can increase its charges. The question whether a flat rate or a meter rate shall operate depends largely on the arguments placed before the board. In Chicago they have the measured service as well as the flat rate. Under the measured service system the first 200 calls are covered by the rental of about £8 per annum. Beyond that number of calls, there is a service price per call. That system operates in the different cities of the different states, and probably also in different cities in the same state. It depends largely upon the facilities provided by the exchange. I do not think that there is anything in the specifications for telephones for the Commonwealth service that would tie the department, in the matter of future additions, to the original suppliers of equipment. When the automatic telephone was adopted in the United States of America, we were able to devise schemes to meet the new conditions. However, I do not think that one firm could, without additional expense, take over and complete a contract entered into by another firm. I know what can be done in the automatic field, but I do not care to talk about the equipment of a competitor. So far as I know, there is no truth in the statements recently made in the press in connexion with the supply of certain electrical equipment to the Melbourne City Council, that contractors are in the habit of adding a certain percentage to their contract prices. the successful contractor dividing the profit with the unsuccessful tenderer. If any such practice were in vogue, I think our firm would have heard of it.

19. *To Mr. Jackson.*—If public tenders must be called, the way now adopted seems to be the best method of obtaining supplies of telephone equipment for the Postal Department; but, of course, there are other ways by which materials can be purchased on a competitive basis. The use of the automatic telephone will, in my opinion, increase to a very great extent. It would be possible for the Postal Department to estimate the number of lines required each year. or over a period of years, and make a contract extending over a considerable period, on the lines adopted by the British Post Office. Under the present method the equipment is supplied according to a schedule of the traffic figures. That means that we have to engineer the job back to the department. All tenderers have to specify the date at which delivery will be commenced and completed. That means that our principals in the factories in Liverpool or Chicago. as the case may be, have to make provision in the factory for the manufacture of the requisite equipment within the contract time, even if it involves the working of overtime. This means that something has to be provided for that cannot be foreseen in manufacturing ahead. The British Post Office and the American Telephone and Telegraph Company have an arrangement under which the Government and the commercial companies are protected in regard to prices. The British Post Office has a standard fixed by which it tells suppliers of equipment what it wants. It orders particular material, and the prices are arranged on a basis which, I think, is quite familiar to your Mr. Brown. If arrangements were made for competitive bids on those lines, I think a great deal of money would be saved.

20. *To Senator Reid.*—I do not know who fixes the prices in Great Britain; I imagine that both the Post Office and the private firms have an arrangement for fixing them.

21. *To Mr. Jackson.*—In short, it means that we are limited to a fair profit.

22. *To Mr. Mathews.*—I am familiar with the Pacific Slope. The humidity in San Francisco is great, but in Los Angeles, which is further back from the coast than San Francisco, the humidity is not so great. In Honolulu the climate is always humid. There is very little trouble with the automatic equipment in San Francisco since provision has been made to cope with the humid conditions. The plants there are not exactly the same as, but they are quite similar to, those in use in Sydney. In the United States of America we insist that the humidity shall not rise above a certain point. Both in Havana and Honolulu, where the greatest amount of humidity has to be contended with, automatic plants are installed. They have been in use in Honolulu for at least thirteen years, and without question they have been successful. I do not consider that there is any hope of a reduction in the price of equipment for a considerable time.

23. *To Mr. Cook.*—I am told that there is great danger of an increase in price owing to increased wages to the employees in this particular line. The payment for patent rights and royalties are practically things of the past. No royalty is paid in Australia. Our firm certainly does not pay any royalties, for we are the originators of the equipment we supply. Some of the firms in England are paying royalties. It is quite natural that manufacturers who have to meet such charges as that pass the cost on to the users of the equipment.

24. *To Senator Lynch.*—In the ordinary course of events, any new system installed in the United States of America would be automatic, unless in the case of a small town of 400 or 500 people the traffic did not warrant the adoption of that system. The minimum population required to justify it largely depends on local conditions and traffic. On the average, with a population below 500 the automatic system does not prove payable. The general superiority of the automatic over the manual system is due to merit alone, for it meets the demands of economy as well as public convenience. The humidity in an automatic exchange should not exceed 73, but 70 is preferable. When the humidity goes higher than that it affects the cables, and there is a consequent loss of current and general efficiency. I do not think air impurities have any serious effect on the plant itself, except that dust is injurious to the equipment. I saw the new plant at Collingwood when it was opened, and I thought it very satisfactory. Although I have not inspected it recently, I am unable to suggest any improvement.

25. *To Senator Reid.*—Dust results in bad service. It is just as important to keep away dust as humidity. I could supply the Committee with particulars of the manufactured cost of equipment as supplied to the British Post Office, with a fair profit added. Apart from batteries and motor generators, our firm manufactures the complete plant from start to finish. We depend on no other for any of the equipment except the motive power. I believe other competing firms are largely in a similar position.

26. *To the Chairman.*—An independent automatic telephone exchange would cost about £20 to £25 per

line for the office itself, but so much of the equipment is as a rule utilized by other exchanges that portion of the plant does not actually belong to it, and it is difficult to apportion the actual cost.

27. *To Mr. Cook.*—It may be that some building material is more useful than others in counteracting the effects of humidity. In Honolulu many people say that cement draws moisture, but I believe that, with the exception of one case, all the larger buildings there are constructed of cement. If they are built of brick, they are cemented over

28. *To Senator Lynch.*—The telephone charges in Australia are cheaper than those in the United States of America. Trunk-line calls between Sydney and Melbourne cost about 5s. for three minutes. In the United States of America the cost for the same distance would be nearer £1. The service in the United States of America is a good one, as is also that between Sydney and Brisbane. The number of companies operating in the United States of America is gradually being reduced, and eventually I think that one company will control the whole of the telephone business there.

(Taken at Melbourne.)

SATURDAY, 12TH JULY, 1924.

Present:

Mr. GREGORY, Chairman;

Senator Barnes	Mr. Cook
Senator Lynch	Mr. Mackay
Senator Reid	Mr. Mathews.

Andrew Lewis, Chief Mechanical Engineer, Department of Works and Railways, sworn and examined.

29. *To the Chairman.*—The work of designing and installing air-conditioning plants for automatic telephone exchanges has been handled by me. I have handled full air-conditioning plants for the Malvern (Victoria), Castlereagh-street (New South Wales), Adelaide (South Australia), Central (manual), Collingwood and Brighton (Victoria) telephone exchanges. In addition I have installed ventilation systems in some twenty public buildings throughout the Commonwealth, and similarly heating systems, which form part of the air-conditioning plant. The complete air-conditioning plant has not been installed in other than telephone exchanges. In the Adelaide exchange we installed a complete plant, which can be operated to restrain the humidity to very nearly 70 per cent., at temperatures of between 70 and 75°. Certain disadvantages connected with the Adelaide exchange have been obviated in later works. The system under which we work provides for pumping air into a room, causing a pressure in that room which is higher than the outside atmospheric pressure; consequently, the tendency is for the air to flow outwards through open doors and windows. In an automatic telephone exchange the air requires the following treatment:—

(1) Dust content eliminated.
(2) Warmed as required to maintain the temperature inside exchange at 60° to 65° F. with an external temperature at or above 32° F.
(3) Cooled as required to maintain the temperature inside exchange at or less than 75° with an external temperature up to 100° F.
(4) Moisture content regulated to maintain humidity at 60 to 65 per cent.
(5) Constant motion of air in switch room with freedom from draughts.

The plant consists of a volume fan, washing and cooling chamber, water elimination battery, heating battery.

DUST.—The air is washed to eliminate dust, &c., by passing through two banks of water sprays spaced at 5-inch and 4½-inch centres; when in operation these sprays form two fairly thick walls of finely-divided water particles in motion, one set being opposed to the air flow and one set assisting the air flow. The dust removed from the air is carried down with the water to the cooling tank from which provision is made for sludging as required.

HEATING.—The air is passed between "Vento Heater" units, containing 463 square feet heating surface. Hot water is circulated through the inside of heaters by means of a centrifugal pump, and the surface temperature can be maintained between 80° F. and 200° F. as required. The heating battery has a maximum capacity of 350,000 B.T.U.'s per hour, and is capable of raising the air temperature through 42° F.

COOLING.—The air is cooled by direct contact with the spray water which is re-circulated in the system, being forced through spray jets by means of centrifugal pump having a capacity of 1,780 gallons per hour. On leaving the sprays the water falls to a cooling tank under the washer casing, and passes over refrigerator coils to the pump suction pipe for re-circulation to sprays. The cooling coils have a capacity of 107,000 B.T.U.'s per hour, and are capable of reducing the spray temperature 6° F., which in turn is capable of reducing the air temperature through 13° F., in addition to the normal evaporation cooling effect.

MOISTURE CONTENT.—The air is passed through eliminators consisting of deflectors having the surface maintained wet by means of scrubbing sprays. Surplus water in the form of spray or suspended water carried through with the air is deposited on these wet deflectors. To maintain the relative humidity or percentage of saturation of the air at 60 to 65 per cent. at comfortable temperatures, it is necessary at times to remove a portion of the water vapour content of the air. This surplus vapour is removed by condensation in direct contact with the spray water which is cooled to a practical limit below the required "dew point" or saturation temperature. The vapour condensed is combined with the cooling water and falls back to tank.

We cannot, under any system with which I am acquainted, eliminate 100 per cent. of the dust content in the air, but with the Collingwood plant we do succeed in eliminating from 98 per cent. to 99 per cent. People entering a building carry dust and dirt on their boots and clothing. A building could be made more dust-proof by closing in the entrance porch in such a way as to make an air lock. At Collingwood there is a verandah covering the main entrance. Double doors should be constructed there. I have mentioned the use of sprays. They, I consider, are the most efficient type of air-washer, and that is the reason why I have had them installed. The cooling process is carried out over a longer period of the year under Victorian conditions. For mechanical engineering work generally, the specification is embodied in the details on the plans of the apparatus required. However, for each of the exchanges which so far have been constructed, specifications have been drawn up and tenders or quotations have been invited for the composite parts, but not for the complete equipment. Up to a month or so ago I knew of no firm which could manufacture the complete equipment. The cost of the Collingwood plant was £4,100. In later references the price has increased on account of the larger plant required. Both Elsternwick and Northcote are larger exchanges than Collingwood. The New Zealand Government is installing air-conditioning plants in its automatic telephone exchanges. It has obtained prices from one firm in Sydney and has ordered the plant. That firm has sublet the various parts to minor contractors, and is drawing a percentage on the costs. In connexion with telephone exchange work it is undesirable to have outsiders working inside the building at the same time as the electrical apparatus is being installed. At present 80 per cent. of our work is subject to tender, and we get very close prices through calling on the people who actually do the work instead of placing the contract with a firm which sub-lets works. Tenders are called for every refrigerating plant. In the case of Collingwood, public tenders were invited and the lowest was accepted.

30. *To Senator Reid.*—I received eight tenders for the last refrigerating plant. It was a refrigerating firm in New South Wales which undertook the New Zealand business. They do not themselves do the duct work, or turn out the fans and other equipment.

31. *To the Chairman.*—The labour costs in the plants we have installed have approximated from 20 per cent. to 25 per cent. I do not think the work could be carried out as well by outside contractors as we can do it

ourselves. No one firm has the specialists in the different branches to enable it to handle the whole of the equipment. No refrigerating plant manufacturer is manufacturing and installing vacuum cleaning plants, which is part of the equipment. Very few handle the fans and ventilation-duct equipment; mostly they sublet such work to other contractors. I think the Northcote price includes the cost of the installation of electric light and mains, which is £600. Deducting that, the cost compares favorably with that for Collingwood—£4,100—which is smaller than the Northcote exchange. We buy the fans or compressors, and the smaller units of the equipment, in batches of half a dozen, to obtain cheap production cost. After the plant was installed at Collingwood I had an officer there specially observing the performance of the plant for quite a long period. The diagrams which the committee saw at Collingwood were compiled as the result of those observations. They showed that the plant was effective in keeping the moisture down. I have prepared a schedule of operation instructions and diagrams with a view to making the plant more effective. The plant usually works all right after being placed in charge of the postal officials. The observations at present are taken only three times during the 24 hours, and the records thus compiled prove that the plant is effective. The moisture must, of course, exceed 70 per cent. before the plant is required to be put into commission to reduce the humidity conditions. On one occasion I saw the humidity in the exchange up to 94 per cent., and after less than two hours' operation of the plant reduced to below 70 per cent. The effect is apparent a quarter of an hour after the plant is put into operation.

32. *To Mr. Mathews.*—The occasion to which I refer was a special one, before the plant was handed over to the postal employees to be placed in operation. The mechanic could not place it in operation on his own initiative on the Sunday.

33. *To the Chairman.*—We had not actually handed the plant over; it was in the early days of the installation of this system. From the examination which has been made I am satisfied that the plant has been kept in a fairly effective condition. It is very unlikely that, after installation, the plant will be allowed to fall into disuse. If the conditions in an exchange are such that the humidity approaches 80 per cent. or 90 per cent. for any prolonged period, the trouble experienced with the electrical apparatus will quickly compel the utilization of the plant. I have made such inquiries as I may without visiting other countries, and, in my opinion, we are doing as well as others with the exception of the automatic control of this apparatus. Other countries are automatically controlling the plant; that, up to the present, I have not attempted to do. The control is by small air or electric motors which set in action the refrigerating plant when the humidity exceeds a certain predetermined amount. I have not visited any plant outside Australia. I have been in touch with the American Blower Company which installed the first of these de-humidifying equipments, and I have been supplied with their descriptive matter. I have made every endeavour to keep myself right up to date on the matter. On a number of occasions I have been asked to suggest a scheme for the House of Representatives. Estimates have been taken out, and although the cost would, in my opinion, be small, my suggestion has been turned down each time. There appears to be an unwillingness to expend a few hundred pounds in improving the existing conditions.

34. *To Mr. Cook.*—I keep in touch with the latest improvements. The expenditure incurred in the installation of an air-conditioning plant is absolutely justified as an insurance against deterioration of the electrical apparatus concerned. It represents about 3 per cent. on the total cost of the apparatus, and no one should hesitate to pay 3 per cent. for protection against moisture. A distinct saving is thereby effected. These plants are undergoing a process of evolution. The Collingwood automatic telephone exchange equipment was the first which we installed. It has been recognized for some years that ultimately double doors and double windows will be included in the construction of telephone exchanges, but we have not yet faced the higher initial cost of constructing buildings which will afford that protection. At Collingwood, however, we could install double doors for a very small expense, and I understand that there is a movement afoot to have them installed there. I have here a diagram showing the humidity inside the Ashfield telephone exchange, Sydney, in February and March, 1920. I have just installed a plant there, and it will be placed in commission within the next week or two. Our limit for a telephone exchange is a humidity of 70 per cent. The diagram shows that for five days the humidity did not fall below 70 per cent., but on the other hand it reached 95 per cent. Those are probably the worst conditions that will be encountered in Sydney. I also have a diagram of the conditions in the Collingwood exchange for one week from 25th February, 1923. Although the variations in temperature outside are from 53 to 104 degrees, inside the building it was maintained at between 62 and 73 degrees. The readings were taken by a man whom I had observing the plant during the day-time. The plant was put in operation at 8 o'clock on a Tuesday morning. The humidity inside the room was then 80 per cent., but when the plant was started it fell very rapidly until it got below 70 per cent. At night, when the plant was shut down, there was a gradual rise until by the following morning it had reached nearly 80 per cent. When the plant was put in operation at 8 a.m., it, together with the heat of the building, reduced the humidity to just over 60 per cent. I have not a similar diagram illustrating the conditions that existed at Collingwood prior to the installation of the plant. According to the official statistics the highest known outside temperature in Sydney has been 108 degrees, and in Melbourne 111 degrees. The lowest Sydney reading has been 35.9 degrees, while the lowest in Melbourne has been 27 degrees. The wettest conditions up to the present have been noted in Sydney. We are commencing to install a plant in Brisbane, and that will probably show a greater humidity range. The best type of building for an automatic telephone exchange is a cavity brick building with ceiling of either concrete or plaster boards, and properly roofed with a good air space between the ceiling and the roof. I favour having two roofings. Except in a consultative capacity, I handle only the mechanical equipment. The chief architect carries out the designing of the building. When suggestions are made for improving the conditions, as a general rule, he will embody them in his designs. An air-conditioning plant would be very much more expensive to operate in a flat-roof type of building than in a building having a protected roof. We are rather favorably situated at Collingwood. There we have a wooden ceiling, plaster-faced, insulated on top, and with a roof to protect the ceiling from the weather and sun. We have the tiled roof above to protect the ceiling from the weather and the sun's rays. Air refrigeration would be very much more costly with a flat concrete roof than with a similar roof protected with tiles and air-spaced. As an air-conditioning proposition solely it would be advantageous to make all windows double, with air space between the two panes. That is now being done in some parts of the world, but more as a protection against cold. I should not go so far as to say that we should immediately adopt that method. It would considerably increase the initial cost of the building. Until we can ascertain over a number of years the running costs of our present system, I do not think that I should be justified in recommending the greater expenditure. As soon as I satisfy myself that the extra outlay is justified, I shall have the matter con-

sidered by the department. A test in a small way would only give us laboratory figures which I have at present.

35. *To Senator Reid.*—I have tried forcing the air into the rooms near the ceiling on one side of the building and taking it out at the bottom on the opposite side. I have also tried putting it in at the top and taking it out at the top. I have seen installations where it is taken in at the bottom and out at the bottom. My experience has led me to adopt the practice of passing the air in just below the ceiling on one side of the room, and taking it out just below the ceiling on the other side of the room. I have done that, not only in telephone exchanges, but in other public buildings. I have recently made calculations to show the difference in cost of operation with a concrete ceiling compared with the type of roof and ceiling proposed for Elsternwick. From an air-conditioning point of view there is very little to choose between the ceiling proposed for Northcote and an ordinary lath and plaster ceiling, particularly if the plaster ceiling is a double one, the under-side ceiling joists being covered with plaster boards, and the top side timbered or fitted with fibro-cement sheets. The heat effect would be better in the latter case than it would be with a concrete ceiling, but I understand that for protection against fire it is necessary to have a concrete ceiling. In referring to the installation of double doors, I meant the provision of a vestibule so that when a man enters the building, the outside door is closed behind him, and he passes through an air lock. At no time can a definite current of air be blown in from the street. When a building faces the north with a glass front, the heat inside the room is distinctly greater than it is with a southern outlook. On the other hand, light is a very important factor in telephone exchanges.

36. *To Mr. Mathews.*—There would be a difference of only from 15 per cent. to 20 per cent. in the cost of a 6-inch fireproof concrete roof, compared with a 4-inch roof. Four inches would hardly be strong enough to span an average telephone exchange. Air-conditioning plants are used mostly in America. I have no knowledge of their having been installed in Europe. I have full particulars of the plant in use in the Grand Rapids exchange. It has been in operation for approximately fourteen years. I do not know whether any of our engineers has seen that plant working. It differs from ours in that, instead of changing the air in the exchange six times, they put in a change of approximately one part of fresh air to five parts of re-circulated air. That makes the operation somewhat less costly for heating during the winter-time. In summer periods, when high humidity conditions prevail and refrigeration is necessary, the difference is not so marked. As the plant has been retained, I take it that it is working effectively. The literature which I have was published by the manufacturers of the plant. I have written to the company, and I am advised that it is still satisfactorily performing its functions. The cost of installing that plant fourteen years ago would have no bearing on present Australian costs. They aimed at a rather higher standard than we when they installed the plant. It was guaranteed to heat the switch room to a temperature of 70 degrees in zero weather, and to cool it to a temperature of 75 degrees under maximum summer conditions; to maintain at all times automatically the temperature in the switch room with a variation of not more than 1 degree; to de-humidify the air in summer, and humidify it in winter, so that the relative humidity in the switch room would be 50 per cent. at all times; to control the relative humidity at a variation of not more than 5 per cent.; to provide 500 cubic feet of air per minute; to wash all incoming air and remove 98 per cent. of all foreign matter. It was found after the first summer's operation that a relative humidity of 60 per cent. and a heating temperature of 75 degrees gave perfect operating conditions; that is to say, they allowed quite a margin on their original humidity guarantee, making the operation very much less costly. To my mind they discovered that it would be very much more costly to operate on the 50 per cent. margin, and they allowed the humidity to rise to 60 per cent. The majority of the telephone undertakings in the United States of America are run by private companies. I have not heard from this company whether the plant has proved effective. The winter conditions there are very much worse than they are here, the temperature frequently falling below zero, and water has to be added to humidify the air at low outside temperatures.

37. *To Senator Lynch.*—There are automatic telephone exchanges in Europe, but I have no knowledge of air-conditioning plants having been installed. The temperature conditions in Great Britain during 90 per cent. of the year are such that the relative humidity can be maintained at a low figure, merely by heating. The variation in temperature is less in Europe than it is here. I should say that the adoption of this system in America was dictated by motives of economy. I can foresee conditions, particularly in Sydney, under which portion of telephone exchange apparatus could be ruined in five years without this plant. It is a matter more for postal engineers who operate this particular plant that we are endeavouring to protect. If a plant were subjected to the atmospheric conditions experienced in the Ashfield exchange—and I understand that the conditions at Mosman are actually worse than those at Ashfield—a portion of the equipment would require renewal in a much shorter period than fifteen years. The 3 per cent. to which I referred is the initial capital outlay. The annual charge is, of course, very much less; it is something less than ½ per cent. Personally, I consider that it has been absolutely necessary to install plants of this description. Variations in temperature are not desirable. The hotter one allows the air to become the greater is its capacity for holding moisture. If there is a high temperature and high moisture conditions exist, and you subject a room to a drop in the temperature, you run the risk of condensation occurring on portion of the equipment; that is to say free water would be present in the room after high temperature conditions. If you maintain a low temperature, the risk of having an actual deposition of moisture inside the room would be less than it would be with occasional high temperatures. Any advantage in the way of a lower temperature obtained by locating the switch room on the lowest floor of the building would be offset by the greater risk of moisture entering the room through the floor. Much more light is obtained from an upper floor, and that is essential for the maintenance of this fine mechanism. Moisture and dust might easily ruin a plant in a very few years; 25 per cent. of its normal life could be lost, because of the absence of such a plant. The present limit in the exchanges is 70 per cent. To maintain a humidity of 60 per cent. would mean nearly doubling the operating costs. If the humidity can be maintained at 70 per cent. at an equable temperature of 70 degrees, the deterioration due to climatic conditions is negligible. There are periods when the plant is not in operation. It may be operated for from two to eight hours in a day. During the remainder of the time, if a door subject to external wind pressure is opened, there is a chance of the external air being blown into the room. On a rainy day, with a single door, half a dozen men entering a building frequently would allow a sufficient quantity of the external atmosphere into the room to make it necessary to commence the plant earlier than if there were an air lock to prevent the draught of external air entering the room. When the plant is working the pressure inside the room is greater than it is outside.

38. *To Mr. Mackay.*—The operating cost of the Collingwood plant, based on a period of six months to the end of last year, is as follows:—

Power	.. ..	£303
Coke	.. ..	£30
Oil	.. ..	£5
Ammonia	..	£5
Labour	.. ..	£113
Total	..	£456 per annum.

The labour costs are higher than I expected they would be. The cleaner spends an hour a day on the supervision of the plant, and portion of the £113 is for the time so spent by him. The £456, therefore, does not altogether represent an additional charge against the exchange; that figure can be reduced by some £50. I understand that a momentary rise in humidity in the exchange at Collingwood does not cause very much trouble. I have made observations with clean paper to try to measure the quantity of dust entering the exchange. I could not measure the quantity we found in the building. In connexion with the plant installed at Brighton, we have had the benefit of three months' operation, and I had the water-washing tank cleaned out yesterday. I have here a sample which shows thick mud 2 inches from the bottom of the bottle, somewhat lighter mud 3 inches above that, and then clear water to the top. That was taken from the bottom of the tank. The total quantity was probably eight times as great as the sample. The cost of operation of the refrigerating plant is trifling; the fan represents approximately one-half of the total power charges. The expenditure is well warranted by the results. The estimate of £813 is for a plain ceiling. I should like to have a lining on the top of the ceiling joist, making the ceiling double. That would increase the expenditure by approximately £150. A reinforced concrete ceiling with tiled roof would not be quite so effective, but the difference would be negligible. The expenditure for a tiled roof in addition to the concrete flat roof would be only an additional £40. To attempt to condition a room with a flat concrete ceiling may mean an increase in operating costs of anything from £100 to £300 per annum more, and the capital expenditure would also be increased by a few hundred pounds. From a cooling point of view I prefer tiles to galvanized iron. An iron roof, also, would not last so long.

39. *To the Chairman.*—A concrete roof without tiles on top would affect the humidity, because the temperature of the exchange could rise to a higher margin than with a protected type of roof, and consequently its capacity for moisture would be greater. In my opinion the CO_2 in a chamber such as the House of Representatives would be absorbed in the moisture in the air and be carried out. If I were dealing with the legislative hall, in addition to having circulation going in at the bottom and out at the top, I would arrange the duct work so that the process could be reversed. I would also place registers under the control of individual members so that they could freshen up to their own requirements the space immediately about them.

40. *To Senator Reid.*—If the air is in constant movement by the passing in of a liberal supply of fresh air and the extraction of the foul air, the effect of occupancy by a large number of persons is negligible. Actually, if the air is stagnant in a room there is an increase in the water content and in its foulness. CO_2 is not now regarded very seriously in ventilation problems; with air movement it is negligible.

41. *To the Chairman.*—We aim to introduce the air through registers at a very low velocity so that the draught cannot be felt. Under any conditions there is, of course, a movement of air, but we aim to make it low. At the present time the practice is to introduce the air above the floor level to obviate the possibility of any draught being caused. The system adopted must depend entirely upon the conditions in the room.

42. *To Senator Reid.*—My idea is to allow the air to enter a room at a very low velocity and to take its own thermal course.

43. *To Senator Lynch.*—We are told that the life of a telephone plant, if adequately protected, is twenty years. It would not be possible to isolate that portion which is liable to suffer from the peculiarities of the atmosphere, and at the same time provide ready access for maintenance and adjustment. A tractor could be put out of commission for a fortnight, taken down and adjusted. In a telephone exchange service, particularly where subscribers are grouped together, great inconvenience would be caused if 50 or 100 lines were thrown out of commission to make an adjustment to one. I do not think one could justify the sealing up of the plant. It must be left open to obtain ready access. Developments may ultimately proceed along those lines, but at the present time it would be disadvantageous to entirely seal up the sets.

(Taken at Melbourne.)

MONDAY, 14TH JULY, 1924.

Present:

Mr. GREGORY (Chairman);

Senator Barnes,	Mr. Mathews,
Senator Lynch,	Mr. Mackay.
Senator Reid,	

Frank William Mattes, Electrical Engineer, Director of the British General Electric Company, sworn and examined.

44. *To the Chairman.*—The general conditions of the tendering for automatic supplies in Australia are equitable to all tenderers. We tender in Australia; but I believe that tenders are called at the same time in the High Commissioner's Office, London. As the Post Office requires each tendering firm to have a representative in Australia, tenders are submitted in Australia, but when there has not been sufficient time we have cabled our quotation from here to Great Britain, and it has been lodged with the High Commissioner. That, however, is only done under high pressure. We prefer to tender here. It is one of the provisions of tendering that the exchange for which you are tendering must work in with existing exchanges in the same network. The telephone organization in Australia can be divided into networks covering the capital cities, and each exchange in each network must necessarily work in with the others in that network. Otherwise there would be chaos. In initiating a scheme of automatic exchanges there is no danger of providing a specification which would enable one firm to secure a monopoly. Generally speaking, with the exception of one American system, the whole of the present automatic manufacturers are working the Strowger step-by-step system. In Great Britain there has been a standardization of equipment, but not of system. There is a difference between the two, which I can best explain by a short history of the Post Office automatic development. Some years ago, when the British postal authorities were thinking of having automatic exchanges, they sent a commission of inquiry to America, which was the home of automatic exchanges. After inquiring very thoroughly into the proposition, the Commission decided that the step-by-step system should be adopted in Great Britain. There are peculiar difficulties in Great Britain, particularly in London, with its tremendous population and large number of telephone exchanges. The postal authorities got all the big British manufacturers of telephone material together and formulated certain circuits, which they based on the different company circuits. Then they called to-

gether the engineers of the various companies and asked them to express their views on the scheme as put forward by the Post Office. After several conferences an all-round sort of compromise was arrived at, by which the big manufacturing companies were enabled to submit quotations on Post Office requirements. That meant that on certain apparatus on which patents were held an arrangement was come to by the Post Office with the patentees, by which a certain order was placed with a patentee, and, in consideration for receiving that order, the patentee gave the right to all the other manufacturers to manufacture the article patented by him. Therefore, the Department's requirements were standardized with the four or five principal manufacturers. Where under his existing scheme the manufacturer was not able to fall in with the Post Office scheme, he had to make alterations to his scheme to enable him to do so. The same scheme is being adopted to a large extent in Australia. The Commonwealth's engineers are fully alive to the position. I have had a number of conversations with them on the subject. Manufacturers and users have come to realize that standardization must be adopted so long as competition is not eliminated. With four or five firms making standard material, the Commonwealth will be quite safe in that respect. It was not a few years ago. Siemens Brothers secured a contract in Brisbane some time ago at a low rate, but the price they were willing to accept did not affect the matter of standardization. We also quoted for that work. We guaranteed to supply a plant that would work in with any standard step-by-step system. In the same way the plant put in by Siemens Brothers would work in with any plant provided by us. There is no difficulty in combining standardization with efficiency. We are quite prepared to quote for exchanges which will work in with existing exchanges. More than that is not required. The British authorities are not now favorable to a continuation of the manual system. This year we have received orders for five or six automatic exchanges in Great Britain; but, as the Postal authorities adopt the policy of keeping all the manufacturers supplied with work as far as possible, if we are equipping five or six exchanges it is quite reasonable to assume that the other three firms have three or four each to equip. Thus the British Post Office must have placed orders this year for at least fifteen or sixteen automatic exchanges. The arrangement in force in Great Britain does not eliminate competition. With four or five firms quoting you have open quotations. It is not a question of being forced to give an order to one individual. When the equipment is standardized, the firm that can make it the cheapest gets the work. As a matter of fact, standardization necessarily increases competition. If you were to establish an exchange in a Melbourne area on some peculiar system that did not lend itself to standardization, you would need to keep on with that system only. I do not think it is possible for the price of automatic equipment to fall for quite a number of years. The reason is an economic one. Great Britain has a vast programme of automatic exchanges. American manufacturers are so full up with America's demands for automatic exchanges that they are doing very little exportation. Japan has a big programme now for her devastated areas. I think her order is something like sixteen boards. South Africa and India are also ordering largely. It is evident that during the next few years there will be more automatic exchange work available than the manufacturers can cope with. They must increase their staffs, and, as the manufacture of automatic apparatus is skilled work, there must be a dearth of skilled labour, with a consequent increase in wages. Therefore, there is more possibility of prices hardening than there is of them coming down. It is usually recognized that the minimum number of subscribers for a standard step-by-step automatic exchange is about 1,000 lines, but it has been proved that very much smaller areas can be taken care of by a relay system of automatics. With the relay system, instead of the selectors moving horizontally and vertically, springs make contact by a system of relays. We have just completed eleven small boards of 50 to 200 lines each on the Bengal coal-fields, and they have given great satisfaction. It is entirely a question of maintenance charges. With a reasonably sound relay automatic system it is possible to put in automatics practically anywhere. Taking all charges into consideration I think that an automatic system would be as cheap as a manual system. It would certainly be more efficient. The Commonwealth authorities have not sought information from my company in connexion with the type of air-conditioning plant required to be installed in an automatic telephone exchange. I do not know of any case in which an air-conditioning plant has been established in connexion with an automatic exchange in Great Britain, but it is hard to compare conditions in England with those in Australia. There is not in Great Britain the moisture or heat that we have in Australia, and when heat and moisture are combined there is a certain amount of oxidization of the cables and contacts. That trouble does not occur in Great Britain. I recommend the use of air-conditioning plants in the coastal towns of Australia, but not for inland towns. An air-conditioning plant does not altogether overcome the dust trouble. I am inclined to think that the dust trouble is to some extent exaggerated. It should not occasion trouble in an exchange which is in fairly constant operation, and where there are not a lot of contacts which are used only once a day. It depends on how you have your banks wired or your exchange modelled. So long as you have your exchange efficiently modelled, and there is no apparatus kicking about which is not doing its fair proportion of work, the dust trouble does not really matter. The whole operation in an automatic exchange is made up of two classes. The first is the ordinary relay operation, in which all the relays work under covers. There are springs for making or breaking contacts. The other is a purely wiping operation, either horizontally or vertically. Dust should be absolutely eliminated if the men in the exchange do not leave the covers off, because the covers are practically airtight. If the sliding contacts are not in use, you may get dust trouble. If they are in use economically and efficiently, the dust is constantly being wiped off. If they are standing for hours unused, they are not wiped, and the next time they are used trouble is caused by any dust that may lodge. From my experience I do not think that the dust trouble is serious from the point of view of maintenance. It is advisable to have vacuum cleaners in all telephone exchanges, automatic or manual. Fifteen years ago, we put a very extensive vacuum-cleaning plant into a British manual exchange. It was a great boon. A vacuum plant is effective in many ways. It helps to keep the apparatus efficient, and also helps to reduce maintenance charges. However careful the mechanics may be, they are constantly snipping off pieces of wire, and as there are thousands of tags kicking about, if a piece of wire comes into contact with these, trouble is caused. If there is reasonable cleansing with a vacuum cleaner, 90 per cent. of the difficulty from this source is removed. It is advisable, generally speaking, to keep the humidity of the room in which an automatic telephone exchange is installed below 70 per cent., but, unless the humidity is fairly constantly above 70 per cent., it will not have a very detrimental effect, that is to say, there will be no detrimental effect unless there are prolonged spells of very high humidity, say, for weeks at a time. I have known cases in Melbourne where the frames and racks in an exchange have been absolutely saturated with moisture after a rainy period, when the humidity must have been well over 90 per cent. for probably two or three weeks, or longer. With humidity at 90 per cent. or more for two or three weeks, serious damage may be done to an automatic exchange. The dust

settling on the moisture and the oxidization of contacts are the cause of trouble. In an electrical contact two pieces of metal come together, and a current passes through them. With dust and moisture, even with dust without moisture, or with moisture without dust, a certain amount of oxidization sets up, particularly on account of moisture, and the effect is that, when the contact is supposed to be made, the oxidization insulates the two points, so that no current passes through and no connexion is made. With excessive moisture very serious trouble may be occasioned on the insulation resistance of the cables. The cables must have a certain amount of resistance between conductor and conductor; otherwise there is overhearing between two lines. With an excessive amount of moisture the insulation resistance is broken down, and necessarily there is overhearing to such an extent that the exchange cannot work. When there is sufficient moisture to break down the insulation resistance, the only thing to do is to drive the moisture out of the exchange and then heat the exchange sufficiently to drive the moisture out of the cables. It is very hard to say at what point of humidity oxidization sets in. It depends upon the amount of current flowing through. Certain points may be taking a much higher current than others, and they will probably oxidize more quickly than others. I would not attempt to set down a hard-and-fast rule, and say that a certain humidity will bring about oxidization. That can only be ascertained by practical experiments. Brass and copper do not oxidize easily, as iron does; but in an automatic exchange equipment we are dealing with german silver and platinum. With german silver, which oxidizes less rapidly than practically anything else, there may be oxidization and low-insulation resistance, causing overhearing. There has never been any arrangement between the tenderers for Commonwealth requirements as regards prices or anything else. I would certainly know if there had been any such arrangement.

45. *To Senator Reid.*—When the British Post Office brought about standardization of equipment, no attempt was made to fix prices. All that was done was to get down to a standard equipment upon which tenderers could quote. When tenders were issued, the four or five firms who were capable of tendering did so, and the one who put in the best tender, from the point of view of price and efficiency, secured the work. Other things being equal, the lowest tender is accepted by the British Post Office. I do not know what system exists now in regard to division of work, but I know that the policy of the British Post Office is to keep as many firms going making telephone apparatus as possible, so that they will always have some one to rely on, and so that there will always be reasonable competition. It is a business proposition from their point of view, because the more factories there are the more competition there is, and if they want material in a rush they can fall back on four or five firms, whereas if they put all their eggs in one basket I do not know where they would be. I have not had any experience of an automatic exchange that has not been established in a coastal district, but I think I am safe in saying that in the majority of Australian inland towns there will very seldom be prolonged spells of humidity of anything in the nature of 70 per cent. As air-conditioning plants are chiefly required to overcome excessive humidity, they will not be required away from the coast, where the humidity is not high. I see no reason why a temperature of 120 degrees in the shade should affect an automatic equipment to any appreciable extent.

46. *To Mr. Mathews.*—There is not in an automatic exchange metal in sufficient bulk for heat to cause it to expand or contract. Expansion or contraction of metal depends upon a combination of bulk and temperature. In an exchange you are dealing with small quantities of metal; the expansion and contraction would be so infinitesimal with a temperature of even 130 degrees that there would be no need to worry about it. We have never specified in our tenders that an air-conditioning plant must be employed. I am not sure that the specifications have not stated that an air-conditioning plant would be required. In our tenders we have a maintenance period of twelve months, but we give no guarantee beyond that period. No company could give a guarantee for an automatic plant for any period of years, because everything depends upon how the plant is managed. Efficiently managed, a plant may last for twenty years. Without efficient management, it may not last for more than ten years. We have no one in our firm in Australia who is conversant with air-conditioning plants. I do not know of any air-conditioning plant having been installed in Great Britain. We are not concerned in the installation of these plants. I do not say that the humidity difficulty has been exaggerated. I have seen very much trouble caused by humidity. I say, however, that the dust difficulty has been exaggerated. I do not think that a fire would keep an exchange properly heated without at the same time increasing the humidity, unless, of course, the room is sealed, and the humid atmosphere outside is prevented from coming in.

47. *To Senator Lynch.*—I understand that the arrangement with the British Post Office still holds good. Owners of patents agreed under certain conditions to allow other manufacturers to use their patents. For instance, there were one or two points in Siemens Brothers dial which the Post Office thought were very good, and they eventually adopted a dial which was a combination of Siemens Brothers, and that which had been elaborated as the result of the experiments of the Post Office itself. In consideration of a certain order being placed with them, Siemens Brothers threw open their patents on their particular portions of the dial, and now all the firms are in a position to manufacture the dials required for automatic telephones. Practically all the material required for automatic exchanges in Australia is covered by patents; but, so far as British contractors are concerned under the arrangement with the British Post Office, most of those patents are thrown open for export to the British colonies and dependencies, and for use in Great Britain. I do not think the public are sufferers by the fact that these patents have not run out, because, as a result of the adoption of the standard Strowger step-by-step system, four or five firms can handle it in four or five different ways, and yet all will get exactly the same results. We are handling it in a certain way, another firm is handling it on their own particular method, which is covered by patents. Each firm has its method covered by patents, but we are all achieving the same object, that is to say, each is giving an efficient service which will work in with what is supplied by other firms. The patents do not affect the purchasers, since material can be purchased from three or four different firms and yet be exactly what is wanted. It was purely on the merits of the tender that we lost the Brisbane contract secured by Siemens Brothers. I know that there were at least four or five tenders on that occasion. If tenders are called for five or six exchanges in the same network all close together, it is probably better in the public interest to call for the lot in one contract. It is better from the stand-points of efficiency, maintenance, and cost. A big quantity of equipment can be handled through a shop cheaper than a small quantity. One skilled man can install two or three exchanges, whereas, if the contract is split up amongst different companies, each company has to supply a special installer for each exchange, and three installers' wages have to be paid instead of one. On the other hand, if tenders are called for equipments in New South Wales and Victoria, no purpose would be served by bunching them. The Commonwealth has under consideration the installation of automatic exchanges at many centres. The sooner it gets its programme going and tenders

are issued, the less likelihood there will be of disappointment in the matter of delivery. Practically every big administration in the world is now calling for telephone equipment, and the manufacturing capacity is limited, as it always must be. At any rate, it will be at the peak point for the next two years. If I were handling the Commonwealth Telephone Department, this fact would worry me tremendously. If I were banking on getting quick delivery two years hence, I would be let down. There is very little prospect of increasing the production of telephone equipment in Australia. Some years ago I became interested in the question of manufacturing telephone apparatus in Australia, and I wrote to our works manager at Home asking him for his views. I think he said that, although the works under his control are one of the most efficient in Great Britain, he had actually to buy from outside firms over 400 separate parts that he could not himself manufacture economically, although our works are a big establishment, where one would imagine everything could be made. If an Australian manufacturer of telephone apparatus had to indent from the other side of the world all those 400 parts, and undoubtedly many other parts, it would not pay him. No business man would put down in Australia a factory on the lines of one of the big British factories; therefore, it would be an absolutely uneconomic problem to attempt to manufacture telephone apparatus in any large way in Australia. There are too many details to be manufactured. Our firm must turn out many thousand different parts. The proportion of telephone equipment now manufactured in Australia is less than one-half of 1 per cent. The only items manufactured in Australia to any extent are wire and insulators. We pay duty on charging generators and iron frames. We are now engaged in an argument with the Customs Department on the matter of paying duty on condensers and induction coils. Generally speaking, we show in our tender the duty for which we are allowing. If we are not satisfied that a duty will be imposed, we stipulate that, if we are asked to pay duty, the Department must make an allowance to us for the amount paid. The form of tender is a standard one, covering, not only telephone equipment, but also insulators and other Postal requirements. The Commonwealth engineers do not know the duty payable on any particular item, and they leave the matter to the contractors. No allowance is made for duty paid unless we stipulate that the tender is put forward on the assumption that no duty will be charged. In that case, if duty is charged, it is paid by the Telephone Department. Cases have occurred in which we have got certain material through the Customs duty free one week and have had to pay duty on it next week.

48. *To Mr. Mackay.*—In our tenders we always provide for the services of an installer to supervise the erection of a plant. The Telephone Department supplies all labour. We supply the material and a skilled man to superintend the departmental labour. We have not been asked to submit a price for installing an exchange. The practice in Great Britain until a few years ago was for the installing company to do the whole job. If we were asked to install an exchange in Australia we would find it impossible to get labour to do the work. Where automatic exchanges in Australia have been installed in new buildings they have proved suitable in every way.

49. *To Mr. Mathews.*—It is questionable whether the iron frames could be manufactured in Australia. They have to be drilled very carefully. There is not a steady demand for them, so that it would not pay us as a company to make them ourselves, although it might pay us to have them made outside. For the last seven or eight years we have had our cable racks made in Australia. If the whole thing were engineered properly, and proper drawings were prepared, it is possible that the iron frames could be made in Australia, but as all sorts and sizes of iron plates and angles have to be used, just the right sizes might not be available at the moment they were required.

50. *To Senator Lynch.*—I should say that, roughly, the life of an equipment without an air-conditioning plant in the fairly narrow limits of a coastal town of Australia would be not more than fifteen years out of a normal life of twenty.

(Taken at Melbourne.)

TUESDAY, 15TH JULY, 1924.

Present:

Senator LYNCH, in the chair;

Senator Barnes	Mr. Mackay
Senator Reid	Mr. Mathews.
Mr. Cook	

Laurence B. Fanning, Superintendent of Telephones, Central Administration, Postmaster-General's Department, sworn and examined.

51. *To Senator Lynch.*—Hitherto the survey and development studies in connexion with the establishment of telephone exchanges have been prepared by the engineering branch. The equipment of an exchange is designed according to the estimate of the number of subscribers that will connect to the exchange and the number of calls that will be originated by them. Elsternwick is one of the most densely settled districts in the Melbourne metropolitan area, and is at present served by the Malvern, Brighton, and Windsor exchanges. This necessitates an undue length of subscribers' lines and heavy capital outlay on outside plant. It is estimated that by June, 1926, the anticipated date of the cutover, there will be 4,000 subscribers in the Elsternwick area. That number will be distributed as follows:—Brighton, 1,800; Malvern, 720; and Windsor, 1,480. Immediately the new exchange is ready, these 4,000 subscribers will be transferred to it. If we do not establish a new exchange in order to meet the development that is taking place in the Brighton, Malvern, and Windsor areas, we shall have to extend the existing equipment and buildings. At Windsor the exchange would reach the limit of its life by 1929, and we should have to erect a new building, because the structure now in use is not capable of extension. At present there are 6,899 subscribers connected with the Windsor exchange, and it is estimated that in 1927 that number will have increased to 8,839, in 1928 to 9,634, and by June, 1929, to 10,510. The capacity of the exchange is 10,000 lines, so that it is imperative that relief be provided before 1929. If an exchange be opened at Elsternwick we can transfer 1,480 lines from Windsor, and by the delimitation of the Windsor area we shall be able to carry on the existing exchange probably till 1935. The opening of the new South Melbourne exchange also will relieve Windsor. In the Malvern area about 500 intending subscribers are waiting for service, and unless action is taken to reduce the pressure on that exchange, it will be necessary to extend the equipment and building earlier than will be necessary if an exchange is opened at Elsternwick. The new exchange would take 1,800 lines off the Brighton exchange. Recently the plant at Brighton was extended in order to give service to a number of waiting subscribers. Further extensions will be required unless an exchange is established at Elsternwick. That would not be an economical policy. In a network such as that in the Melbourne metropolitan area it is absolutely essential that the location of the exchanges should be such as will enable all subscribers to be reached with an average wire mileage

as short as can possibly be secured. This course is necessary in order to economize in respect of outside plant. If we do not go ahead with the Elsternwick project practically the whole cost of the equipment, which amounts to about £168,000, will be distributed over the Brighton, Malvern, and Windsor exchanges; whereas, if we expend the money at Elsternwick, we shall save on outside plant by the reduction in the length of subscribers' lines. Some of the lines connected with the Brighton and Windsor exchanges are nearly 2 miles in length. In a few years Elsternwick will probably have about 10,000 subscribers, and a big saving in capital expenditure on outside plant will result from having the exchange in the local telephonic centre. This proposal is economical from the departmental point of view, and it will also give to some subscribers service at a lower rental than if they are connected with more distant exchanges. We are simply following the best modern practice of establishing exchanges wherever the density of telephone lines justifies this course. The telephonic centre of an area is arrived at after making a careful survey of the whole district, taking into account the character of the business and private settlement, the probable increase of settlement, and past telephonic development in the neighbourhood. In the interests of economy it is essential that the exchange shall be at the centre of the distribution of wires. If the practice of serving the Elsternwick area from the Brighton, Windsor, and Malvern exchanges is continued, we shall ultimately expend far more money than is involved in the Elsternwick project. Later we may find it necessary to give further relief by establishing an exchange at Caulfield, and to relieve Northcote by another exchange at Preston, and Canterbury by an exchange at Balwyn. As to the relative merits of the automatic and manual switching systems the department has adopted a policy of installing automatic plants in the capital cities, and it would be unwise and uneconomical to alter that policy. The modern tendency is to develop the machine-switching system rather than the manual.

52. *To Mr. Mackay.*—There is a possibility that the general demand for automatic equipment will delay deliveries, but that risk would not warrant us in deferring the installation of automatic systems. We have gone so far in the conversion to automatic that it would be inadvisable to turn back and install manual switching plants. We have no reason to fear that we shall not get deliveries to enable us to open the new exchanges by the dates we have estimated. In any case there is no certainty that manual plants would be provided quicker than automatic.

53. *To Senator Lynch.*—Increasing the number of exchanges makes for greater public convenience and economy. No matter how many exchanges there are in the network, it will be possible for every subscriber to connect with any other subscriber in the network as simply as if all were connected with the one exchange. Of course the reduction in the length of subscribers' lines is more economical for the department, and that means that we can give service at a more reasonable rate; moreover, when the length of line is short we can give service to subscribers more rapidly. With the exception of the Central, Windsor and Hawthorn exchanges, the manual equipment in use in the Melbourne metropolitan area is not modern. It is of the magneto non-multiple type. A better service is given in the areas that are automatically served, and, whilst the difference might not be so marked if we were using a modern manual plant, there is no doubt that when the Melbourne network is wholly automatic the service will be much better than it is to-day. There are disadvantages in the operation of the two systems in the one network, and, having committed ourselves to automatic switching, the sooner we convert the whole network the better. The magneto non-multiple plant is all right for a small exchange where any operator can connect with every subscriber on the board, but it does not meet requirements in a large exchange. I have nothing to do with the purchase of material, but I know that tenders are dealt with by a board which has to report direct to the head of the department. So far as I know, the present system ensures fair competition and reasonable prices. I certainly do not think a non-technical body, such as the Commonwealth Tender Board, would be qualified to deal with tenders for engineering supplies the Postal Department. At present the demand for telephone switching equipment is not large enough to warrant private enterprise embarking upon the manufacture of it in Australia. I do not anticipate any reduction in telephone charges; as a matter of fact, the Australian rates are probably the lowest in the world. On last year's working throughout the Commonwealth, the telephone branch showed a net profit, after paying interest on capital, of about £233,000. Whilst we are fully persuaded of the superiority of the automatic system, we do not scrap a manual plant until it has reached the limit of its useful life. On a previous occasion I told the committee that I did not think that the installation of an automatic plant at Box Hill would be justified, because by extending the existing manual plant we could carry on satisfactorily until 1928 or 1929.

54. *To Mr. Mackay.*—The establishment of an exchange at Elsternwick will reduce the charges to some subscribers, who are at present beyond the 2-mile radius from the exchange with which they are now connected.

55. *To Mr. Mathews.*—At present there are in the Melbourne metropolitan network 45,550 subscribers' lines and 64,671 stations. We anticipate that within the next five years the number of lines will be doubled. We look forward to an annual increase at the rate of 15 per cent., so that in five years there will be approximately 100,000 subscribers in the network. The switchboard in the Melbourne central exchange is of the common battery multiple type, and it cannot be extended beyond its capacity of 11,700 lines. It is anticipated that nearly 20,000 subscribers will be connected with that exchange within ten years, and it is proposed to convert it to automatic in three or four years.

56. *To Senator Reid.*—The Brighton exchange has developed at the rate of 10.59 per cent. per annum, the Windsor exchange at 12.39 per cent., and the Malvern exchange at 26.7 per cent. The probable rate of development in the Elsternwick area may be inferred from those figures. We expect to have 4,000 subscribers at the date of cutover, June, 1926; at the end of five years, 5,700 subscribers; and at the end of ten years, 6,710 subscribers; and at the end of twenty years, 9,500. The cost per unit of giving service increases as the network extends, because the equipment becomes more complicated. Whilst service in a small area with 200 subscribers might cost, say, £25 per line, the cost would be more than doubled in a large multi-office network. Exchange equipment must be designed to handle the maximum traffic, and that means that a large proportion of it must be idle except during the busiest hours of the day. Estimates placed before the committee show the capital cost of automatic exchange equipment at about £18 per subscriber's line, whilst calculations made in connexion with the North Melbourne and South Melbourne exchanges gave the cost of a modern common battery manual plant at about £16 10s. per line. The manual plant involves a heavy operating cost, which outweighs any saving on capital cost, as compared with an automatic system.

57. *To Senator Lynch.*—The establishment of the new exchange at Elsternwick will not seriously affect the staffs at present employed at Brighton, Windsor, and Malvern.

58. *To Mr. Cook.*—Wireless telephony is not yet of much use commercially, and except, perhaps, over long distances in remote areas, is not likely to be a competitor with the present system within the lifetime of the exchanges we are now establishing.

(Taken at Melbourne.)

SATURDAY, 19th JULY, 1924.

Present:

Senator LYNCH (in the chair);

Senator Barnes	Mr. Jackson
Senator Reid	Mr. Mackay
Mr. Cook	Mr. Mathews.

James Ross Briggs, Town Clerk, City of Caulfield, sworn and examined.

59. *To Senator Lynch.*—I am aware of the proposal by the Post and Telegraph Department to erect an automatic telephone exchange in Selwyn-street, Elsternwick. The site, in my opinion, is quite satisfactory. There is urgent need for greater telephone facilities in the city of Caulfield and contiguous areas. Shopkeepers of Caulfield have frequently asked me if anything could be done in the matter. Recently we have had experience as a municipal council of the grave difficulty caused by the lack of telephones. The council was desirous of having a telephone installed at the works dépôt some distance from the Town Hall so that it would not be necessary for officers of the council to travel backwards and forwards whenever they desired to communicate with the works dépôt. We made the application in the ordinary way about a month ago and a couple of days ago I received advice that it would be available in from six to eight months. This means that from the time of lodging the application we shall have to wait nine months for the telephone. The engineer who has been recently appointed also made application for a telephone to his private residence and has been advised that he will have to wait for a period up to nine months because, under present conditions, the department is not in a position to provide the telephone earlier. This I think is the experience generally. There has been a very rapid increase in the population of Caulfield, which is served by Brighton, Malvern, and Oakleigh exchanges. The erection of an exchange at Elsternwick would relieve the exchanges referred to and no doubt permit an improved service being made available at a much earlier date than at present is possible. In 1912 Caulfield had a population of 18,210, in 1919 it had increased to 35,563 and at the end of 1923 the population was returned at 52,489. In other words it has almost trebled in eleven years and Caulfield is now first in point of population among the suburban municipalities. Referring again to the difficulty experienced by people in getting telephone connexions I may say that only yesterday a ratepayer told me that he would have had the telephone long since, but that he knew from the experience of others that he could not expect to get it under about twelve months and he did not feel disposed to make the application. People do not care to wait that length of time, I have no doubt that in quite a number of instances if there was hope of being able to get the telephone within a reasonable time there would be a substantial increase in the number of applications. The expansion of population will, I believe, be maintained for some years to come. We have taken out the figures for Caulfield and basing the requirements of the people on the same area as is now permitted for each dwelling the population of Caulfield should eventually reach 100,000. Roughly the boundaries are Dandenong-road on the north, North-road on the south, the railway line at Elsternwick on the west, and Poath-road, Oakleigh, on the east, the area being about 5,600 acres—the largest of the cities, with the exception of Camberwell, in the metropolitan area. In view of the fact that we have adopted the system of rating on unimproved values, it is not likely that land will be held out of use for speculative purposes. I am familiar with the automatic telephone system. In my opinion it is quite satisfactory and a distinct advancement on the old manual system. Recently I visited Europe and America, and from my experience there I should say that the telephone system in Australia is quite as satisfactory as in any other country.

60. *To Senator Reid.*—The increase in population at Glenhuntly has been very rapid indeed. I have not the actual figures as we have not taken out a subdivision of the municipality known as Glenhuntly, but the growth in population between Glenhuntly and Ormond station has been very considerable in recent years. The new tramway being laid in Hawthorn-road northward to North-road will lead to a further increase, as there is a considerable area of open country on the other side and unquestionably it will be rapidly occupied. The experience of Caulfield, which in 1913 made itself liable for the purpose of having the tramway system introduced under the old Prahran and Malvern Tramways Trust, justifies the belief that further extensions will lead to a further expansion in population.

61. *To Mr. Jackson.*—The site for the proposed exchange is close to Elsternwick, which is an important shopping centre of the Caulfield municipality. As a matter of fact there are five or six shopping centres in Caulfield close to the railway stations of Malvern, Caulfield, Carnegie, Garden Vale, Murrumbeena, Elsternwick and Ormond, and communities have grouped themselves round those centres. The City Council by-laws restrict businesses to certain defined areas. I do not anticipate a much greater expansion of the shopping area near the Elsternwick station, because the street known as Glenhuntly-road is pretty well built upon already. There are very few vacant allotments in close proximity to the site of the proposed exchange. I have not taken out the figures as to the number of shops in Elsternwick compared with the total population, and I cannot say definitely if there is one shop to every 23 people, but it is a long road and ultimately it will be a continuous line of shops. The experience of Collingwood, where the revenue per line is about £16 per annum as compared with an estimate of £7 per annum, justifes the belief that the revenue of the Elsternwick exchange will be buoyant.

62. *To Mr. Mathews.*—I have used the automatic telephone for eight or nine years and in my opinion it is much better than the manual system. I have no complaint to make about it. Mechanically it is quite satisfactory. I think that is the opinion generally of business people who use it.

63. *To Mr. Mackay.*—I regularly use the Brighton, Malvern and Windsor exchanges through the council lines. I cannot say what provision there is at those exchanges for additional subscribers, but I am satisfied that the complaints about the delay in getting telephone connection is very general.

64. *To Mr. Cook.*—I believe the growth of the surrounding territory which will be served by the proposed exchange, will continue. I have submitted to me regularly month by month, figures relating to the applications for permission to erect further houses and shops, and I know that this work is going on steadily. This year perhaps will not be so good as last year from the point of view of numbers of applications, but they are sufficiently high to warrant the belief that the expansion to the city will continue for some years. Last year and the year before might have been regarded as boom years from the building point of view, but in my opinion the retarding of building operations, experienced lately, has brought the position, so far as Caulfield is concerned at all events, back to normal. Building costs are not quite so high as they were six months ago. I believe the delay in getting telephone connexion is due simply to the fact that the department is unable to provide the facilities. I am satisfied that if people could get the telephones within a reasonable time there would be many more applications.

65. *To Senator Lynch.*—It is difficult to say just to what extent the progress of Caulfield has been retarded by the absence of greater telephone facilities. I can only say that, in common with other suburban areas,

Caulfield has been affected. I have been in communication with officials of the neighbouring local governing bodies on this subject. Their views are represented by what I have said as to the pressing need for improved telephone facilities.

(Taken at Melbourne.)

MONDAY, 21ST JULY, 1924.

Present:

Mr. GREGORY, Chairman;

Senator Barnes	Mr. Jackson
Senator Lynch	Mr. Mackay
Senator Reid	Mr. Mathews.

Harry Percy Brown, Secretary, Postmaster-General's Department, Melbourne, sworn and examined:—

66. *To the Chairman.*—I am aware that the Committee has had referred to it, the establishment of automatic telephone services in different parts of the Commonwealth. I have had considerable experience in connexion with automatic telephone services in Great Britain, but not in other countries. It is the policy of the British postal authorities to develop multi office network entirely on an automatic basis, and particularly in London. It has been stated that in Great Britain they were holding their hands in the matter of automatic telephone services, and continuing with the manual system for a time. This policy was being followed, I understand, not because of any difference in the efficiency or cost of the system, but because the British Post Office has for a good many years been fully investigating every type of automatic system that was of any consequence before adopting any particular type. They were naturally anxious to have the very best available. I am aware that the cost of automatic services considerably increased during the war period and shortly afterwards. All plants, both automatic and manual, increased very considerably in cost after the war. Our cost went up in the neighbourhood of 150 per cent. to 180 per cent. for both manual and automatic equipment. Taking the relative cost of the two systems, I have no doubt whatever that in regard to the multi office net works, where there are large exchanges and high calling rates, and particularly in those cases where there is a fairly large percentage of junction traffic, the automatic exchange is undoubtedly more economical than the manual system. The character of the service in such circumstances under an automatic system is invariably better, and of course the holding time of the plant, which is a very important factor from an economic stand-point, is much reduced under the automatic system, because immediately a person using a line hangs up the receiver the switches are released. When there is a multi office network the instantaneous release of the plant is a vital factor in keeping down costs. I have been asked if my experiences of the automatic system in Australia is as satisfactory as it was in Great Britain. In this connexion, I may say that there are some exchanges here which are comparatively old and which have been starved both as regards the money allotted to them for plant and as regards the condition of the buildings. There were one or two instances where work was in progress, but the conditions under which they were endeavouring to maintain the plant were abominable, and the service as a result was not as good as it ought to have been. In addition, the provision of junction line plant has been inadequate, the effect of which has been to cause unnecessary wear on the switches necessitating more rapid deterioration of the plant than might have otherwise been the case. I do not think that these comments apply particularly to plant installed in pre-war days. We have not any automatic exchanges operating in Great Britain under similar conditions. Those automatic exchanges erected in Australia during recent years are of a high standard, and reflect great credit upon those responsible for their lay out, installation and subsequent maintenance. The engineers of the Works and Railways Department have realized the necessity of specially designing the buildings for automatic equipment, and generally speaking, the whole of the work undertaken has been carried out in a very satisfactory manner. I have not visited the Perth automatic exchange. I have visited the Geelong exchange, and the comments just made concerning unsatisfactory exchanges apply partly to that building, but the equipment there is in a better condition than that in others which I had in my mind. There is in my opinion no doubt as to the wisdom of continuing the present policy of establishing automatic exchanges throughout the metropolitan area. Plans have been prepared to indicate the probable development in the Melbourne network for some years ahead. So far as I am aware, no inquiries have been conducted, the results of which would disclose the total cost of the ultimate work. Neither do I think that could be done. The telephone business is peculiar and a great deal of care and attention has to be devoted to development which may be anticipated. I have found that the development, in many cases, has been more rapid than was expected. In rapidly developing cities there is extreme difficulty in forecasting telephone development. In these circumstances it is almost impracticable to give an estimate of what a complete automatic system for the ultimate development of Melbourne would be. It is impossible to fix a particular time at which the service will reach a maximum. If you were to ask for an estimate of the cost involved in this connexion in providing the necessary equipment for the next ten years, it could perhaps be supplied. The first important point is to consider the development and layout, and study the network in order to gradually develop the conduit and cable routes, so that when the time arrives exchange sites can be selected to meet prospective requirements. In remote suburban areas it would be difficult to say what the development is likely to be. Plans were made on a particular basis several years ago, but they have been revised twice since I came to Melbourne. In certain cases the accommodation anticipated to be required was found to be inadequate to meet the needs of particular districts. For example, the Malvern increase has been beyond expectations, and it may be necessary at a comparatively early date to provide supplementary exchanges to give relief. I shall supply the committee with plans showing the estimated development in the city area. The area is subdivided in respect of each exchange, and a forecast is made of the development five and ten years hence. It indicates roughly the business we anticipate, and the points at which exchanges will have to be situated. No definite plan has been drawn up for Hobart, but the proposals concerning Sydney, Melbourne, Brisbane, and Adelaide can be supplied. The question of whether the expenditure on automatic plant in metropolitan networks is likely to interfere with the development of telephonic services in the country, depends entirely upon the money made available. If we are to meet the business which is offering at the moment it is obvious that we shall have to have larger grants. I do not regard the money to be spent in the next three years as sufficient to meet the needs of the community. It will have to continue from year to year on a fairly extensive scale. In connexion with line plant and exchange equipment it would be desirable to give us time to consider developmental plans, and endeavour to forecast the expenditure under both headings. If the committee desires detailed information on these points it could best be supplied by Mr. Crawford, the Chief Engineer. So far as I understand, we do not place any deductions made for depreciation to a special fund on which we can operate should we desire. We are studying the method of accountancy at the present moment. We ought to be able to make book entries year by year, and place to a depreciation account certain amounts in respect of the whole of our

plant, so that we would have the right to call upon that account year by year as the need presented itself. Such a fund should be ours by right. It is correct, of course, in connexion with any Government department that the Treasury should deal with the financial side of any departmental undertakings, but there ought to be recognition of the principle that if money is placed in a depreciation account the department should be able to draw upon it when replacements were necessary. We would not mind what the Treasury did with the money in a depreciation account so long as it was available when we required it. In the past we have had reasonable treatment, and I trust that in the future our requirements will be favorably considered. If we are to be blocked on some later date, it will be a serious matter indeed for the community, for the communication system, as with the transport system, is essential if we are to have reasonable development. So far as I understand the present system, any deductions made for depreciation would go back to the Treasurer, and appear in the receipts for the year. They would be included in the year's surplus, if there were one. We have our own accrued depreciation fund, which is used in connexion with our commercial balance-sheet. If the system showed a profit of £1,000,000 after allowing for depreciation and interest charges, that amount would go into the Treasury, and be included in the surplus, if there were one. Although provision has been made for an ordinary ½ per cent. deduction and 1 per cent. sinking fund for loans, that is primarily to redeem loans, and will not benefit the post office finances. No sums are definitely set aside for our use in respect of the depreciation we indicate in our books. We ask for certain moneys to meet our telegraphic and telephonic requirements year by year, and they would in the ordinary course come out of a fund such as I have referred to. The Treasury does not hold any specified amount to meet depreciation costs, but, should we want, say, £300,000 for renewals, the money would be supplied by the Treasury. If the committee were to recommend that there should be a depreciation account from which the cost of replacements could be met when required, I should not like it to be applied solely to automatic exchanges, but rather to the whole of our plant. We should have a fund showing the accrued depreciation upon which we might be able to draw when necessary. I understand, however, that the committee has in this instance been authorized to deal only with the question of automatic exchanges. I would not favour the keeping of separate accounts in connexion with automatic exchanges. The Treasury has adopted the policy that it finances the department by taking its profits and making up its losses, and the fact that the Postal Department owes the Consolidated Revenue a fairly large sum does not affect the position. The tender board system in Australia is not similar to the system under which they operate in Great Britain. Generally speaking, the practice here is for a number of men to consider the tenders, whereas in Great Britain the individual branch is responsible, and the recommendations are made by one man. As to the Commonwealth Supply and Tender Board, I consider that the heads of departments are the best people to undertake the duties in connexion with the departments generally, as the work is not of a serious character. The work covered by the tenders is not to be compared with that usually required by the Post and Telegraph Department, which is full of complexities and technical difficulties. In the case of automatic exchange equipment, it would be quite impracticable for persons who were other than experts to consider tenders. Generally speaking, the tenders dealt with by the Commonwealth Supply and Tender Board are of a comparatively simple nature, and relate generally to specifications and prices for some particular item. The data is prepared by officers conversant with the business, and it does not require much time for heads of departments to conclude what is the best to be done in each particular case. Tenders for work associated with automatic exchanges do not come before the Tender Board. If they did, the position would be practically hopeless. The study of tenders in connexion with automatic exchange equipment on the present basis is exceedingly difficult. The specifications that we issue leave it open to contractors to provide variations of a certain character, and it means that when the tenders are received a very detailed study has to be carried out by experts in order to determine the relative merits, not from the stand-point of the intrinsic value of the plant, but from the service which might be obtained when the plant is installed. So far as the department is concerned, it is necessary to purchase a good service, while, on the other hand, the contractor is concerned in selling plant. These two factors have to be reconciled. It is desirable as early as possibly to take the engineering work out of the contractors' hands, and do it ourselves. When I came here one of the first things that came under my notice was a number of tenders for a particular exchange, the bundle of papers for which was about 2 ft. 6 in. high. It required a good deal of application and search amongst these tenders to ascertain the value of the variations made and to determine what was the right thing to do. That is not fair to the contractor or to the department. We have since made an endeavour to put these specifications on a better footing, and, instead of allowing them to be dealt with by state officers who have ordinary routine work to perform, we have arranged for the work to be centralized at head-quarters, and have altered and improved specifications in an endeavour to get a semblance of unity in the tenders. In connexion with automatic exchanges, we get tenders for plants to give a particular service, taking into consideration the probable number of switches likely to be required to get the traffic through with certain probable losses. We take the busiest hour or half hour of the day, and estimate the amount of traffic to get through. We estimate that there should not be more than, say, sixteen calls per thousand lost during the busy period, and the contractors will endeavour to get that result by different methods. Obviously, the first thing is the number of switches to be supplied, but there are other factors, such as the arrangement of the trunk lines in different sequences which also have to be considered. If one has to study the whole of these proposals as submitted by every contractor, it is a very complex problem. It will be found that one contractor will say that he can give better results, with a fewer number of switches, than another. These matters have to be checked. The only satisfactory method, in my opinion, and one which we hope will ultimately be adopted, is one whereby the department itself will make a study of the question, and specify the number of switches which are to be put into a system. In connexion with the consideration of tenders, the practice at present is to bring to head-quarters an expert from the particular state concerned who will be responsible for attending to the installation of the equipment after the tenders have been received. The state officer is in constant consultation with the experts at head-quarters, and after everything is scheduled the decision is then discussed with the chief engineer, who decides whether their conclusions are sound. The matter is then brought before me, and I investigate it as far as I think it necessary before a decision is reached, and when that is done we place the order. I have no doubt whatever that the most efficient safeguards are provided to ensure that the most economical purchases are made. I understand that it was alleged that a successful tenderer in connexion with some contracts for the Sydney City Council divided a certain amount amongst the unsuccessful tenderers; but I am certain that nothing like that happens in connexion with the automatic equipment, as the competition is very keen. Every care is taken, too, to see that the work is done efficiently, and the honesty of the officers concerned cannot be challenged. I am absolutely positive that the integrity and honesty of the men cannot be questioned. Formerly it was the practice for certain tenders to be considered in the states, but that work is now being centralized at head-

quarters. I make no reflection whatever upon any of the officers, and I say that in no case has there been an instance in which any one yielded to temptation. The possibility of it happening is materially reduced under the present arrangement, as only one body of officers will have to deal with the work at head-quarters. It would be quite impossible under the present arrangement to come to what I might term an illegitimate decision in connexion with tenders. If it is true that copper wire was purchased some time ago at £160 per ton when the price based upon the market value of electrolytic copper should have been £129 10s. a ton, I can only say that it must have been very poor buying on the part of the department. With certain lines it is the policy of the department to purchase Australian-made material, which in some cases is very heavily protected, and obviously more costly. Under the present system of purchasing there is little likelihood of such a thing as irregularities in the acceptance of tenders happening. There is keen competition in nearly every line. There are, of course, some instances in which a monopoly is held by one firm in a particular state, and in these cases higher prices than are warranted are being paid. In some cases we receive as many as ten tenders, and in other isolated cases, where there is no opposition, we receive perhaps only one. I do not wish to pose as a specialist in the matter of air-conditioning. In certain circumstances undoubtedly the two great enemies of the engineer in maintaining an automatic equipment are dust and moisture, both of which give rise to considerable trouble. There is low insulation, bad contacts, the possibility of triple connexions, and cut-offs, and a series of troubles arise as a result of these conditions. In addition, there is serious deterioration of the plant that progressively increases cost in maintaining it. It is, therefore, very important that we should, as far as practicable, eliminate dust. Dust has been eliminated in some instances by providing cheese-cloth or wire of a fine mesh at every open window, but even that is not altogether satisfactory, as this material has to be renewed. Even with its use the ventilation sometimes suffers, and it can only be employed when there is no likelihood of any trouble from humidity. In order to indicate the seriousness of dust and humidity, I may mention that we had some tests made a year or two ago which indicated that the drop in insulation resistance on the fibre used very largely in telephone apparatus construction was 50 per cent. when exposed to a humidity of 80 per cent. for twelve hours. The tests made with silk-cotton covered, beeswaxed wire showed that there was a drop in insulation resistance of from 434 meghoms to .45. If one examined the switches in an automatic exchange, one would be impressed by the minute character of some of the parts which are vital in effecting connexions. The insulation between the points of contact is only about a sixteen-thousandth part of an inch in thickness, so that if any moisture or dust is present it acts very seriously against the efficiency of the equipment. Although the normal voltage of a particular system may be only 48, it is possible, when the dialling impulses are being received over short lines, that the voltage may rise as high as 800, and consequently good insulation and freedom from dust and moisture are essential. It is necessary to ensure as far as we economically can against these troubles. In some places, where there is high humidity with a low temperature, we can deal with humidity by utilizing heating plants. In other places where there is high humidity with high temperature, and where it is necessary to keep the staff in the exchange to maintain the plant, it is impracticable to deal with the problem solely by heating. In such cases it is necessary to have complete air-conditioning plant. Although I would not commit myself by stating that in every automatic exchange in the Commonwealth there should be a complete air-conditioning plant, I would say that in cases where there is high humidity and high temperature there is no doubt as to what ought to be done, and that is to put in a complete air-conditioning plant.

67. *To Senator Lynch.*—I have already stated that in the case of a multi-office net-work there is no question as to the superiority of automatic exchanges over manual exchanges. In exchanges where the communication is principally over trunk systems, it is possible to arrive at a point where one system would be as good as the other. Where the calling rate was low, and the percentage of trunk traffic high, and practically no junction traffic, a manual system would probably be more economical than an automatic system. If it were a question of starting afresh, there is no doubt, in my opinion, that the automatic system would be the most economical for use in the metropolitan network. I have not any general figures to show the percentage advantage of one system over the other. It is very difficult to give general figures, as so many factors have to be taken into consideration. In dealing with such a matter, calling rates are very important, and the amount of junction traffic is vital. It would be very difficult to generalize. From detailed investigations made here, and from those made in England, it is quite clear that we get much greater economy, and incidentally a much more efficient service, by using the automatic system in multi-office network instead of the manual system, and the advantage is clearer still in favour of automatics if you have a high calling rate and a large junction traffic. In the metropolitan network system, I do not think we can possibly go wrong in establishing automatic services. During recent years I have not known or heard of any case where the automatic system has been abolished, but a few years ago, I believe, in the United States of America there was an instance in which a change was made, but it was because of the relationship existing between the companies operating the telephone systems. The efficiency of the plant was not involved. I do not think there has been any stage in its development when the automatic system has not held its own against the manual system, especially in a large net-work service. The problem of obtaining inter-communication with a six-figure system has been exceedingly difficult, and it is only within recent years that a reasonable solution of the problem has been found. If we were to go back ten years we would find that it would not be the policy of any telephone engineer to put in a full system in such a city as London or New York, but the difficulties have now been overcome, and a complete system has been laid out for London. Any doubt which existed has now been removed owing to the manner in which the system has been perfected. I cannot see any likelihood of the existing telephone charges being reduced. In fact, if any alteration is made it may be in the direction of increasing them. If accounts are placed on a proper footing, and a depreciation fund established, it is questionable whether the present charges for telephonic services are adequate. As the accounts stand at present, there are indications that the telephone service is paying handsomely; but one has to bear in mind the question of depreciation, and consider what factors that may introduce. Generally speaking, here the charges are lower than anywhere else in the world, notwithstanding that the rate of pay here is higher, the hours worked shorter, and the cost of equipment obviously greater. That comparison applies to systems operated by governments and by private enterprise. The charges prevailing in Australia are lower than those in England. It has been stated that a prospective subscriber in Melbourne will have in some instances to wait nine months before being supplied with a telephone service. The cause is that, in the first place, when the requirements were foreseen some time ago money was not available. An enormous time elapses between the date on which we get authority to undertake the work and the date on which a service is made available. The purchase of stores is a very big item, and sometimes two years elapse after we receive the authority before the goods became available. Unless we are permitted to commit ourselves to an expenditure of this kind long in advance, there is no doubt that the

public will be seriously hampered in getting telephone facilities. There has been a big reduction in the time in which a prospective subscriber has to wait for telephonic connexion. Six months ago the number who had been waiting for connexion for twelve months was large, but to-day it is comparatively small. We would like every prospective subscriber in the metropolitan area to be given a connexion within, say, three weeks, and if we had the necessary money we could reach that stage throughout the Commonwealth within twelve months. In Sydney we are getting very close to it now, where the time taken is from six to eight weeks. It will never be satisfactory until we reach the stage where we have to canvass business. If we did that now, we would be overwhelmed. As to the possibility of reducing the cost as the volume of business increases, I should say, in the matter of an automatic plant, that it would not be an appreciable factor when one takes into consideration the size of the net-work to be served, particularly from the point of view of junction traffic. If we had a very big net-work, and had a large proportion of junction traffic, the automatic system would be the more economical. I do not think we need anticipate that the cost of the service will rise as the business increases in volume. If we look at it from the point of view of a manual equipment, the exchange cost is where the increase takes place, due to the fact that we have to make the whole of the subscribers of the exchange available to every operator. That is done by providing a multiple which is repeated before the whole of the operators, so that when a call is coming in to a subscriber, any one operator may be able to make the connexion without the assistance of another operator. That multiple increases in geometrical proportion, because of the number of subscribers, and because of the greater number of operators necessary to handle the business. The number of connexions with subscribers on the exchange first called is a small proportion of the total handled; the balance has to be transferred.

68. *To Mr. Mackay.*—A good many improvements have been made in connexion with automatic plant, but they are in minor ways, and are chiefly in design and construction. The alterations in principle are comparatively few apart from those which enable the subscriber to obtain more ready access to subscribers in a big net-work system. A great deal has been done with a view to manufacturing parts which offer greater resistance to moisture, but whatever is done the experts are always confronted with the same difficulty. It would be impracticable to call tenders simultaneously for three automatic exchanges, situated in different districts, even if they were required, because of the complexities involved in each case. We have endeavoured to do it as far as possible where the exchanges are in the same area, and will intercommunicate. In connexion with five exchanges in Adelaide, and three supplementary exchanges, we invited tenders at the same time. In such circumstances this plan is advantageous, because a contractor can tender more economically on a bulk supply basis.

69. *To Senator Reid.*—It is impossible to say how many subscribers should be secured to enable an automatic exchange to work on an economic basis unless one knows the conditions under which the service would be rendered. There would be little doubt as to the wisdom of establishing an automatic exchange in a multi-office net-work, if, say, 500 subscribers would be available in five years. Installation work is carried on by the officers of the department instead of bringing engineers from the other side of the world. In connexion with tenders for automatic exchanges, the branch concerned has its own experts, who investigate the merits of each proposal, and the head of the branch then confers with the chief engineer. When the Commonwealth Tender Board was established, it was considered that it would be more satisfactory and expeditious if the officials of the Post and Telegraph Department dealt with their own tenders. Matters relating to automatic exchange equipment are settled by experts, but in the matter of bulk stores I have a tender board which advises me as to what should be done.

70. *To Mr. Jackson.*—The equipment at the Brisbane South automatic exchange was supplied by an English contractor. As to whether or not we have the best purchasing system, I think that when we have done the engineering work on our own specifications there will be little room for further improvement. We are not purchasing miscellaneous stores five years ahead, but, generally speaking, we invite tenders on an annual basis, which is as far as I would be prepared to go in the matter of telephones and supplementary equipment. Formally the tender work was done by the states, but we are now cutting that out as much as possible, and inviting competitive tenders for the material required for all states in one schedule. It would not do to commit ourselves to too big an expenditure in advance, particularly as no one can see what will happen in regard to prices during the next five years. The system in vogue at present is much better than that which originally prevailed.

71. *To Mr. Mathews.*—Our accounting system and the method of preparing accounts for the collection of telephone revenue, are being carefully investigated to see whether any improvement can be effected. In my opinion, the flat rate for telephone charges has gone for ever, and no telephone administration would think of reverting to it, because it is altogether inequitable. Those who make a small use of the telephone under the flat system would be compelled to pay as much as those who were continually using the service. A great deal of care is exercised in connexion with the examination of meters, and careful tests are made to ensure the accuracy of the record. As neither human being nor machine is infallible, we are always confronted with the possibility of error, and, as a result of observations made over thousands of circuits which are independent of the human element, we believe that the percentage of errors is very low. Every administration which sells service by meter is confronted with the same difficulty. The department is exercising every care to ensure that the accounts are accurately kept. I think there are some cases in which complaints are justified, because it is possible in some circumstances for recording instruments to be erratic, but there is less likelihood of inaccurate registration under the automatic than under the manual system.

72. *To the Chairman.*—We are carrying the whole fire risk ourselves, and every provision is made to see that new buildings are as fireproof as possible. I have, of course, visited some old structures, which are anything but fireproof. Every care should be taken to see that the buildings are constructed in such a way that damage by fire is unlikely, not only because of the value of the plant, but because of the serious effect which a total or partial loss by fire would have upon the business of the community.

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