

1926.

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VICTORIA.



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# R E P O R T

ON THE

## STATUS AND AFFAIRS OF THE STATE ELECTRICITY COMMISSION OF VICTORIA;

AND

## THE SCOPE AND WORKING OF THE STATE ELECTRICITY COMMISSION ACTS.

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BY WILLITS H. SAWYER.

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PRESENTED TO BOTH HOUSES OF PARLIAMENT BY HIS EXCELLENCY THE LIEUTENANT-  
GOVERNOR'S COMMAND.

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[COPY.]

GOVERNMENT OF VICTORIA.

Chief Secretary's Office,  
Melbourne, 3rd March, 1926.

SIR,

I beg to forward herewith a Commission under the hand of His Excellency the Governor and the Seal of the State appointing you to be a Royal Commission to inquire into the status and affairs of the Electricity Commission of Victoria and into the scope and working of the State Electricity Commission Acts.

Yours faithfully,

(Sgd.)

W. P. HEATHERSHAW,  
Under Secretary.

W. H. Sawyer, Esq.,  
c/o The Secretary to the Law Department,  
Crown Law Offices,  
Melbourne.

[COPY.]

GEORGE V. by the Grace of God of the United Kingdom of Great Britain and Ireland and of the British Dominions beyond the Seas, King, Defender of the Faith, Emperor of India.

TO Our Trusty and Well-beloved WILLITS H. SAWYER, ESQUIRE.

GREETING :

WHEREAS the Governor of our State of Victoria, with the advice of the Executive Council thereof, has deemed it expedient that a Commission should forthwith issue to inquire generally into the status and affairs of the Electricity Commission of Victoria and into the scope and working of the State Electricity Commission Acts, and more especially as regards—

- (1) The Commission's works of power generation and distribution as they exist to-day, with particular regard as to their general lay-out, the quality and efficiency of the plant, equipment and accessories established and of the methods of operation employed.
- (2) The works and projects now in progress for extending the supply of the State's generating capacity and the scheme or schemes contemplated for so doing, more particularly with regard to the Sugarloaf Hydro-Electric Scheme and for the further extension of the transmission systems to Metropolitan and Provincial centres.
- (3) The works and projects which the Commission has under consideration for the future extension in its various systems, with particular reference to the increase of generating capacity both in basic-load and in peak-load stations operated or to be operated by the Commission.
- (4) The Commission's sources of revenue from electric supply and the prospects of the growth of such revenue as to the Commission's operating expenses and overhead charges and the influence thereon of future growth of production, more especially as to the reasonableness of the Commission's tariffs and charges and as to whether the Electricity Supply undertakings are economically sound or will become so without any burden on consumers or the State.
- (5) As to the agreement for the ultimate acquisition by the Commission of the Melbourne Electric Supply Company's undertaking and as to the effect of such agreement upon the future revenue of the Commission including the technical procedure now in process of execution for the supply of energy to and the conversion to three-phase distribution of the Company's Melbourne undertaking.
- (6) The Commission's proposals for popularising the use of electricity and for the sale of electricity consuming equipment.
- (7) The economic value as a low-grade fuel of brown coal deposits at Yallourn under present and prospective methods of coal-winning, with special reference to possible alternative fuels.
- (8) The Commission's coal-winning methods, present and prospective, and its proposals and schemes for further developing the open-cut workings at Yallourn and for cheapening the cost of production there.
- (9) The Commission's briquette undertaking at Yallourn and the disposition of the output therefrom, having regard to the cost of production, present and prospective, as well as the output having to compete commercially with other available fuels, both domestic and industrial.
- (10) The internal organization of the Commission, more particularly in relation to the control of its operations and staff at Melbourne, at Yallourn, and at other Provincial Centres.
- (11) The system of distribution of electric power throughout the Metropolitan area and country districts as between the Commission and other Authorities.
- (12) The reasonableness of the overhead charges and operating costs in the various phases of the Commission's undertakings.

NOW KNOW YE that We reposing great trust and confidence in your knowledge and ability have constituted and appointed and by these presents do constitute and appoint you WILLITS H. SAWYER to be our Commission for the purposes aforesaid ; AND WE do by these presents give and grant unto you full power and authority to call before you such person or persons as you shall judge likely to afford you any information upon the subject of this our Commission, and to inquire of and concerning the premises by all other lawful ways and means whatsoever : AND WE will and command that this our Commission shall continue in full force and virtue and that you our said Commissioner shall and may from time to time, and at any place or places, proceed in the execution thereof, and of every matter and thing contained therein, although the same be not continued from time to time by adjournment : AND WE DIRECT that you do with as little delay as possible report to us under your hand and seal your opinion resulting from the said inquiry.

IN TESTIMONY WHEREOF We have caused these Our Letters to be made patent and the Seal of our said State to be hereunto affixed.

(SEAL) WITNESS Our Trusty and Well-beloved cousin the Right Honorable GEORGE EDWARD JOHN MOWBRAY, Earl of Stradbroke, Knight Commander of the Most Distinguished Order of Saint Michael and Saint George, Companion of the Most Honorable Order of the Bath, Commander of the Royal Victorian Order, Commander of the Most Excellent Order of the British Empire ; AIDE-DE-CAMP to His Majesty the King ; Governor of the State of Victoria in the Commonwealth of Australia at Melbourne, this Third day of March, One thousand nine hundred and twenty-six, and in the Sixteenth year of the Reign of His Majesty King George V.

By His Excellency's Command,  
(Sgd.) STANLEY S. ARGYLE.

(Sgd.) STRADBROKE.

Entered on record by me in Register of Patents Book, No. 29, Pages 169 and 170, this Third day of March, One thousand nine hundred and twenty-six.

(Sgd.) W. P. HEATHERSHAW,  
Under Secretary.



# R E P O R T .

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*To His Excellency the Honorable SIR WILLIAM HILL IRVINE, Doctor of Laws, Knight  
Commander of the Most Distinguished Order of Saint Michael and Saint George,  
Lieutenant-Governor of the State of Victoria and its Dependencies in the Commonwealth of Australia, &c., &c., &c.,*

MAY IT PLEASE YOUR EXCELLENCY :

I, WILLITS H. SAWYER, being appointed a Royal Commission to inquire into the status and affairs of the Electricity Commission of Victoria and the scope and workings of the State Electricity Commission Acts, have the honour to report as follows :—

Before proceeding with a discussion of the problems upon which I was especially asked to report, I give below certain general comments and, in effect, a summation—in non-technical language—of my general conclusions.

## SUMMATION.

Fundamentally, the undertaking is, as a whole, economically sound and, by virtue of the importance of electrical energy to the State, it must go forward. To-day it is not directly financially profitable. The estimates given me show that it will become directly financially profitable during the calendar year 1927. With these estimates and this assumption I differ. I agree closely with the estimates as to the revenue expected within the next few years, but I believe that the operating expenses will be greater than have been assumed.

In my opinion, the Commission has proceeded in the past with information of an incomplete nature from its staff. The estimates now being made profit, to a certain extent, from past experience, but, in general, are even now too optimistic, and are not based on the thorough analysis necessary in such undertakings. The net loss from Electric Supply Undertakings for the fiscal year ending 30th June, 1925, was £241,000, and for the fiscal year ending 30th June, 1926, the net loss is estimated to be reduced to approximately £200,000. For neither of these years has depreciation been taken into account. Taking it into account, as the Commission proposes to do, beginning 1st July, 1926, I expect to see a net loss for the fiscal year ending 30th June, 1928, but by the fiscal year ending 30th June, 1930, there should be a net profit on the present combined undertaking and on practically every present separate undertaking. Until there is a real net profit, I recommend that there be no appreciable reduction in rates.

It seems to me unnecessary at this time to refer at length to the immense amount of brown coal deposits in the State of Victoria, or to what an asset Yallourn is to the State. It has been said many times before, and is true, but it is not an asset to the extent optimistically prophesied in early reports and even of later date ; but that asset can be, and, I believe, will be, translated into terms of electrical power, light, and heat, at monetary rates which will make the investment worth while.

I have no quarrel with those who say that, based on earlier reports, the public had a reasonable right to expect cheaper electricity with lower capital expenditure than obtains to-day, but I see no reason why I should condemn the undertaking because the earlier reports were too optimistic. The important question now is : Is the undertaking based fundamentally on economically sound principles ? That I have answered unequivocally—"Yes, it is." I may not be correct as to the exact date at which the economic soundness will be actually proven, but let it be clearly understood that there should be no interpretation contrary to my definite statement as set out above.

While I have criticized the estimates, the design, and the operation as to portions of the undertaking, it should be appreciated that the undertaking presents many new and complicated problems. Although the staff is composed of technically-skilled men, speaking generally, it has lacked the practical experience to cope, to the desired degree, with the problems which confronted it. This is but natural, and it is not a criticism of the personnel. There is admittedly a scarcity of engineers in Australia who are familiar with large power-house design and operation, and the other problems confronting this staff, including the complex problem of how to win and burn most successfully brown coal with 65 per cent. moisture. I recommend that the Commission's practice of sending men abroad for experience be not only continued, but very appreciably broadened.

I recommend postponing a decision as to the building of any major power plant extension until a more thorough study can be made; also, that the proposed extension to the briquette plant be postponed until the coal winning situation is more definite as to appreciably reduced costs of coal winning.

I also recommend more complete and more frank publicity, especially as to finances. I consider the contract with the Melbourne Electric Supply Company as advantageous to the State.

As to coal winning, it would seem best to me to take advantage of the lower moisture coal in the old open cut, and I recommend that, at least for the immediate future, power station coal be largely taken from the old open cut where the moisture content is approximately 48 per cent. I would not be surprised if it were found expedient to continue to use coal from the old open cut for several years, but in any case, coal from the old open cut should be used until, based on careful studies, and taking all things into consideration, definite plans have been worked out which show it more advisable to return to the new open cut. I recommend postponing the expenditure of £489,000 proposed in connexion with coal winning in the new cut.

I recommend proceeding with the Sugarloaf-Rubicon scheme, although the real data as to what may be expected in output is quite meagre. This scheme would not, in my opinion, be practicable by itself, but works in to the best advantage with a scheme like Yallourn.

The Commission's undertakings have grown to such an extent that the present form of organization is entirely inadequate to cope with the many and complicated problems which now present themselves, and I recommend quite radical re-organization and also augmentation of the present personnel.

As to retail distribution by the Commission, regarding which there has been considerable criticism as additional functions taken over by the Commission but not previously contemplated, my conclusion is that the State Electricity Commission, from an economical and efficiency standpoint, should conduct the retail distribution, but should furnish the local authorities with full and complete information.

I have previously approved the Commission making a trial of selling electrical appliances on a time-payment basis, and, in general, am in accord with the programme of the Commission, looking toward furnishing appliances and giving better service to customers.

I also recommend the formation of what may be called a Power Advisory Council, consisting of at least one representative each from the Electricity Commission, the Railways Commission, and the Tramways Board. It appears to me to be a mistake for any one of these three organizations to go ahead on power matters without at least getting the advice of the others interested. Such a council as proposed should work for mutual benefit of all contributing parties and the State at large.

The present deficit is mainly due to overbuilding and high cost of coal winning, and I consider it essential to hold new capital expenditure to a minimum until liquidation of present burdens is more apparent.

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*1. The Commission's works of power generation and distribution as they exist to-day, with particular regard as to their general layout, the quality and efficiency of the plant, equipment and accessories established, and of the methods of operation employed.*

The electrical portion of the Yallourn generating plant, together with the control and switchyard, calls for little comment, and can be passed, for the present, as, in general, a satisfactory lay-out. There has been some trouble with the steam turbines, but I see no reason for condemning either the Commission or the manufacturer in this connexion, although it is hard, at this time, to understand why units as small as 12,500 kw. should ever have been installed. The original plan called for larger units and, if the size of units was to have been changed, it would appear that it should not have been decreased below, approximately, 18,000 kw., since larger units would have cost less money per kilowatt, would have been more economical, and more in accordance with the trend of the industry, as exemplified by other large power stations built elsewhere at that time. If small sized units were to be used, it does not appear that it was necessary to install all five units, totalling 60,000 kw., two years ago, since even to-day the total load on the station is only approximately 30,000 kw.

The boiler plant was designed with the intention of burning brown coal with 48 per cent. moisture. If the moisture content had not exceeded 48 per cent., ten boilers in operation would have been able to supply steam for 50,000 kw. of electrical energy, with the remaining two boilers as spares.



Based upon earlier reports, the Commission was originally led to expect the brown coal in the new cut to have less than 50 per cent. moisture, the moisture in the old open cut mine being actually less than 50 per cent. It now appears that in connexion with the new open cut mine the Commission proceeded without sufficient information from the staff, although with the information given them the Commissioners themselves had a reasonable right to expect a much lower percentage of moisture from the new open cut than the 65 per cent. which actually obtains to-day.

In the latter part of 1921 estimates as to the briquetting plant were revised on the basis of utilizing 60 per cent. moisture coal, yet the Yallourn Power Station boiler plant was proceeded with on a basis of burning the lower moisture coal, and not the 60 per cent. to 65 per cent. moisture coal which at that time seemed probable. It is true that by 1924 pre-driers were installed on three boilers, with the expectation that these driers would pre-dry the coal to a satisfactory extent so that it could be economically burned in the chain grates.

For various reasons these pre-driers never worked out satisfactorily from a practical standpoint. While to-day, based on past experience, there might be some alterations made in these driers which would make them more effective, it is apparent, and has been for some time, that experiments and practical tests along other lines should have been proceeded with at Yallourn Power Station.

Since my arrival here I have approved the installation of a supplementary step grate, and also an air pre-heater on one boiler. The supplementary step grate is in no way new to the industry, and should have been installed and tested out in practice long ago, assuming even that chain grates were justified when first installed.

In brief, my answer to Question 1, in so far as the Yallourn boiler plant is concerned, is that "the general lay-out, the quality and efficiency of the plant, equipment and accessories established, and of the methods of operation employed" have not been and are not now satisfactory for burning coal of approximately 65 per cent. moisture, and, further, that sufficient initiative and diligence have not been shown to rectify earlier errors. The Commission's staff has been confronted with a most complicated problem in connexion with the satisfactory burning of this high moisture coal, but it has neglected to use, to the extent that I think it should be used, its own power plant as a laboratory to determine the proper solution. As indicated before, the plant was originally built larger than was necessary at that time, this being now possibly very much more evident than was apparent when the plant was originally designed. Once having been built, there was made available a number of boilers not actually needed for service which could have been used for re-equipment, and then tested in actual service.

This brings up another thought which I wish to express, and that is, speaking generally, it appears as if this power plant had been designed and operated by engineers who lacked sufficient previous experience in the design, construction, and operation of large power plants. Due to the existence of but very few large power plants in this country, the number of Australian engineers experienced in their design and operation is necessarily definitely limited, and my remarks should not therefore be interpreted as a criticism of the men themselves, but it does bring out clearly that this situation must be faced squarely in all future projects. The men employed in this particular part of the undertaking are capable men, except from the point that they have not had sufficient experience along these particular lines. Not having had the experience, several of them should have been sent abroad at an early date to get the wider experience necessary for the successful carrying out of a large developmental plan. The reason given me for not sending more men abroad is that the urgency of the local situation demanded that these engineers be employed here to push forward the undertaking. This is largely true, but undertakings of this nature always appear to need every available man on the job at the time, and I now recommend that the policy of sending engineers to other parts of Australia and abroad to study and obtain first-hand information be carried out to a greater extent than has heretofore been considered practicable. They will then be in a position to have better and more first-hand information, and thus do better and more efficient work upon their return.

From this time on I also recommend a close community of interest between the railways, the tramways, and the Electricity Commission, especially on this question of power, in which all three are vitally interested. The railways and the tramways also have right here in Melbourne as good power engineers as there are, presumably, in the Commonwealth of Australia. The railways, the tramways, and the Electricity Commission are all public servants, and advantage should be taken of this fact for the mutual benefit of all three undertakings and of the public served. It would seem to me a mistake not to take advantage in the future of such an opportunity as this.

I would, therefore, recommend the formation of what might be called a Power Advisory Council, consisting of representatives from the Electricity Commission, the railways, the tramways, and possibly other undertakings. This council should be kept well posted on all power plans

and undertakings involving any of their mutual interests. While the members of this council cannot, of course, give sufficient time to do more than express a definite opinion of all such matters, their advice cannot be other than helpful.

The main transmission line between Yallourn and Melbourne is well built of the best materials, and is apparently satisfactory, except from one stand-point. It seems to have been assumed that the lack of severe lightning conditions and the general climatic conditions were such that less insulation could be used than is prevalent, on the average, elsewhere for high voltages such as 132,000 volts at which this line operates. While it may be possible in the future to give good service with the present insulation, I have already recommended additional insulation, which has now been ordered. Everything reasonable should be done to prevent a recurrence of transmission line troubles which occurred recently during the latter part of February and early in March, and regarding which there had apparently been previous warnings.

The operating staff proposes that hereafter, during dry seasons and times when bush fires are prevalent, the present insulators be washed to clean them from dust, dirt, and grime, which is apparently the direct cause of considerable of the flashovers and transmission line outages, but even assuming the insulators are washed as proposed, I still recommend additional insulation, as the best service practicable is most essential.

While I do not agree with the design of all engineering details of Newport "B" Generating Station, there is little for me to comment on in connexion with this plant, and really nothing calling for any comments in a general report of this character. The station is well designed, and is giving good results. It has already proven particularly fortunate that the Commission had an electricity supply at two different locations, so that in case for any reason of failure at one source the other source would be available.

At the Yarraville Terminal Substation the type of equipment and its arrangement with the transformers and switchgear outdoors is in conformity with good practice. The initial expenditures appear to be large when considered in the light of the total loads carried on the station up to the present time.

The employment of 22,000 volts as the potential for transmission of power from Yarraville Terminal Station to the various distribution substations in and about the metropolis is sound in spite of the fact that there have been several breakdowns in the underground cables. Whether these breakdowns were due to improper manufacture, installation, or operation was not investigated by me sufficiently to justify comment at this time.

There is a trend on some large systems in Europe as well as in America to employ cable voltages of a higher value, notably 33,000 volts for similar duty. Should future developments in Melbourne require the use of higher cable transmission voltage, advantage can then be taken of the higher voltage by employing separate transformers on radially connected feeders to substations.

As the system capacity increases in the future the exclusive use of the so-called ring or loop system of 22,000 volt circuit connexions now employed by the Commission may lead to difficulties from a service point of view. As long as the number of circuits and substations is as small as at present no particular difficulties need be expected due to this system, but when the load grows to twice or three times its present size, the operation of these circuits looped in series through many substations will become not only complicated, but may also be attended by serious operating troubles.

At the present time both the equipment for substations and 22,000-volt cable for the circuits have been purchased, and considerable of the equipment delivered for installation during the latter part of 1926 and early part of 1927 to bring the total installed substation capacity in the metropolis to approximately 125,000 k.v.a., all connexions being based upon the loop system of operation.

As the Melbourne system grows in the future a judicious selection of radial connexions to new substations, and re-arrangement of some of the present loop connexions, so as to operate as radial connexions to existing substations, should give better results than to continue with the loop system. It is therefore recommended that, when the next increases in substations or transmission circuits are provided for, the loop or ring system be not further continued without careful thought being given to the subject of these connexions and the experiences of the present connexions thoroughly reviewed.

An inspection has been made of the completed substations known as substation "B" in Collingwood, substation "C" in Brunswick, substation "D" in Flemington, and substation "J" on the premises of the Melbourne City Council. The equipment used in these substations is generally well arranged in accordance with present practice elsewhere. Some of the switchgear will in later years—particularly in the indoor substations—be found to be subject to the difficulties dwelt upon in the preceding paragraphs as the result of the loop system of connexions, although this equipment is entirely adequate at the present time.

The absence of feeder voltage regulators on the 6,600-volt feeders used for supplying the reticulated area is noticeable. At the present time dependence is placed on the voltage control of the generators at Newport "B" Power Station and of the synchronous condensers at the Yarraville Terminal Station for voltage regulation. These methods of regulation serve the purpose under the present relatively small loads on the system, but within the next few years additional methods of regulation will be necessary to give proper voltage regulation to the consumers. This can probably be most economically accomplished by the use of automatic induction feeder regulators placed in the 6,600-volt circuits.

The two major wood pole lines, namely, the Thomastown-Sugarloaf-North-East 66,000-volt double pole "H" frame type of structure, and the single pole 44,000-volt circuit structure of the transmission line from Geelong to Warrnambool, both of which have been inspected, are in conformity with good practice for this style of structure. As a matter of fact, in view of the type of wood pole employed, namely, the ironbark pole, these structures are probably superior in strength and life to similar wood pole lines elsewhere located in regions of similar climatic characteristics. My remarks as to insulation on the 132,000-volt line apply also to the 66,000-volt line. Four units are not enough for 66,000-volt insulation if reliability of service is to be given the consideration it should be given.

The 66 kv., 44 kv., and 22 kv. substations which have been inspected are in conformity with good practice for this class of service. These substations are uniformly of the outdoor type, are simple and well arranged, and the equipment is of satisfactory type for this duty.

The Thomastown Terminal Substation will eventually be used to receive power developed by the Sugarloaf-Rubicon hydro-electric undertaking and transmitted to Thomastown at 66,000 volts, and to control the supply of this power through transformers where it will be reduced to 22,000 volts for distribution to the Melbourne substation.

A considerable part of this substation has already been completed this year to permit of the required supply to be made to the North-East District, Albury, and Corowa with energy produced at Melbourne and Yallourn until the hydro-electric plants are completed.

The equipment already purchased and installed includes 18,000 k.v.a. in transformers, and practically all of the switchgear and control panels to be used in the completed substation of 27,000 k.v.a. capacity, and a separate building has been completed for housing two synchronous condensers which have not been ordered. Until 1928, when the first hydro-electric power from Sugarloaf is expected to be available, this substation will be required to handle a load of approximately 1,000 kw. maximum. In spite of this, before the end of the present year approximately £60,000 will have been expended on this substation.

In view of these facts, it would appear that the expenditure for permanent works at this substation could to advantage have been deferred for nearly two years, and scheduled so as to be ready in 1928 at the same time as the hydro-electric plant would be completed, and that some temporary connexions could have been arranged which would have resulted in material saving in capital charges during the ensuing two years.

With regard to the two 7,500 k.v.a. synchronous condensers mentioned above, which are intended for use for voltage regulation of the transmission line at this substation, I would suggest consideration of regulating the line voltage by other means, such as the manipulation of the ratio adjusters in the transformers and by control of the generator voltage at Newport "B." Even assuming one condenser is required, it is doubtful if the reserve capacity of the second condenser could be justified economically. A failure of even the single condenser might not seriously embarrass the transmission line voltage regulation or the system capacity. I would not recommend the purchase of more than one condenser at the present time.

As previously mentioned, the total capacity of transformers provided for the metropolitan substations is nearly 125,000 k.v.a., not including the transformer capacity installed at Yarraville and Thomastown Terminal Substations, but including the transformers at Richmond Power Station and at Melbourne City Council Station. One index of the amount of the reserve in these initial installations is the staff's estimates of the total load to be carried at all power stations of 48,000 kw. in 1926, 70,000 kw. in 1927, and 78,000 kw. in 1928.

It is my belief that the amount of reserve provided both as to transformers and as to switchgear is unnecessary, and that a more thorough analytical study of the requirements would have resulted in deferring part of this investment until the need for the additional equipment was justified, thereby saving the capital charges on the equipment unnecessarily installed in advance of the requirements.

The electrical equipment purchased or planned in the last few years is, generally speaking, suitable for the purposes intended, but in some instances on too extravagant a scale considering the present load and the load to be anticipated in the near future.

The Essendon-Flemington district is suitably laid out for the load and character of territory served. The main substation (substation "D") of 3,000 k.v.a. capacity supplies a load at 6,600 volts, of 2,500 kw. at the present time, and at numerous load centres this voltage is reduced through satisfactorily housed transformer substations or vaults to 400/230-volt four-wire three phase for local reticulation.

The district circuits are operated by a staff at district headquarters, and this method of operation is giving satisfactory results. The station and circuit arrangements are capable of economical expansion for any reasonable load increases.

The construction and operating practice in the four provincial districts appear to be commendatory, with the exception that I consider that the 115-mile transmission line serving the south-western district should have been constructed for 66,000-volt transmission (using pin type insulators) instead of 44,000-volt. This line is at present operating at 22,000 volts, and at an early date this voltage should be raised to the designed voltage of 44,000 volts.

*2. The works and projects now in progress for extending the supply of the State's generating capacity and the scheme or schemes contemplated for so doing, more particularly with regard to the Sugarloaf Hydro-Electric Scheme and for the further extension of the transmission systems to Metropolitan and Provincial Centres.*

The original report in 1922 by the chief engineer, based largely upon the report of Messrs. J. M. and H. E. Coane, contemplated 25,800 horse-power of turbine capacity, located at Sugarloaf, Rubicon, Lower Rubicon, Royston, and Snob's Creek, at a cost of £551,370 for the hydro-electric development, and a cost of £241,800 for transmission line with steel towers to Melbourne and for substation at Melbourne, or a total of £793,170. The present scheme which is under way contemplates 35,050 horse-power of turbine capacity located at Sugarloaf, Rubicon, Lower Rubicon, Rubicon Falls, and Royston, but not including Snob's Creek. The total cost of the present scheme, including £20,000 for daily pondages on the Rubicon and Royston, is estimated at £619,910 for the hydro-electric development, and £244,800 for wood structure transmission line and substation at Melbourne, or a total of £864,710. It will be noted that none of the cost prices given above include transmission and distribution to the north-east district from Sugarloaf.

Taking all things into account, I recommend going ahead with the Sugarloaf-Rubicon hydro-electric scheme as now planned by the Commission. This recommendation refers to the scheme in general, and should not be considered as approval of all details as now planned, as sufficient investigation has not been made of such details to warrant either approval or disapproval. In the examination made, there were, however, no details noticed which appeared to be unsatisfactory for the purpose intended. I have taken into account the fact that, other things being approximately equal, there is a distinct advantage in proceeding with a hydro-electric undertaking in this general location not in any way relying upon the winning of coal or allied undertakings. In times of emergency this may be a distinct advantage.

Having approved the scheme as a whole, I wish to comment briefly regarding it. Data that would enable one to determine the amount of power which would be available from the undertaking are meagre, especially as to power obtainable in years of minimum flow from the mountain streams. The first gaugings of the mountain streams were in December, 1920, and gaugings even since that date are subject to interpolation, regarding which there is altogether too meagre data. I know of no good reason why more gauge readings have not been taken close to the proposed location of the offtake dams, so that more complete information might now be available.

May, June, and July are admittedly critical months in connexion with power available from the Sugarloaf-Rubicon scheme. The Sugarloaf project is, of course, primarily an irrigation project, and advantage was taken of this fact to obtain power from Sugarloaf for at least the eight months of the year when Sugarloaf would be normally discharging for irrigation purposes. If Sugarloaf is shut down at the end of April to allow the reservoir to fill up during May, June, and the other winter months, the month of May becomes the low month of the year in figuring the amount of primary power which is available the year round. If Sugarloaf continues to discharge water during the month of May, the month of June then becomes the key month. If it is assumed that power can be taken from Sugarloaf during both the months of May and June, this results in a very appreciable increase in primary power from the total scheme.

I have read some correspondence from the State Rivers and Water Supply Commission, and have had considerable correspondence and discussions with the chairman and the staff of the Electricity Commission and others interested. After giving thought to all angles of this situation, I do not see my way clear to now assume that power from Sugarloaf will be available in June at times of low flow in the mountain streams. I assume that Sugarloaf power may possibly be available in May. Taking the minimum flow for May, 1921, primary horse-power available would be 3,940 horse-power



from the Rubicon and Royston installations. Taking the month of June, the primary horse-power available from the Rubicon and Royston installations would be 6,310. The low flow in May, 1921, was in the early part of the month, but on the 29th May the flow corresponded to only 5,290 horse-power. It did, however, rain the next day, which brought the streams up. I am drawing attention to this 29th May reading, due to the fact that if rain had been delayed three days this low reading—corresponding to 5,290 horse-power—would have occurred in June.

Taking into account the fact that there have been no gaugings of mountain streams except since December, 1920, and that there have been no real drought years since then, also taking into account the way the gauge readings had to be interpolated and the probabilities as to what would be permissible as to power from Sugarloaf in May or June, I do not consider it safe to assume that there will be over 6,000 primary horse-power available at the turbine shafts from the Sugarloaf-Rubicon-Royston scheme. It is necessary to determine this primary horse-power in order to determine whether the scheme should go forward, as it is only by determination of primary horse-power that one may know just what can be depended upon from the hydro-electric scheme during the winter months when there is the highest electrical peak of the year on the general system.

Putting my conclusions in other words, the Sugarloaf-Rubicon scheme can be assumed to augment the steam stations during the winter months, when the peak load of the system occurs, by 6,000 horse-power of primary power, which is, within reason, reliable whenever needed. This 6,000 horse-power at the turbine shaft is equivalent to approximately 4,000 kw. of electrical energy at Melbourne.

The staff estimates that, in an average year, there will be 117,500,000 kilowatt-hours available from the Sugarloaf-Rubicon scheme. I do not agree with the assumption that, in an average year, it will be practicable to secure from the Sugarloaf scheme 117,500,000 kilowatt-hours for the use of the system, as I do not believe it possible to so regulate and adjust load between two large steam stations and four or five small hydro stations so that the hydro stations can at all times take advantage of all water flowing, without wastage, up to the capacity of the water turbines. I think that, in practice, the actual kilowatt-hours delivered in an average year to the system will fall far short of 117,500,000.

The original 1922 hydro scheme included no daily pondages, and the Commission has acted wisely in approving the expenditure of £20,000 for daily pondages, which are figured so as to allow the turbines to use the total daily flow of water during a portion of the day only, with water being stored in the pondage during the remaining portion of the day. Although the pondage scheme is helpful, it will not be helpful, in my opinion, to the extent figured on by the staff.

At my request, I was furnished with a diagram showing how, with water conditions existing as on 29th May, 1921, the staff would propose to operate the mountain stream stations as a part of the general system. With two steam stations—one producing, say, 50,000 kw., and the other, say, 15,000 kw. or 30,000 kw.—it will be found to be impracticable to vary the output of four different mountain stream stations, so that power from the mountain streams can be utilized as figured on, as the full power of the water cannot be utilized, in varying amounts through the day, just when and as wanted.

In connexion with the Sugarloaf-Rubicon scheme, I have had considerable correspondence and discussions with the chairman, and with the staff, as to the price at which power should be charged to the north-east district. In the estimate given me for the north-east district, 2,300 kw., estimated to be used by the north-east district, was charged at £4 per kilowatt, or a total of £9,200. This 2,300 kw. was assumed to be used at approximately 35 per cent. load factor, with 7,200,000 kilowatt-hours per year. I took exception to such a low price as £9,200 for 2,300 kw. of primary power, estimated to take 7,200,000 kilowatt-hours. The view was taken, however, that the Commission would be justified in asking the north-east district to purchase this power for an appreciably less price than £9,200.

With these viewpoints I disagree. I believe that each district should be charged a fair price for power, regardless as to whether such price makes a profit or a loss showing, and I do not regard a price as low as £9,200 as a fair price.

The staff assumes that 117,500,000 kilowatt-hours are worth, in connexion with steam stations, 0.125d. per kilowatt-hour. If this amount of power were to be utilized by the system, this would only be possible due to the fact that there is already an investment of several millions of pounds in steam station power supply equipment. The fact that the system now has these existing steam stations makes the Sugarloaf-Rubicon scheme possible, and I cannot, therefore, approve of charges to the north-east which do not take into account the immense sum now invested in steam stations.

The Sugarloaf-Rubicon scheme is a 4,000 kw. output scheme, which, by reason of pondages and secondary kilowatt-hours, which can be utilized in connexion with existing steam stations, is worth far more than would be assumed were it not to be used as a part of the existing system primarily fed by steam stations. It is in no proper sense a 25,000-kw. scheme.

All of the above facts were, of course, taken into account by me in my recommendation that the scheme be proceeded with, and I have elaborated upon the details of the scheme and the methods of operation proposed, because I feel it my duty to bring out these facts. My criticism, briefly, is that this scheme has been proceeded with without the thorough analysis which I consider essential to such an undertaking. The estimates and forecasts of such undertakings, involving an expenditure of close to £1,000,000, in this instance, should also be searchingly reviewed by an executive, preferably with business and engineering training in the utility field.

Sub-stations "G," "R," "H," "K," "M," and "O," have been planned by the Commission for the purpose of taking over the bulk supply of the load carried in the area distributed by the Melbourne Electric Supply Company from its power station in Richmond, which is now supplemented by power purchased from the Newport "A" Generating Station, and converted through frequency changers in the Richmond Power Station from 25 cycles to 50 cycles, single phase. Simultaneously with the construction of these new sub-stations, the system of connexions in nearly the entire area is being changed from single-phase to three-phase operation.

While the equipment has been purchased for five new sub-stations, which are scheduled for completion during the present year and the early part of 1927, the only sub-station in substantial process of construction is sub-station "G," in South Melbourne. An inspection of this sub-station on 29th April showed that the building for the switch gear was completed, and the foundations were ready for the transformers for outdoor location. The 6,600-volt and 22,000-volt switch gear was on the ground, and is of the latest type. The Commission's staff is to be commended for the general conditions of personal safety which will exist when the installation is completed, which should be within the next 60 days. The sub-station has a capacity of 18,000 kw.

The designs of the remaining sub-stations, namely, sub-stations "R," "K," "M," and "O," are in too preliminary a state at this writing to permit of comments to be made as to the installations; but the number, location, and capacity would appear sufficient to handle the growth in this area for several years to come.

The staff's estimate indicates a total capital cost for the extension of a 22,000-volt single-circuit transmission line 49 miles in length, from Shepparton to Echuca, including the reticulation in Echuca, Mooroopna, Tatura, Kyabram, and Tongala, and a portion of the sub-station at Shepparton chargeable to the Echuca extension, of £96,390. It is assumed that this will increase to £105,000 by the year 1929.

On the basis of that expenditure, my estimate indicates that, with all charges included, this extension will about break even in 1929, and it should be proceeded with.

The staff's estimates for the extension from Sunshine to Sunbury indicate a total capital expenditure of £13,520 for this project, a total annual cost of £2,872, and a total revenue of £3,057. The financial success of this undertaking appears to be assured.

The staff's total estimated cost for the 42-mile 22,000-volt transmission line extension from Maffra to Bairnsdale, including reticulation at Stratford and Bairnsdale, is £50,650.

In 1929, it is assumed that this amount will be increased to £60,000. On that basis, my estimates indicate that the district will about break even in 1929, and, therefore, this extension also should be proceeded with.

### *3. The works and projects which the Commission has under consideration for the future extension in its various systems, with particular reference to the increase of generating capacity both in basic-load and in peak-load stations operated or to be operated by the Commission.*

I visited Yallourn early in March, and while there was given certain information regarding coal-winning, both at the new cut and at the old cut. About that time, it was suggested to me that I postpone my studies with relation to coal-winning until after a report was submitted by Mr. Klitzing, the general manager of the Marga Brown Coal Workings in Germany. My understanding at that time was that there was no question whatever as to the advisability of continuing winning power-station coal from the new cut, and that the only question was how this could most economically be done. I, therefore, confined my time primarily to the study of other questions involved in my report, and, as a result of the study of the problems involved in Question 3 I wrote that portion of my report as appears below under "A".

I later found that my previous understandings as to the situation, both as to new-cut and as to old-cut coal, were incorrect, and after Mr. Klitzing made his report I came to the conclusion that it was essential to concentrate on winning coal from the old open cut, and have so recommended. With old open-cut coal containing only approximately 48 per cent. moisture available, the procedure which I had previously recommended under "A" might be naturally assumed to be somewhat changed, and under the sub-head "B", on page 37, I discuss the situation, assuming

old-cut coal available. I have purposely left in my report the discussion given under "A", as previously written, due to the fact that the change in my conclusions is but slight, and as it is problematical to-day as to just what will be done in the future in connexion with coal-winning, I felt it might be helpful if, instead of changing my report in any way to meet changed conditions, I left it as written so that the whole subject might be covered more thoroughly.

"A".—Data have been submitted to me showing the electrical load anticipated for an extended future period. These data show that, in the winter of 1929, with an output from Yallourn Station of 54,000 kw. and from Newport "B" of 16,000 kw., together with 11,500 kw. from Sugarloaf Group (not including Snob's Creek Section) this available supply of 81,500 kw. will be slightly under the demand of 86,000 kw. estimated for that year. We have spent considerable time on checking the above demand, both as to kilowatts and as to kilowatt-hours, and as a result of this check I estimate a somewhat higher demand than the data submitted indicated, and believe it is essential to provide for some additional supply in 1929 over the supply of 81,500 kw. referred to above, and also that appreciable additional facilities should be provided not later than the winter of 1930. Melbourne's electrical load is growing rapidly, and will continue to grow.

In support of the above recommendation, it should be appreciated that by 1930 the Railways Newport "A" Station, while, presumably, not needed entirely by the Railways, cannot be depended upon for any considerable amount of industrial or other commercial power supply in Melbourne. Furthermore, the present Melbourne City Council Station is admittedly antiquated, and is now used only to carry peak loads and for emergency purposes. The Richmond Power Station of the Melbourne Electric Supply Company is also fit to be used only for emergencies and stand-by purposes. It is rightfully planned to shut this station down within the next year.

The indications are, therefore, that Melbourne will soon be, in effect, almost entirely dependent for industrial and commercial power and lighting supply upon the Electricity Commission, and it is most essential that the Commission take steps at an early date to provide additional facilities, looking toward giving sufficient service in 1929 and thereafter.

The first step to be taken toward this goal is to bring the present Yallourn boiler plant up to its originally-designed capacity, so that when using new-cut coal sufficient steam can be furnished when needed for the full capacity of the turbines now installed. In this connexion, the Commission has, with my approval, already ordered a supplementary step grate and an air preheater for trial on one boiler, though I, personally, did not pass any opinion on the make of step grate or of preheater. There is no question but that supplementary step grates and air preheaters will increase present boiler capacity very appreciably when burning 65 per cent. moisture coal. There is a question as to whether this is the most desirable and economical way to obtain this increased capacity, and also the design for grates and preheaters to best meet the local conditions is open to question.

Bearing in mind, not only the present plant, but possible future extensions, I see no reason why one of the two remaining boilers which have not been equipped with grates should not be equipped immediately with the latest design of mechanical step grate. It is obvious that, sooner or later, these boilers will need to be equipped with some form of furnace equipment, and at this juncture it would appear that a step grate would serve the double purpose of bringing this boiler to its designed steaming capacity and also add to the Commission's knowledge of its major boiler-house problem, namely, that of burning 65 per cent. moisture coal.

I am informed that the Commission is prepared to furnish a sufficient quantity of old-cut brown coal of approximately 48 per cent. moisture, if necessary, for steaming purposes. With this old-cut coal there is no question of the present boilers carrying the desired load until at least such time as trials of equipment referred to above are completed and the boilers are equipped to burn new-cut coal. The tests should therefore go forward as fast as practicable, and new equipment should be installed, based on the results of these tests. In the meantime, it will probably be advisable to use a considerable quantity of old-cut coal.

There have been submitted to me approximate estimates, made as a result of a preliminary study as to where and how additional extensions of plant should be built to take care of the 1930 load. These estimates are made on different many bases, but the two estimates which deserve, in my opinion, the most attention are—(1) the estimate calling for a new extension of the Yallourn plant by 62,500 kw. of additional capacity, this extension to be capable of burning new-cut coal with moisture up to 65 per cent., using air preheaters and based on the Commission's present knowledge of power generation from such fuel; and (2) the estimate based on a new extension of Newport "B" plant of 56,250 kw. capacity, assuming preheaters and 15 per cent. moisture coal which has been pre-dried at Yallourn from 65 per cent. moisture.

These approximate estimates show little difference in the economics of the two plants on an annual basis, taking into account all fixed charges and operating costs to deliver 43,200 kw. to Melbourne. It is the thought of the staff that the most desirable means by which to provide

for the augmentation of its Power Station capacity to meet the demand likely to arise in 1930 and onwards, is to proceed forthwith with an extension of the Yallourn Power House, based upon the burning of the raw 65 per cent. moisture fuel direct to the boiler furnaces, and to prepare specifications and plans so that tenders can be invited not later than September of this year for that portion of the proposed plant which it will be necessary to have installed in 1930. This portion is stated to be one more 12,500 kw. turbine unit and one 25,000 kw. turbine unit.

In this connexion, it is the intention to proceed with a new boiler-house building extension to house all boilers, with necessary reserve needed to supply steam for two 25,000 kw. turbines and one additional 12,500 kw. turbine. Only half of these boilers are to be installed initially, but the initial installation is to include coal and ash facilities and coal bunkers for the full number of boilers needed for 63,500 kw. The turbine room is to be extended for only one 25,000 kw. turbine, but extended anticipating a further extension for the second turbine.

Under these circumstances, the studies of the design for the complete plant should, of necessity, be made before tenders are invited for even the first installation. Before a decision is arrived at as to future plant embodying radical extensions, there must be a most careful study made, and the Commission's staff, as at present constituted, has neither the time nor information at hand to make the necessary studies and do the necessary work to arrive at a conclusion regarding this new plant between now and 1st September. I feel, therefore, that it is most essential that a decision as to extensive undertakings of this nature should be postponed until a careful, thorough study of all factors can be made, and I would definitely recommend that, although a study along these broad lines be commenced at once, a decision as to the method of provision for supply for 1929 and 1930 should be first arrived at, as indicated above, and then this should be followed up by the more extensive plant, looking toward taking care of necessary demands from 1930 upwards.

Although the economic results of the approximate estimates work out about the same for the Newport "B" extension burning 15 per cent. moisture brown coal and the Yallourn extension burning 65 per cent. moisture brown coal, the Commission's staff is apparently of the opinion that the drying of coal from 65 per cent. moisture to 15 per cent. moisture is somewhat speculative, and it was mainly upon this basis, apparently, that it felt it should proceed with the extension to Yallourn and not to Newport "B". Admittedly, it is entirely possible to dry coal from 65 per cent. to 15 per cent. moisture, but the question of the exact economics of doing this, under different conditions is, to a certain extent, speculative. To meet such a situation the best test is one of practical application. Apparatus to dry coal from 65 per cent. moisture to 15 per cent. moisture, for a major extension, would consist of a considerable number of units. I would suggest the purchase and installation of at least one such unit at as early a date as practicable, so that definite and authoritative information can be obtained as to the economics of drying coal under conditions such as would obtain in actual practice. It could thus be determined whether such speculation could not, within reason, be overcome if intelligent effort were directed to that end.

I would also suggest that steps be taken at once to install additional boiler capacity at Newport "B" preferably of the present design. At present the boiler capacity at Newport "B" is only enough to supply steam to one of the two 15,000 kw. turbines installed. Additional boiler capacity, so that both turbines could be operated at the same time, is the cheapest method whereby 15,000 kw. of additional power can be obtained for the system.

The Richmond Power Station, which is shortly to be shut down, should be kept for the present for emergency use, making such slight expenditures as are necessary in order that it may fulfil this function. I have also suggested to the Commission a study, looking toward a different procedure than was contemplated by it, so that Richmond Station might best be prepared to generate three-phase energy. It does not appear probable that Richmond Station should be radically altered, or that any considerable sum of money should be expended on it.

By means of the additional 15,000 kw. capacity so provided at Newport "B", and the utilization of the Richmond Power Station for emergency purposes, a larger load than that predicted by the staff in 1930 could be satisfactorily carried. Under these conditions, it is therefore not necessary to come to a final decision at this time as to further major extensions, either at Yallourn or Newport "B", although, as previously stated, a complete and exhaustive study along these lines should be immediately started by men competent and with full time to devote to this intricate and complicated question.

In passing, let it be understood that I would not expect the Richmond Power Station to be available for emergency purposes were it not again put in operation. A station closed and cold for months cannot be relied upon, even for emergencies, but if by 1929 or 1930 it is seen that the Richmond Power Station is likely to be needed, it can be put into operation and used to such limited extent as seems best, so that, if needed, it can be called upon and nearly its full capacity of 10,000 kw. utilized.



At this time I also want to discuss very frankly one other of the real major problems to be met. As previously stated, the preliminary estimates of the staff show the economics of an extension at Newport "B" and at Yallourn to be about the same for power delivered to Melbourne. If, after careful study has been made, the economics show that an extension at Newport "B" is approximately as sound as an extension at Yallourn, I would favour an extension at Newport "B", burning normally, as previously indicated, brown coal with approximately 15 per cent. moisture.

At first thought this may be considered as criticism of the fact that the present Yallourn Station was built at the coal-fields. It is definitely no criticism of that nature. I agree that this first station should have been built at the coal supply. With the station located at the coal supply, the Commission was in a position to burn the coal in its raw state, or in whatever form later proved desirable; but, if now, with the advance in the status of the art, a final study shows that it is approximately as economical and sound to burn brown coal at Newport "B" as at Yallourn, it is at Newport "B" that the large extension should be planned. At Newport "B" there would also be no question as to the sufficiency of water supply for condensing purposes for practically any capacity station.

In my opinion there are several reasons why this conclusion is sound. To depend upon transmission lines for 50,000 kw. for Melbourne is one thing, but to depend upon transmission lines for practically its total supply in future years is far different. I see no disadvantage in having a portion of the supply—such as 50,000 kw.—coming from a separate station located in a separate district, since, in case of trouble at the Melbourne station, the "eggs are not all in one basket"; but, other things being even approximately equal, it is certainly most desirable from a "service" stand-point that the generating station be located as close to the centre of the bulk of the supply as it is practicable to locate it.

It would not be fair to say that there will always be transmission line troubles, but several times there have already occurred transmission line troubles which were not contemplated, and which were considered most improbable by the Commission's engineers. The result of these transmission line troubles was the cutting off of the supply of current at Melbourne. A separate transmission line was proposed, by a second and different route, as distinctly more of an insurance against disruption of supply than the one present transmission line; but it is entirely conceivable that trouble or accident may occur at the Yallourn Station, or in connexion with coal winning, that will entirely cut off all supply of electrical energy or all supply of coal from Yallourn. With a station in Melbourne, which would normally burn dried brown coal, it could—in case of cessation of supply of brown coal—burn New South Wales coal or Wonthaggi coal.

I am unable to pass, at the present time, definitely on this question of location of plant, because sufficient studies have not yet been made, but I have purposely gone out of my way to give my views with regard to the location of future supply at the source of demand, because I feel that the future extensive additions to plant should be at Melbourne, even at a slightly increased normal cost of energy generated.

I agree that if the more extensive plant is at Yallourn, the indications now are that the coal should be burned unscreened, unpulverized, and undried. In other words, normal run-of-mine, as it comes, but if it works out economically sound to dry coal from 65 per cent. or 48 per cent. moisture to 15 per cent. moisture and ship to Newport "B", most careful thought should be given to a further step, namely, that of pulverizing and burning this 15 per cent. moisture coal at Newport "B".

As to the burning of pulverized coal under these local conditions, I am not passing upon this for the same reason as referred to above, because such decisions should not be arrived at except as the result of careful, analytical studies, taking into account local conditions, and admittedly I have insufficient time to arrive at a final decision with regard to such a question as this. A study of pulverized coal should not be omitted on the ground that it is the "universal practice" in Germany "to burn the fuel in its raw state," as it was only a few years ago that black coal was universally burned unpulverized in its raw state, but to-day many of the new plants burn pulverized black coal, and all engineers should at least study the economics of pulverizing before arriving at decisions as to the economics as to how the fuel should be burned.

There is another reason also why any conclusions as to using pulverized coal should be held in abeyance. Mr. Merz, in an early report, pointed out the advantages of operating the present Newport "B" as a peak-load station, and, as a matter of fact, it is to-day being largely so operated. The present preliminary estimates of future extensions assumed, in effect, that present Yallourn Station brought up to capacity would be operated at close to 50 per cent. load factor, with a maximum demand of 50,000 kw., and that the new plant, located either at Yallourn or at Melbourne, would be operated at 50 per cent. load factor. The present Yallourn Station is definitely to be brought up to capacity, and it then represents a certain investment. There is also the main transmission line and the Yarraville investment already made. These investments

should all be considered as being utilized to the fullest extent practicable, and then estimates made as to where additional capacity can best be secured. In other words, it should be assumed that the present Yallourn Station is to be operated just as close to 100 per cent. load factor as is practicable, and then comparisons made as to whether the new plant should be an extension of Yallourn or an extension of Newport "B", considering the extension in either place as a peak-load station.

Yallourn is now being normally operated on approximately a 60 per cent. load factor, and Newport "B" on approximately a 30 per cent. load factor basis, and this is as it should be. The important point being stressed herein is that conclusions drawn from estimates should take into account actual operating conditions. It should be borne in mind that, even if Newport "B" extension is normally operated as peak-load station only, this does not preclude it being used at a high-load factor during emergencies, and the fact should never be lost sight of that Newport "B", while normally built to burn dried Yallourn brown coal, should also be able to burn black coal or other brown coal.

I have said nothing about burning black coal normally at Newport "B" on future extensions as my figures definitely indicate that, at least with the trend of comparative future cost of brown coal and black coal, brown coal should be burned.

It might be proper at this time to draw attention to the fact that there should at all time be a community of interests between the Railways Commission and the Electricity Commissions with regard to the generation and interchange of power. The railways are now carrying certain power loads. This should apparently be continued until the Electricity Commission is fully in a position to carry this load continuously more economically than the railways can carry it. It is most important that present facilities for interchange be kept, within reason, intact for future interchange.

The question has arisen in my own mind of recommending than an outside consulting engineer, qualified in the practice and economics of power-station design, be called in to undertake this study and carry out the conclusions arrived at. However, after careful thought, it has seemed to me not wise to lay down such definite procedure, but, on the other hand, it should be plainly understood that I do not believe that any operating staff, with the multiplicity of problems which the Commission's engineering staff now has, should, by itself, without outside technical assistance, come to decisions on such weighty and far-reaching problems. It is no criticism of the Commission's staff when I say that it is, from my view-point, absolutely impracticable to proceed along such lines. The undertaking is too big, and has too many complications already, without expecting the normal staff to prosecute such additional studies and work efficiently.

To sum up, my general conclusions are—

1. Do not install another turbine of *less* than approximately 25,000 kw. capacity.
2. Use old cut coal to whatever extent advisable until studies and tests can be completed and Yallourn boiler plant brought up to 60,000 kw. capacity, using 65 per cent. moisture coal.
3. Proceed at once with installation of boilers at Newport "B," so that both turbines can be operated to full capacity.
4. Hold Richmond Power Station in reserve, as planned, but do not expect to operate it in an "emergency" unless it is kept under fire, carrying some load.
5. Proceed at once with practical tests at Yallourn to determine the economics of drying coal from 65 per cent. moisture to 15 per cent. moisture.
6. Proceed with studies of new plant, and, if indications are that new plant will not be in operation by the date needed, install an additional 25,000 kw. turbine at Newport "B" in space now available in the present turbine room.
7. Unless the economics are distinctly against it, locate the new plant capacity at Melbourne.
8. Include in the study of the plant at Melbourne a study based on this plant being normally operated as a peak-load station.
9. Include in the study of a new plant at Melbourne a study of burning pulverized coal.
10. Outside competent engineers should preferably be employed in connexion with the study and construction of a new plant, and one or more men of the Commission's staff should be sent abroad at once to study the latest designs of large power plants.

"B."—Using old cut coal exclusively, except that required for test boilers, simplifies the boiler-room problem at Yallourn. Ten of these boilers, burning 48 per cent. moisture coal, should produce enough steam to operate 50,000 kw. capacity of turbines. It may not, therefore, be necessary to rush the new equipment of all boilers so that they can satisfactorily burn the new cut coal.

Under "A" I contemplated that old cut coal would be available to whatever extent was necessary. I am now assuming that it is not only available, but will be used on all boilers, except those needing to use new cut coal for test purposes. If old cut coal were to be used for a considerable period in the future, I would not necessarily advise equipping all the twelve boilers with step grates or air preheaters at once, even assuming that it is determined from the tests that this is the most economical way to burn new cut coal, as all this extra capacity will not then be necessary. I would not, however, even if old cut coal were to be continued in use, want to stop with simply the equipment of one or two boilers with proper equipment to burn new cut coal.

There is, therefore, little difference between the conclusions which I arrived at under "A" and the conclusions which I have now reached. Yallourn station's effective boiler capacity should be materially and appreciably increased at the earliest possible date in connexion with burning of new cut coal, even if new cut coal is not to be used in the near future. If old cut coal were to be used for new major extensions, either at Yallourn or Newport "B," it would not modify to any considerable extent my previous conclusions, but it would now appear to be improbable that old cut coal will be used for any major extensions.

All of the studies, analyses, and tests recommended under "A" should in any case be carried out.

Under date of 7th May there was submitted to me—"Estimated loan requirements, year ending 30th September, 1927." I recommend that the expenditure of £139,750, referred to therein as the amount to be spent during this period toward "duplication of existing 132,000 volt line with works for supply at Richmond," be not preceded with, unless and until definite decision as to major power-house extension is arrived at, as referred to above.

4. *The Commission's sources of revenue from electric supply and the prospects of the growth of such revenue as to the Commission's operating expenses and overhead charges and the influence thereon of future growth of production, more especially as to the reasonableness of the Commission's tariffs and charges and as to whether the Electricity Supply undertakings are economically sound or will become so without any burden on consumers or the State.*

I have been given estimates of revenue expected from electric operations for the years 1926 to 1930 inclusive, and of operating expenses and overhead charges as estimated for the calendar year 1927. These estimates show for 1927 a net surplus from all electrical undertakings after payment of all operating expenses, interest charges, and depreciation.

I have made an extended investigation as to future revenues and operating expenses. My investigation has not been as complete as would be desirable, but far more time has been put on this subject than would be expected in such a brief survey as I am attempting to make of the whole of the undertakings. I found, shortly after I started my investigation, that I would probably differ radically with the estimates made by the Commission's staff, and therefore felt it necessary to spend far more time than I had previously allotted to this subject. The question of future revenues and operating expenses is most important and crucial.

My estimates show slightly less revenue for future years than the staff's estimate, but I should not be surprised if, with proper initiative and service, the staff's expectations as to revenue were realized. It is in connexion with operating expenses in which I differ radically. I have no hesitancy in saying that I do not believe it possible for the combined electrical undertakings to show a net surplus for the calendar year 1927, after all proper charges—including depreciation—have been made. I do not believe it probable that there will be a net surplus for the calendar year 1928. I do believe it to be possible and probable that there will be a net surplus on the present electrical undertakings in the calendar year 1929.

The only limitation which I care to make in connexion with the above statement as to my forecasts is that rates are not to be reduced in the meantime to an extent which will appreciably affect the surplus.

The estimates made by the staff as to coal winning costs in 1927 were based on winning approximately 5,000 tons of new cut coal per day for approximately 300 days in the year. I consider it impracticable to win this tonnage with the present equipment, even at a higher price per ton than estimated by the staff.

The staff's estimate for Yallourn Power Station for 1927 shows a total cost per kilowatt hour—including interest and depreciation—of approximately 0.4d. I consider these figures as slightly optimistic.

I also differ with the staff's estimates as to the district undertakings. The estimate given me for the north-east district, for the calendar year 1928, shows a net surplus of £29,100. In this case, I estimate the revenue to be slightly less than that estimated by the staff, but, again, it is entirely possible that the staff's anticipations may be realized. The main difference again lies in the question of operating costs, in which the most flagrant difference is in the cost of power

charged to the north-east district. The staff estimates that the north-east district will take, in 1928, 2,300 kilowatts of demand, and 7,200,000 kilowatt-hours of energy. The total cost of this energy is given at £9,200. The form in which this was first given me was to show the total cost of power as 2,300 kw. at £4 per kw., or £9,200, with no extra charge per kilowatt-hour. After I had drawn attention to this matter, I was told that the Commission would be justified in charging the north-east district with an appreciably less amount for 2,300 kw., and 7,200,000 kw. hrs. than the £9,200 per annum referred to above.

I have discussed this matter quite at length in my answer to question 2, but, taking into account all factors, it is my belief that the charge to the north-east district for 2,300 kw. and 7,200,000 kw. hrs. should be approximately twice £9,200 per annum.

For the south-western district, the estimates given me show a surplus of £3,500 for the calendar year 1927, after paying all proper charges, including cost of operation, interest, and depreciation. With this estimate I also differ. I estimate there will be a definite net loss in the calendar year 1927. This loss will gradually decrease, and the district is likely to be profitable, after showing all proper charges, by 1929.

The staff's estimate as to Gippsland shows this district as making a profit in 1926 of approximately £10,000, after including all proper charges. I do not believe that this profit will be realized, although within the next few years this district will unquestionably become profitable.

Until the estimates above referred to were made in November, 1925, no estimates of future operating expenses had ever been forecast for either the Chairman or the Commission.

I have recommended to the Commission that, in the future, estimates as to revenue and operating expense for the ensuing year should be made by all departments. The making of such estimates by the staff should bring about a critical study of the conditions to be met during the ensuing year, and this, in itself, is most helpful in meeting the problems when they do obtain. If the practice of making estimates for the ensuing year is put in force, the actual results should, from time to time, be checked against the estimates, so that, by experience, the staff may learn to better analyse future problems.

As to the reasonableness of the Commission's tariffs and charges, it is, of course, appreciated that the Commission is now selling electricity below cost. I find the tariffs now in force to be either slightly less, or the same, as the tariffs in force before the Commission started distribution. I consider the tariffs reasonable, taking all things into account. I believe a two-part rate tariff should ultimately prevail throughout the State of Victoria, as opposed to a flat rate tariff. A two-part tariff is by far the more equitable and just, as the consumer pays more nearly in proportion to the cost of the electricity for the amount of energy which he uses.

The above statements comparing the two-part tariff and flat rate charge are general statements, based on the assumption that a two-part tariff would produce the same total revenue from the community as the flat rate tariff. As a matter of fact, the Commission's two-part tariff was designed so that practically no customer paid more than he previously did on the flat rate tariff, and many customers paid less. The Commission's two-part tariff is a distinct advantage to the consumer over their alternative flat rate tariff. The Commission should keep the number of different tariffs to a minimum in the State, and should make no tariffs or rates except those open to the public and published.

To sum up my answer to question 4, heretofore referred to as a most important and crucial question, my conclusions are that—

1. Tariffs and charges are, taking all things into account, reasonable ; and
2. There should result from these tariffs and charges a very appreciable future growth in the use of electricity.
3. The Electricity Supply Undertakings are not yet proven economically sound, but are, in my opinion, fundamentally sound, and will be proven so without any undue burden on the consumers or the State.

In answering this question 4, I have given my opinions very frankly and bluntly, and have, in effect, criticized the Commission's staff, but nothing which I have said should be interpreted in contradiction to my definite statement that the Electric Supply Undertakings are fundamentally, economically sound, and will prove themselves so ultimately.

5. *As to the agreement for the ultimate acquisition by the Commission of the Melbourne Electric Supply Company's undertaking and as to the effect of such agreement upon the future revenue of the Commission, including the technical procedure now in process of execution for the supply of energy to and the conversion to three-phase distribution of the Company's Melbourne undertaking.*

I have reviewed the circumstances attending the conclusion of the agreement for the acquisition of the undertakings of the Melbourne Electric Supply Company, at Melbourne and Geelong, and the details of the financial arrangements arrived at and ratified by Act of Parliament.



I have particularly studied the *Melbourne Electric Supply Company Limited Act 1924*, and the agreement made the eighteenth day of June, One thousand nine hundred and twenty-four, before the Hon. Sir Arthur Robinson, K.C.M.G., His Majesty's Attorney-General of the State of Victoria, and, at that time, the responsible Minister of the Crown administering the State Electricity Commission Acts for and on behalf of His Majesty's Victorian State Government of the one part and the Melbourne Electric Supply Company Limited of the other part.

It is my conclusion that the agreement is of very considerable value and benefit by reason of the following main considerations :—

- (a) Ultimate acquisition of valuable assets on very moderate terms.
- (b) Strict limitation of future profits to the shareholders of the company.
- (c) Acceleration of the work of conversion to three-phase.

This agreement also gives an assured market for State generated electricity, and, in general, is of a character highly advantageous to the Government.

The financial benefits which will accrue to the Commission's finances within the next five years should be of material assistance in paying to the present owners of the company in 1930, the agreed upon sum, which amounts to, less debenture liabilities estimated as at that date, close to £1,500,000.

The technical procedure now in the course of execution for the further supply of energy by the Commission to the Melbourne Electric Supply Company is comprehensive, and, in general, embodies good standard practice. I have questioned some engineering details, and have asked the engineering staff to give further thought to other details, especially as to the advisability of the continuance, to the extent originally proposed, of what is commonly known as the "ring" system of substation connexions. These are, however, details not warranting repetition here.

There is, to-day, temporary complication in connexion with changing over from single-phase to three-phase energy, and such complication will continue, and will, to a certain extent, be a handicap and hardship to some customers, but there is a distinct advantage to all to be gained by the three-phase distribution, and the Commission and the company have acted wisely in taking steps to eliminate the single-phase distribution, and to standardize the three-phase distribution.

There is a certain portion of the district in which the change from single-phase to three-phase has been postponed till the more remote future, but this is in residential areas where there is practically no industrial power used, and the single-phase distribution is, under the circumstances, advisable for the present.

The Commission is, of course, rightfully looking forward to standardization, not only of frequency and phases, but also of voltages, throughout the State, both in its own and in other undertakings.

#### 6. *The Commission's proposals for popularizing the use of electricity and for the sale of electricity-consuming equipment.*

The best proposal "for popularizing electricity" is one based, to the greatest extent practicable, on satisfying the customer.

In discussing the question of service to the customer, there is the thought in the minds of all the Commission's staff that such service is being rendered to-day, and it is undoubtedly the desire of the Commission's staff to render such service; but there is room for improvement. Even with those undertakings where the question of service and of satisfying the customer has been given primary attention over a considerable period of years, there is always a chance for improvement, and the mutual advantage resulting from most intensive studies as to how best serve the customer is most strongly urged. The sale of electricity being a monopoly, there is not the natural tendency to give thought to satisfying the customers which would result with merchandising competition such as is prevalent in other industries; but the need for such effort is even more apparent. A State undertaking has even greater responsibilities along this line than would a private corporation, for such an undertaking should be distinctly the servant of the public served, and there should be a more strenuous, a more efficient, and a more personal effort put forth on the part of all concerned toward satisfying the customer.

An analysis of statistics definitely shows that neither the Commonwealth of Australia, nor the State of Victoria, nor Melbourne, is utilizing electrical energy on a *per capita* basis to the extent that is to their unquestionable advantage to utilize it. This comparatively low rate of consumption *per capita* is due, among other things, to two causes—one being the fact that the public does not fully appreciate the advantages to be gained by it in the further utilization of electrical energy; and the other to the fact that not enough attention has been paid by the seller of electrical energy to make it easy for the customer to take advantage of the benefits accruing from the more extended use of electricity.



Consideration of any large electric power scheme would be incomplete unless there is constantly borne in mind the far-reaching effect of power on the well-being and prosperity of the people. As exemplified in varying degree in all the industrial countries, the benefits can be nation-wide, extending far beyond the districts actually served with power. In this connexion, I would call your attention to the very detailed analysis of economic conditions in Australia, which was included in the presidential address of G. A. Julius, Esq., delivered before the Institution of Engineers, Australia, at Hobart, in February, 1926.

There is a distinct objection to propaganda, using the word in its narrow sense, towards popularizing the use of electricity; but it is the duty of the Commission to see that, not only through personal contact, but by extensive publicity, full, definite, and complete information is given to the public, so that it may appreciate the advantages of a more extensive use of electricity. I believe in publicity of the facts, and this includes a belief in advertising in newspapers, as well as by pamphlets and otherwise.

If it be true that the home is brighter, healthier, and better with more extended utilization of electricity, it is the duty of the Commission to give publicity to this fact in such a way that it will be understood and appreciated by the customers. If it be a fact that electrical motorization of an industrial factory will result in more efficient economical production, it again becomes the duty of the Commission to give publicity in all practical ways to this fact.

That the two assumptions referred to above are recognized throughout the world as facts is apparent, as will be noted from the world-wide publicity movement towards what is frequently called "the education of the public."

It may not be out of place to again refer to the question of "cheap electricity." Quite often, the thought is expressed that the public would utilize electrical energy more if it were only cheaper. There is a fraction of truth in this thought; but, always, service is more important than price. The customer must pay the cost of the service, and will, within reason, cheerfully do so if and when the service rendered is satisfactory.

As to the proposals for the sale of electricity-consuming equipment, the Commission and the staff—and particularly the sales department—apparently appreciate the necessity of a more active, far-reaching, constructive policy in connexion with "popularizing the use of electricity and for the sale of electricity-consuming equipment," but also have apparently felt that the carrying out of such a policy might be looked upon with disfavour by the electrical trade, and by critical persons, as amounting to an interference with private industry.

There seems to be a feeling on the part of the Commission's staff that others in the electrical industry are not giving the Commission's staff the co-operation which they should toward making it easy for the customer to use electrical appliances. Such a situation is generally, and apparently is in this particular case, entirely due, not to one party, but partially to all parties interested in the situation. There must be full co-operation throughout the electrical industry, as such co-operation is advantageous to all, including the public served, and upon the Commission's staff primarily devolves the responsibility of assisting to bring about this co-operation so that all may benefit thereby.

The Commission has been given responsibility by the States, and has in other directions fully accepted this responsibility, even to the extent of taking over in the face of criticism, in some places, the retail distribution. Having accepted such a responsibility as this, the Commission cannot stop, but must, within reason, do everything practicable to satisfy the customers to whom it is furnishing electricity. If its customers desire electrical-consuming equipment, it is the duty of the Commission to either furnish this electrical apparatus itself on terms satisfactory to the customer, or make certain that the customer can purchase such electrical devices on a satisfactory basis. The position as it is to-day is unsatisfactory to the customer and to the Commission; and, as a first step toward a broader, more constructive policy, approval has already been given by me to the establishment of a hire-purchase plan of the Commission furnishing customers with electrical devices in a few trial locations.

The Commission will not, and should not be content, however, with this first step, but must continue its endeavours to the end that electrical devices, on a basis satisfactory to the customer, are on sale, not only at the Commission's offices or show-rooms, but are for sale on a satisfactory basis by practically all in the electrical trade, as well as by other merchants. In other words, the Commission should act as a "clearance house," as it were, to see that its customers are satisfied; but the Commission should not seek to make money by the sale of electrical appliances, except as profit made by these sales is used for the general benefit of its customers.

Although I have in the earlier part of the answer to this question said, in effect, that the Commission should put forth more effort towards satisfying its customers, I have in connexion with the plans for the sale of electrical appliances particularly cautioned it to go slowly. This was not because I did not agree with its plans, but because this is a new undertaking and requires careful thought as to what it is best to do, and even after all plans have been worked out on paper actual experience is necessary.

I have recommended, and the Commission agrees, that this plan shall be put into effect, first in only one, or at the most, in only two localities with the thought that as experience is gained and the demand grows there will be a gradual expansion. The details of the plan have been already worked out by the Commission, and have received my careful attention, and, generally speaking, I endorse the plan.

We all agree with the underlying principle of satisfying our customers, but how this can best be accomplished can be answered only by wide experience. I want to see the Commission do far more than it has done, but its staff is as yet untrained to do those things which I think should be done in the way I think they should be done. From years of experience I have come to the conclusion that the sales or commercial department—or as I prefer to call it, the “service department”—is too often underrated as a secondary department. This department is of prime importance to the success of any undertaking. It should be separate and distinct from the engineering department, though, of course, co-ordinated with it. It should be operated on a far-reaching, human, business basis, always keeping in mind, that nothing so much begets confidence as an appreciative customer; and, further, that such appreciation can best be brought about by courtesy and the elimination of even little annoyances. Too much time cannot be spent upon detailed explanations, though the main thought should always be to remove the annoyance which needs the explanation rather than to explain why the annoyance is necessary.

The thoughts expressed above are not in the line of criticism of the Commission or of any Australian undertaking, but are given with the thought that experience shows that there is always opportunity even in the best managed undertakings to give better and more helpful service to our customers—the public served.

I recommend that the sales or service department be enlarged, and that at an early date one or more of its staff be sent abroad to particularly study service and sales methods.

There is another thought which is, I believe, particularly pertinent to Victoria, and that is that in the provincial districts where there are already transmission lines special effort should be made to give the farmer the benefits accruing from the use of electricity. It is specially essential that there be co-operation between the Commission, the Department of Agriculture, the agricultural colleges, and the manufacturers of electrically-driven farm apparatus, all working together to make electricity available to the farmer and to instruct him as to how best utilize it. There is to-day, here as elsewhere, too decided a drift from the farm and the towns to the larger cities. Give the farmer and the small towns electricity, with its accompanying labour-saving devices for the farm and for the home, and a real step has been taken towards decentralization.

I also appreciate that the Commission is to-day handicapped in the sale of electricity due to the high costs of electrical appliances, motors, and other electrical apparatus. The real handicap is, however, to the housekeeper and the manufacturer who must pay these high prices or go without the advantages accruing from the utilization of electrical energy. The consumption of electricity *per capita* for the State of Victoria as given me by the Commission is so unduly low that I have not shown the actual figure, but to whatever extent it is low, compared to other countries, Victoria is handicapped in many of her manufacturing activities and in the making of a brighter, healthier, better home life.

#### *7. The economic value as a low-grade fuel of brown-coal deposits at Yallourn under present and prospective methods of coal-winning, with special reference to possible alternative fuels.*

The economic value of Yallourn brown coal as a fuel for power station use should be based on the price at which electrical energy from such a source can be distributed in bulk to the metropolis or elsewhere as compared with the price for similar distribution from black coal, likewise on the price at which briquettes can be sold so as to return a reasonable profit on the investment as compared with other types of fuel.

Based on the above assumptions the present Yallourn development has not as yet proven the economic value of brown coal, this being due primarily to the high cost of winning a high moisture content coal, but there is no question in my mind but that the economic value of brown coal will ultimately be definitely proven.

In considering the economic value of the Yallourn brown coal deposits consideration has to be given to both the “old open cut” with approximately 48 per cent. moisture, and the “new open cut” with approximately 65 per cent. moisture. The former admittedly has a very restricted life as against the almost unlimited quantities of coal in the latter. Bearing in mind the comparative calorific values and the amount of work still to be done at the power station before 65 per cent. moisture coal can satisfactorily be utilized, it is my opinion that at present, and probably for some years to come, the old open cut coal is of greater economic value than the new open cut coal in so far as a supply of fuel to the power station is concerned.

The Commission originally proceeded with the present Yallourn developments with the expectation based on the forecast results that all coal which it proposed to develop had a moisture content of approximately 48 per cent. With the advent of 65 per cent. moisture coal not only were the forecasts of costs completely upset, but the Commission was confronted with many complex engineering problems in the way of coal winning and coal burning, which even at this date have yet to be commercially solved in so far as they effect Yallourn.

While the subject of the economic value of brown coal might be discussed at much greater length, I have purposely refrained from attempting to lay down a definite detailed programme and state under just what conditions the economic value would be proven. For any programme to be successful those responsible for the carrying out of the programme should be in thorough accord with it, and there should be the closest of co-operation.

Although the economic value has not yet been proven I have no hesitancy in stating that I believe the Commission will make this proof within a comparatively few years.

#### *8. The Commission's coal-winning methods, present and prospective, and its proposals and schemes for further developing the open-cut workings at Yallourn and for cheapening the cost of production there.*

The present coal-winning methods are both too inadequate and too costly. There can be no disagreement as to those facts, and it would seem unnecessary for me to take steps to prove it, as the Commission itself well recognizes this, and did recognize it long before I was engaged to make a report on this undertaking. The situation has now become even more acute, and prompt action, looking towards a remedy, is necessary.

During the last six or eight months, the cost of winning new-cut coal has averaged in excess of 4s. per ton. The Commission has also been unable to win enough coal from the new cut to take care of the requirements of both the power station and the briquette plant. The result has been that the briquette plant has not been kept up to full capacity, and the cost of briquettes has been thereby increased, and it has also been necessary to go over to the old cut to produce enough coal to keep the power house going.

The cost of winning old-cut coal by hand labour, as at present obtains, is approximately 10s. per ton. Production at the present time is approximately 15,000 tons of old-cut coal and 60,000 tons of new-cut coal per month.

When I visited Yallourn, shortly after my arrival, in company with the chairman, I did not then appreciate the acuteness of the coal-winning situation or of the coal-burning situation, although I had a distinct feeling at that time that, pending a thorough study of the whole situation with regard to winning new-cut coal, hand labour at the old cut should be replaced, in so far as practicable, by existing machinery to the end that the cost of winning old-cut coal might be materially reduced and that old-cut coal might be used temporarily at least as a basic supply for the power station. I suggested at that time that one of the smaller shovels should be immediately sent from the new cut over to the old cut, but a further study and analysis by me was at that time postponed, upon the suggestion of the chairman, until after completion of investigation and report by Mr. Klitzing, who was expected to arrive very shortly.

It appears that, realizing that changes in coal-winning procedure were essential, the Commission in 1925 sent Mr. J. M. Bridge, its engineer for coal supply, to make an investigation of the method of operation of brown coal undertakings in Europe and elsewhere. Mr. Bridge has recently returned, and is now engaged in preparing recommendations and reports.

Some time before my arrival, the Commission had secured the services of Mr. J. Klitzing director of the Ilse Bergbau A.G., which is one of the largest and most important groups of brown coal undertakings in the world. Mr. Klitzing has been here some eight weeks, and before his departure made a report to the Commission, under date 21st April, on its coal-winning operations. I have, by the courtesy of the Commission, had an opportunity to read this report, and also, just before he sailed, I met Mr. Klitzing and had several brief conferences with him. While he says very little in his report about present operations, he recommends radical changes. His proposals are based upon his experiences in Germany, and impressed me as recommendations of an expert thoroughly familiar, from practical experience, in brown coal-winning operations. He recommends an expenditure of £489,000, this including the purchase of German coal-winning dredges such as he has found from experience most suitable for this work. If his recommendations are followed out he estimates the cost of winning new-cut coal will be reduced to approximately 1s. 1d. per ton for mine wages, capital charges on new mining investment, maintenance and repair of mine, and portion of overburden charges. He does not include in this cost of approximately 1s. 1d. any charges on capital already invested or any administration, stores, or drainage charges.



After he had finished the report, of 21st April above referred to, he also made a report on "Proposals for early reduction in operating costs (1) of the old mine, and (2) of the new open cut, taking into consideration the existing transport conditions." This report was afterwards translated and given to me on 5th May. In this report Mr. Klitzing states that he thinks the reorganization of the "old mine" will be a good investment for the future, and then proposes radical changes in connexion with the present winning of the old-cut coal. His plan contemplates temporarily operating the new cut in one shift, solely for briquette-plant coal, producing approximately 1,600 tons per day, and obtaining from the old cut all the coal needed for power-house purposes, and at the old cut utilizing machines and plant which are not now required in the new open cut, and also utilizing new machinery which can be later used in the new cut when recommendations given in his 21st April report as to the new cut are put into effect.

Mr. Klitzing estimates that by utilizing four electric locomotives, fifteen coal trucks, and erecting a bunker structure—all of which will be utilized later in the main plant—also by utilizing two of the present shovels, together with present steam locomotives and overburden trucks and certain re-arrangement of transport, that coal from the old mine would cost 3.06s. per ton on a basis of production of 1,000 tons of coal per day, and 2.39s. per ton on the basis of production of 2,000 tons per day (i.e., in two shifts). The above figures of 3.06s. and 2.39s. per ton do not include cost of administration, management, township, railways, roads, bridges, land, and drainage, but are simply the direct coal-winning costs including, however, interest and amortization on a total capital cost of both old and new investments.

Mr. Klitzing further states that Mr. Bridge estimates that 1,500 tons per day from the new cut, for use of the briquette factory, will cost a total of 3s. 4d. per ton of coal delivered to the briquette factory.

Under date 1st May, I wrote to the chairman stating that it was my thought that, for the present, practically the entire thoughts and activities of the Coal Supply Branch should be concentrated on the most economical method of getting out power-house coal from the old cut at the lowest practicable cost, without any appreciable new capital expenditure, and further stated that it appeared to me probable that it would be best to use the old-cut coal for a very considerable period, but that the important point which I had in mind was to concentrate immediately on getting into full power-house production from the old cut at the lowest cost with a minimum capital expenditure.

The situation to-day is admittedly critical. Sufficient new-cut coal cannot be obtained, and, further, the power house requires at least some old-cut coal in order to carry its load. I am of the opinion that this problem should be approached in three stages. The first stage is to do everything practicable with machinery and facilities now at hand, so as to begin immediate production of enough old-cut coal for power-house requirements at the minimum price practicable, without waiting for any new apparatus to be purchased and installed and without any large expenditure of new capital. Every ounce of energy available should be concentrated on this first stage problem. The result will unquestionably be an appreciable reduction of present costs.

The second stage of attacking this problem is to further reduce cost of production from the old cut by a moderate expenditure of new money. I do not, however, concur with the thought that an emergency exists which justifies the purchase in Germany, without calling for general tenders elsewhere, of electric locomotives, trucks, or electrical converting apparatus.

I am of the opinion that if this problem of producing old cut coal at a minimum price is properly attacked, it will be several years before it will be necessary to incur the large expenditure necessary to further economically develop the new cut—which is the third stage. In this assumption I may be wrong, but I would not, at this time, go ahead with an expenditure estimated at £489,000. Postponing decision on this for at least a few months is certainly not vital. It is far more vital that advantage be taken of Mr. Bridge's studies and of Mr. Klitzing's visit here, and of the general awakened interest, to concentrate on the situation actually confronting the Coal Supply Branch to-day. Mr. Klitzing's report is most constructive. His visit here was most helpful, but full approval to-day of Mr. Klitzing's plans can have no bearing on coal winning for at least the next year. I know of no valid reason why advantage should not be taken of utilizing all the old cut coal, with its lower percentage moisture, which it is practicable to do. I am not impressed with the necessity of saving this coal for some future time when it may be used in connexion with gasification. Three tons of old cut coal of 48 per cent. moisture are worth slightly more than 5 tons of new cut coal with 65 per cent. moisture, based on net calorific value, but there is a further saving in boiler capacity by burning 48 per cent. moisture coal.

I have discussed this question quite at length in order that you might know my general views, which, in brief, are—

1. Postpone for the present any consideration of expenditure of any such large amount as £489,000.

2. Plan to take, at the earliest date practicable, all coal for power-house purposes from the old cut, and to this end immediately transfer from the new cut to the old cut shovel, locomotive, trucks, and tracks for over-burden removal.
3. Re-arrange transport and reduce the price of winning old cut coal by the maximum amount practicable without waiting for new machinery or spending any appreciable new money.
4. Further decrease the cost of winning old cut coal by a moderate expenditure of money.
5. Decide then what the next step should be.

There are some 18,000,000 tons of coal available at the old cut. At the present time, by burning old cut coal exclusively, the power station would consume approximately 350,000 tons of coal per annum. This will, of course, materially increase each year, and is estimated at approximately 700,000 tons per annum in 1928.

My recommendation as to the temporary postponement of expenditure approaching £489,000 is definite.

In the final analysis there is no other alternative than to transfer coal-winning activities for full power-house requirements over to the old cut. Mr. Klitzing states, on page 19 of his 21st April report, "It would not be right, in my opinion, to omit modernizing, and thus improving the working of the old brown coal mine in connexion with the new project, since, first of all, according to the present state of coal-winning operations in the new mine, the old mine will have to supply coal for the power station for at least two years from now." Mr. Klitzing and I are in thorough accord that the old mine will have to supply coal for the power station for at least two years from now. It is my present assumption that the old mine—or the "old cut," as I have previously referred to it—should be used to supply coal for the power station for probably the next four years, or at least for the next three years.

I prefer to have my thoughts, other than with regard to the postponement of the large investment, treated as suggestions rather than as definite recommendations. I was not engaged as an expert in the winning of brown coal, and have applied myself to this problem more from a business stand-point. If this undertaking were now well organized and on a paying basis, I would undoubtedly have taken a different view of several questions than the views which I have expressed in this report. I am signing my name to a statement that the Commission's present undertaking is fundamentally, economically sound, and I cannot, therefore, see my way clear to be a party to further large expenditures until there is a decided improvement in connexion with return on past expenditures. I would not make such a statement as this if I were not convinced that necessary improvement was possible and practicable.

For the fiscal year ending 30th June, 1926, the loss from electrical undertakings is estimated to be approximately £200,000, without any allowance for depreciation. The total cost of brown coal used by the Yallourn Power Station for this period is estimated as approximately £150,000.

It should be appreciated that I have written the above answer to question 8 without having seen the report which Mr. Bridge is preparing, and also before the full Commission have taken any formal action with regard to Mr. Klitzing's recommendations.

*9. The Commission's briquette undertaking at Yallourn and the disposition of the output therefrom, having regard to the cost of production, present and prospective, as well as the output having to compete commercially with other available fuels, both domestic and industrial.*

Briquette manufacture showed, for the year ending 30th June, 1925, a loss of £36,257 (exclusive of depreciation), and for the year ending 30th June, 1926, a comparative figure will probably show a loss slightly in excess of this amount. This loss is due largely to the fact that raw brown coal has cost more delivered to the briquette plant than was estimated. It takes approximately 4 tons of raw brown coal, with 65 per cent. moisture, to make 1 ton of briquettes, with 15 per cent. moisture.

There has been expended to date on the briquette plant approximately £554,000. It was understood at the time this plant was installed that this was a "half unit," and that later, if briquette manufacture proved satisfactory, the plant would be doubled in size. The present plant, with a rated capacity of 108,000 tons per year, produced during the last eight months, at the rate of 81,000 tons of briquettes per year. It is now proposed, at an estimated additional expenditure of £715,000, to enlarge the present plant, so that the total yearly output will be 358,500 tons of briquettes per year.

I recommend that enlargement of the briquette plant as proposed be postponed for the present, and until there is more practical evidence at hand as to the reduction in the cost of winning coal. The commission point out, to me particularly, that one of the fundamental features of decreasing

the cost of winning coal is to increase production. This is true. On the other hand, I believe that no serious harm will accrue by postponement. It would take three years before the new plant would come into operation, and during that time, if the cost of winning coal is reduced, as is now anticipated, the present briquetting plant should be on a paying basis. The cost of producing briquettes for the next three years, until the new plant is in operation, will not be influenced by the decision as to whether or not the new plant should be proceeded with.

I have held extended discussions with the Commission and the staff as to the advisability of proceeding with, or postponing the expenditure, of this large amount of money to build the extension.

As my recommendation for postponement is not based upon non-agreement with technical details of the proposed plant, it seems unnecessary to enter here into discussion as to these technical details. My decision is largely based upon the fact that this expenditure can be postponed.

My recommendation as to postponement gave no consideration to the desirability or necessity of "the creation of an enlarged source of fuel supply, for all purposes, to further safeguard the State of Victoria from losses to industry through industrial troubles which have, in the past, seriously affected the supply of imported black coal." As to this safeguard, the Commissioners themselves are better able to judge than I am, and, on this basis alone, would be justified in going ahead with the extension as proposed, if they find that the conditions warrant. I do not consider that "the meeting of the public demand for this form of domestic fuel" is such as to warrant my giving serious weight to this point, although there is no question but that, at an appreciably lower price than to-day's prices, there would be an appreciable increase in the demand for briquettes, and the increase in demand would largely be influenced by any decrease in price.

I regret that I could not agree with the Commission as to the desirability of my approving of this expenditure at this time, but if this were a private enterprise on which I were passing, my recommendation would definitely be to postpone.

I agree that the probabilities are that the time will come when the conditions have so changed that I, myself, would approve of going ahead with the plans along the general lines outlined. When that time does come, I believe that another study should be made to determine the advisability of making a portion only of the proposed installation at one time, and installing the remainder of the plant at a somewhat later date, when the market for briquettes has been built up to the supply existing at that time.

#### 10. *The internal organization of the Commission, more particularly in relation to the control of its operations and staff at Melbourne, at Yallourn, and at other Provincial Centres.*

The form of organization under which the Commission and its staff are now operating is practically the same as it was in the beginning. Meanwhile, the undertaking has grown in size and complications. There has been an increase in the magnitude of all previous undertakings, and new undertakings and new functions have been taken on. The Commission has outgrown its form of organization, and it is imperative that there be quite a radical reorganization.

At present, the Chairman is serving as Chairman, performing, in so far as his time allows, the proper duties of a Chairman of such a Commission as this. As Chief Executive, he is also performing all the functions of what might be called a general manager, and, in addition, is performing functions and co-ordinating branches of different departments to an extent which is not practicable in a business organization to be done even by a general manager. There are at least three separate departments at Yallourn, all reporting on their detailed activities to the Chairman. The division of authority at Yallourn is such that no one man or no one department can be held responsible to any one except the Chairman. I concur with the resolution of the Commissioners looking toward the early appointment of a superintendent in charge of all activities at Yallourn.

I care little for titles, but many of the titles in the organization are most misleading, and lead to complications and confusion. The title "Chief Engineer" ordinarily conveys to all a distinct meaning, but here the title of "Chief Engineer" is most misleading. The man in charge of power sales reports to the "Chief Engineer." The District Superintendents in charge of operation report to the Secretary for administration, and are under the Power Sales Engineer for technical and service supply questions, and, under the present form of organization, must also, in effect, come under the Chief Engineer. Over the Engineering work in connexion with the briquette plant or coal winning, the Chief Engineer has no voice. The Civil Engineer reports to the Electric Supply Branch, and the Engineer-in-Charge of Coal Supply has no jurisdiction over the Civil Engineer, except through the Chairman.

The Secretary's duties concern all departments to a greater or less extent, and he is necessarily more or less of a free lance, but there appears to be too much division of authority.

No set form of organization should be prescribed as the best form for all undertakings of this character, as local conditions and personnel available must both be taken into account. There should be, however, an executive in full charge, a man who is experienced as a business executive, who should co-ordinate all departments and all activities, and pass on all major questions, after a business man's searching analysis. This man should preferably be a man with an engineering training, and with public utility experience. A man with the experience such as I have in mind should need no recommendations from me as to the detailed form of organization best suited to reasonably co-ordinate all activities in the most efficient manner. He would also change the titles and the form of organization from time to time to fit in with available personnel and changed conditions. There are, however, certain underlying principles which should be kept in mind. The Engineering Department should, within reason, be what the name indicates, and the Chief Engineer should have charge of the engineering and construction work of all activities. He should have under him the Electrical Engineer, the Civil Engineer, the Mechanical Engineer, and the Construction Engineer. He would normally report to the executive in charge.

The second broad division would be what might be called the Operating Department, whose duty it would be to furnish power, either in the form of electrical energy or briquettes. The Superintendent-in-Charge of these operations would control coal winning operations, briquette plant, electric power-houses—both steam and hydraulic—and all transmission and sub-station operation.

The third broad division would be the Commercial Department. The manager of this department would control the operation of all district offices, be responsible for the sales of all electrical energy, electrical appliances, and briquettes and coal sales.

I shall not attempt to define the duties of the Secretary, as I am not familiar enough with the normal functions of such an officer in organizations of this kind. I should assume that, in addition to his duties as Secretary, the Auditor and the Accountant should report to him. I would not normally expect a Fuel Sales Manager to report to the Secretary.

I have not given a full accounting as to the Legal Department, Publicity Department, Purchasing Department, or Welfare Department, but have simply attempted to outline certain broad demarcations.

The executive officer in charge of all departments and all activities would presumably have directly under him a first assistant, who would, however, have no definite jurisdiction over various departments, except as speaking for the executive in charge.

I hold no brief for any particular form of organization, but I do recommend radical re-organization on a business basis, looking toward co-ordination, co-operation, and thorough efficiency.

I have discussed this matter quite fully with the full Commission, and it is my understanding that they are in accord with my general recommendations. The Chairman especially has, for some time, felt that it was imperative that he be relieved from a mass of detailed executive work which now falls upon his shoulders. He has been carrying a load which no man should be called upon to carry. He has been serving his State unremittingly at too great a personal sacrifice. No man can continue to carry the load which Sir John Monash has been carrying as a sense of duty. His time and energies can be better devoted to guiding the policy of the Commission, and in inspiration and leadership. It is not fair to longer call upon him to exercise detailed management of operation.

Although the Commissioners and I seem to be in general accord as to what should be done, and as to the necessity of early action along these lines, I would urge as speedy action as is practicable. The present condition cannot long continue, except with detrimental results to the Commission's undertakings. The problems are too many, too big, and too complicated to be satisfactorily handled under the present form of organization.

I am in full accord with the resolution passed by the Commissioners, and the commitment entered into on behalf of the Government with regard to an additional Commissioner, and the appointment of a Deputy Chairman, and I am signing this report with the understanding that the assurances given me will be carried out.

#### 11. *The system of distribution of electric power throughout the Metropolitan area and country districts as between the Commission and other Authorities?*

The above subject really calls upon me to investigate and to pass on the question as to whether the Commission should continue to expand its "retail" distribution, or whether it should withdraw from that field. There is no question but that the early reports referred only to the Commission doing a "bulk supply" business, and there is, of course, no question but that the Commission is now doing a very considerable amount of retail business, and that the present tendency is for the Commission to take on more retail distribution.





The advent of the Commission into the retail distribution is rather of a natural corollary to its earlier activities, but is not necessarily such. I do not believe that there is anything fundamental whereby the distribution of electricity can be better performed by an authority different from that which generates it. In fact, other things being equal, the tendency would be toward better efficiency, if the generating and distribution undertaking were the same, and I disagree with those critics who take the ground that, under no consideration, should the same undertaking which generates electricity also distribute and retail it. In general, those who criticize the Commission entering the retail distribution field are not those directly affected as customers of the Commission. The retail business already taken over by the Commission was taken over upon the request of municipalities. The retail service being rendered by the Commission is good. There has been a considerable number of private individuals—customers of the Commission—who have appeared before me of their own free will, to point out to me the good service being rendered to them by the Commission. I have had but one complaint from a retail customer, and, after investigation, I question whether this was a just complaint.

In making the above statement, I am not overlooking the fact that a number have been to see me to point out the shortcomings and errors of the policy of the Commission doing a retail distribution business, but I am differentiating between complaints and criticisms of this nature, and complaints and criticisms as to the actual service being rendered by the Commission, which would have been obviated if some body other than the Commission had charge of the retail distribution.

Let us give thought to the Melbourne district situation by itself, not taking into account the provincial or country districts. The Commission is now furnishing retail supply to the residents of Essendon and Flemington, and is furnishing bulk supply to the Melbourne City Council, the Melbourne Electric Supply Company, and other municipalities not in the Melbourne City Council, or the Melbourne Electric Supply Company's territory. The Commission has contracts whereby it will ultimately purchase the Melbourne Electric Supply Company, and, at the present time, it has jurisdiction over the activities of the Melbourne Electric Supply Company. In other words, the Melbourne Electric Supply Company is to-day acting, in effect, as the agent of the Commission in all the retail business which it does.

There is no question, in my mind, that the whole electrical distribution of the metropolis can be most efficiently, economically, and beneficially operated by a centralized authority, able to employ a properly paid and competent staff of experts in all branches of the work. This authority should know no arbitrary lines on the map separating municipalities. The customer on one side of the street should receive the same service at the same rates, from the same wires, as does the customer on the other side of the street, even if the map does show an arbitrary municipal division line. Not only should the high tension lines and substations be laid out so as to most efficiently serve the metropolis as a whole, but if there is to be economical efficiency, low tension distribution lines must be laid out in the same manner, otherwise the definite tendency is towards uneconomic electrical distribution.

Certain of the responsible critics whom I have interviewed have pointed out to me the shortcomings of a policy which would allow the Commission to have the complete charge of all electrical undertakings of the State of Victoria. The Electricity Commission is a State body; it has statutory powers as to orders, service, and rates in connexion with all electrical undertakings, whether distribution be made by the Commission or otherwise. It is particularly pointed out to me that with the Commission handling all retail distribution the customer with a grievance must take his complaint to the Electricity Commission, which is in turn both operator responsible for the complaint—if it be a just one—and also the regulatory body of the State, regulating its own acts as it were. In other words, the point is made that the Commission is supreme, with broad monopolistic powers, and there will undoubtedly be a human tendency not to view a complaint from the same judicial atmosphere as would be the case if the regulatory Commission and the operator were not one and the same. There is also the natural human tendency and desire for local control, or at least a local voice in the handling of local problems.

My conclusion is that the State Electricity Commission, from an economical and an efficiency stand-point, should have charge ultimately of the retail distribution in the whole of the metropolitan district. I believe, however, that if a monopoly of this kind is to endure, the municipalities and public served are entitled to, and should have, full and complete information as to the local undertaking. I have no aversion to large undertakings or even monopolies providing they are properly regulated, and one of the best methods I know of regulating such undertakings is through full publicity. There should be at all times available—through proper channels—complete technical and financial information as to the metropolitan undertaking, without the necessity of municipalities or the public appealing to members of Parliament to secure the information. Such publicity could be

transmitted to the municipalities and the public through a local board representing the municipalities, this local board being kept fully advised by the Commission, or this information could be given out by the Commission so fully and in such a broad and public way that no local board would be necessary. The municipalities and the public served are, however, entitled to full and complete information as to the local undertaking.

I should not consider it satisfactory if the information were confined to such limited information as has previously been made available through the annual report of the State Electricity Commission. So far as the provincial districts are concerned the district superintendents could well make quarterly reports to the shire secretaries, giving such local information as to the number of residence customers, the number of power customers, the kilowatt demand, and units used by the different classes of customers together with revenue received. The district superintendent could also furnish to all the shire secretaries in his district a yearly report, giving not only the above information, but also a fairly complete income statement and balance-sheet for the district.

Speaking generally, criticism of the State Electricity Commission undertaking should be most effectively minimized by more complete publicity of all its undertakings. The press particularly should be given official statements as to, not only the doings of the Commission and the resources thereof, but as to the results of its undertakings.

It might be proper at this place to draw attention to the fact that, although I gave public notices by advertisement of my desire to interview any person or persons who could afford me information on the subject of my Commission, very few callers availed themselves of the opportunity thus offered by me. It was my natural expectation that a number of dissatisfied customers and critics of the Commission would appear before me, because there are, of course, in every undertaking dissatisfied customers and critics. One customer came to me complaining how a certain rate schedule worked temporarily detrimental to him, this being in connexion with a change-over between single-phase and three-phase supply. One came to discuss with me the availability of other brown coal than Morwell or Yallourn. Another came on a similar mission, except that the deposit of brown coal he referred to was in a still different district. There were, however, a number of private customers—including several ladies—who came to me apparently of their own free will and desire to tell me that the service rendered to them by the Commission was good service, and much better than before the Commission had undertaken the retail distribution. An official from a smaller municipality, a considerable distance from Melbourne, came here to tell me how much better the service was to-day than before the Commission undertook the retail distribution. I find in the Commission's files many letters from municipalities where it is handling the retail distribution which are most commendatory. The information given me in my investigation leads me to believe that the Commission is giving as good or better service to the customer than would be given by others. I believe that on the whole the Commission is to-day giving better service where it is handling retail distribution than the customers would have received if the Commission had not taken over the retail distribution. This may not be true in every locality, but is, I believe, true in general, and in by far the major portion of the cases.

This question has also been discussed with me, at my request, by a number of representative citizens, not only of Melbourne, but of other parts of the State, who were and are definitely opposed to the Commission taking over retail distribution. All, however, seem agreed that each separate municipality should not have its own separate force to handle its own local retail undertaking, but the retail undertaking should be for a local district—in most cases a comparatively small district. Before the Commission came into being, the general practice was towards a large number of separate municipal undertakings, both as to generation and distribution, with a considerable number of the smaller municipalities without any electricity. I believe that if the plans some of these gentlemen have in mind had been worked out along the particular lines which they recommend, such plans would have operated very satisfactorily, but there is first of all the question whether plans as broad as theirs would have been agreed to and carried out by the separate municipalities grouping themselves together, and, moreover, I am confronted with the fact that many of these municipalities have now grouped themselves under the Commission for retail distribution.

I have not only interviewed responsible critics on this subject, but have read many newspaper clippings and analysed reports of the Select Committee and of other Committees, and have even read *Hansard* in this connexion. It was best and necessary that I did this. In the financial analysis I am confronted with the actual situation as it exists to-day, and not as it might have been if the Commission had never been empowered to embark upon retail distribution.

It is, however, my best judgment that the taking over of retail distribution by the State Electricity Commission was a progressive step, and to the best interests of all concerned.

12. *The reasonableness of the overhead charges and operating costs in the various phases of the Commission's undertakings.*

I am somewhat at a loss to understand just what is meant by "the reasonableness of the overhead charges," but I assume that the overhead charges referred to include particularly the emoluments of the Commissioners, the annual charges due to the head-quarters building in William-street, Melbourne, and also insurance, publicity, audit, and legal departments. I have not examined in detail all these special accounts, but I find no reason to question the reasonableness of these and similar charges. The fact is that I believe that certain of the overhead expenses are entirely too low for the efficient conduct of the electric and fuel supply operation.

In Question 10, I have referred to the necessity for certain re-organization of the staff. This re-organization should add a number of comparatively high-priced men and will increase the present overhead charges. The net result should, however, be a decrease in operating expense, due to more efficient operation.

It is needless for me to point out again that past operating expenses in connexion with some of the activities have been higher than would now appear to have been necessary if the problems had been analysed more thoroughly.

May I take this opportunity to draw your attention to what I have referred to above as the "emoluments of the Commissioners"? It must certainly be appreciated that the money paid these Commissioners is not compensatory to them for the duties performed or the time given by them. They are therefore serving their State from a sense of duty and a desire to do their share. This leads me to another thought which has impressed itself on me many times. Men of such high calibre and standing and unquestionable integrity as Sir John Monash, Sir Thomas Lyle, Sir Robert Gibson, and the Hon. George Swinburne cannot afford to give of their services to the State unless they are given intelligent and adequate support by the community. The State is indeed fortunate that it has been able to call to such an important undertaking as this men of such true worth; but the day will come when men of this type will have to refuse to perform such services if they are to be subjected to unjustifiable criticism and no fair consideration is to be given for the service performed by them at a sacrifice and to their personal and business loss.

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In conclusion, I want to pay my respects to and thank the many who have so kindly assisted me in obtaining the necessary information, so that this report might be possible. It is with pleasure that I record the fact that not once has it been necessary for me to exercise my authority as a Royal Commission in order that I might obtain needed information, or to ascertain the truth, although it is very possible that, having the authority of a Royal Commissioner was of itself, at times, helpful. While the number of people who called upon me in answer to my advertisement and public announcement that I was desirous of securing information was comparatively small, there were quite a few private individuals who came to me from what they considered a sense of duty—some of them to comment, and some of them to criticize— including those who came from honest, though selfish, interest.

At my request, a number of what I call responsible critics came and pointed out to me wherein they considered the Commission's past doings and policy had been in error. A very considerable amount of this criticism was really constructive. After investigation, I have not agreed with many of these criticisms, but practically all the criticisms were taken seriously and investigated. Constructive criticism is always helpful, and should be welcomed. There are, however, among these so-called responsible critics some who should know better, who seem to be obsessed and prejudiced to the point that known public facts are unduly and unfairly distorted. Such criticism is harmful and destructive to the best interests of your State, and should be so regarded by all fair-thinking citizens.

I wish that members of the Commission's staff might know how much I appreciate how very patient they have all been with me. I have felt it necessary to criticize some of their acts and doings as engineers, and they have had a right to assume, for some time, that I would so criticize. I have been treated, however, by them fairly and courteously, and will carry away with me many pleasant remembrances of their many kindnesses to me.

As to the Commissioners, I have many times thought how fortunate the State was that men of this high type and character would so freely give their services to the State at such a personal sacrifice. I can hardly conceive of a higher type of citizenship and personality devoted to public

duty than is embodied in this Commission. It is but natural that their personality has reflected itself in the constructive assistance which they have rendered me. Officially and unofficially, every possible courtesy has been shown me.

I have also especially much appreciated the frankly helpful attitude of the many public utility officials, and of the manufacturers and manufacturers' agents, all of whom have not only furnished all data required, but have been of assistance to me in every way practicable.

I might add that I have felt at times overwhelmed by the wealth of hospitality and courtesy extended to me in Melbourne and in Victoria. I shall return with a most close personal appreciation of the many courtesies extended to me.

This conclusion would not be complete if I did not include Mr. D. J. Nolan, whose services were loaned to me by the Railways Commissioners, primarily due to his combustion and general power-station engineering experience. He has been of most valuable assistance to me, not only in the above capacity, but in connexion with practically all other phases of my report work.

While this report has been written in the first person, and I take full responsibility for all and every statement in it, it should be understood that this is, in effect, a joint report of my colleague—Mr. H. W. Eales—and myself. He has shared with me the work and the responsibility, and is entitled to share with me the credit, if any, that may be given as a result of this report. Without him it would have been impossible for me to have made even approximately as thorough an investigation as I have been able to do with his assistance.

To the Hon. the Attorney-General—Mr. Eggleston—I also desire to extend my thanks and appreciation, and, through him, to all of those referred to above, and the many others, who have not only made this report possible, but have made my visit here most pleasant and enjoyable.

All of which I have the honour to submit to Your Excellency's consideration.

Witness my hand and seal this nineteenth day of May, 1926.

(SEAL) WILLITS H. SAWYER.

A. T. LEWIS, Secretary to the Law Department.

