The Transactions of the South African Institute of Electrical Engineers.

Founded June, 1909; Incorporated December, 1909.

VOL. XVIII., JAN., 1927. PART 1

Proceedings at Annual General Meeeting.

27TH JANUARY, 1927.

The Eighteenth Annual General Meeting of the South African Institute of Electrical Engineers was held at 8.5 p.m., at the Associated Scientific and Technical Club, 100, Fox Street, Johannesburg, on Thursday, 27th January, 1927—Mr. V. Pickles (President) in the chair.

There were present 67 members and visitors, and the Secretary.

MINUTES.

The Minutes of the last General Meeting were taken as read and confirmed

NEW MEMBERS.

Messrs. P. E. Gregson and G. K. Nowlan were elected scrutineers of the ballot for the election of new members, and, after their scrutiny, the following candidates were declared duly elected:—

Sprighton, Ernest Charles; Resident Engineer, P. O. Box 99, Cleveland Proposed by V. Pickles; seconded by C. L. Bryden; supported by C. J. Monk and Major E. F. Rendell.

Keller, Albert; Electrical Engineer, c/o The Griffin Engineering Co., Ltd., 43, Anderson Street, Johannesburg. Proposed by Dr. J. H. Dobson; seconded by R. H. Gould; supported by Lieut.-Col. J. Stewart Ross, A. W. Stoker and H. W. Clayden.

The Council has admitted as Technical Associate:

Wilding, Benjamin; Draughtsman, c/o Messrs. Wright, Boag & Co., Johannesburg.

ANNUAL REPORT, 1926.

Your Council herewith submits the report on the work for the year ended December 31st, 1926.

FINANCE.

(Note.—The figures shown in italics are the corresponding amounts for the year 1925.)

The income from all sources, with the exception of revenue from advertisements and sales of the *Journals*, amounts to £1,231 2s. 6d. (*£1,290 17s. 9d.*), which is £59 15s. 3d. less than last year. This reduction is accounted for by the smaller membership, consequent on the number of members removed from the roll at the end of last year. The revenue from entrance fees is also less on account of the fewer new members elected during the year. This fact is no doubt a result of the more rigid conditions imposed under the revised Constitution.

The expenditure for the year has been less than that for 1925, and it is pleasing to report that there is a credit balance on the year's working of £73 8s. 8d., as compared with a loss of £316 17s. 1d. last year.

JOURNAL.

Finance:

The cost of production of the *Journal* was £749 19s. 1d. (*£680 14s. 7d.*). The revenue from advertisements and sales was £774 2s. 11d. (*£560 10s. 8d.* for eleven issues), showing a profit of £24 3s. 10d. (*less £120 3s. 11d.*).

Papers:

The following papers were read during the year:—

"The Use of Ball and Roller Bearings in Electrical Machines," by Wm. C. Massie (*Visitor*).

"Some Applications of Variable Frequency Currents," by J. Burnard Bullock (*Associate Member*).

"Electric Light and Power Supply Schemes for Moderate Sized Towns in South Africa," by R. F. Botting, A.M.I.E.E. (*Member*).

"An Introduction to the Study of Electric Traction in Natal," by T. P. Pask, M.I.E.E. (*Member*).

"Powdered Fuel and its Effect on Boiler Plant Practice," by W. J. Cotterell, M.I.Mech.E., M.A.S.M.E. (*Member*).

"The Cam and Motor Gold Mining Company (1919), Ltd.," by J. T. McCauley (*Member*).

"Some Notes on Mine Engineering Work in Northern Rhodesia," by E. Vivian Perrow, A.M.I.E.E. (*Member*).

"Notes on Rating of Underground Cables Based on Temperature Rise," by G. K. Nowlan, A.M.I.E.E. (*Member*).

"Wired Wireless Application to a 132 K.V. Transmission Line," by C. W. R. Campbell (*Member*).

"Some Notes on Electrical Breakdowns," by Major E. F. Rendell, M.C., M.I.E.E. (*Member*).

"Test Corrections for Impulse Steam Turbines," by R. Livingstone (*Visitor*).

Discussions:

The Council is pleased to report a greater interest amongst members in discussing papers read before the Institute. Two meetings have been devoted entirely to discussion and have proved both interesting and useful. Your Council considers that it is due to authors of papers that the Council should organise such discussions, and looks forward to a continuance of the practice.

V.F.P. Awards.

The Council has awarded the V.F.P. Premiums to the following members for contributions to the Proceedings of the Institute during the year 1925, viz.:—

£10 Premium to Mr. John Roberts.

£10 Premium to Messrs. V. A. Bright, E. Ehrenburg, J. Stewart Ross and C. Shaw.

£5 Premium to Mr. E. H. D. Brunner.

Membership.

The membership of the Institute is as follows:—

	Hon. M.	M.	A.M.	A.	Tech. A.	Tel A.	S.	Total
At January 1st, 1926	2	145	153	22	69	5	39	435
Elected, admitted and transferred	—	7	8	—	4	—	2	21
	2	152	161	22	73	5	41	456
Transferred, resigned, struck off and deceased	—	7	13	5	10	2	13	50
	2	145	148	17	63	3	28	406

"Notes on the Use of Electric Power for Forging, Normalising and Hardening Drill Steel Bits," by E. H. D. Brunner (*Associate Member*).

"Some Methods of Testing Insulators and Semi-Conductors," by Professor O. R. Randall, M.I.E.E. (*Member*).

Council and Committee Meetings.

There have been held under the 1926 Council to the present date 15 meetings of the Council, 12 of the Finance, 12 of the Papers and Editorial, and 12 of the General Purposes Committees. Attendances have been as follows:—

	Council.	Finance.	Papers and Editorial.	General Purposes.
V. Pickles	13	1	10	—
Dr. H. J. van der Bijl	10	2	6	1
V. A. Bright	15	13	—	2
A. E. Val Davies	2	—	1	—
P. E. Gregson	12	1	1	10
A. M. Jacobs	6	—	5	—
C. J. Monk	6	5	—	—
G. K. Nowlan	10	7	1	1
Major E. F. Rendell	10	8	—	1
Lt.-Col. J. Stewart Ross	9	6	—	—
P. Saunders	7	—	—	7
A. R. Walsh	8	1	—	6
W. H. Badger	14	1	—	8
J. Burnard Bullock	9	—	6	—
E. Grafton	7	—	—	4
W. H. F. Tredre	6	3	—	3
Jos. White	8	—	8	—

Visit to Colenso.

An outstanding event during the year was the visit to the Power Station at Colenso and a trip on a section of the electrified portion of the Natal main line. The visit took place on May 28th, 1926, and was a combined one with members of the S.A. Institution of Engineers.

The visit took place following on the paper by Mr. T. P. Pask, M.I.E.E. (*Member*), on "An Introduction to the Study of Electric Traction in Natal."

The visitors were met at Diamana Station by Col. F. R. Collins, V.D., D.S.O., chief mechanical engineer; Mr. T. P. Pask, chief electrical engineer, and several other members of the Natal electrificatioin staff of the S.A. Railways.

A most instructive and enjoyable day was spent in a tour of the sub-station, Diamana, the power station at Colenso, and the running sheds. The adoption by the S.A. Railways of the most recent developments in electric traction equipment was favourably commented on by the members present.

In the evening a dinner was held in one of the large dining cars, when the thanks to the Railway Administration were heartily expressed by Mr. V. Pickles, on behalf of the Institute of Electrical Engineers, and Mr. C. E. Mason for the Institution of Engineers. In every way this was a most successful visit and one to be remembered.

Visit to Johannesburg Sub-Station.

By kind permission of the General Manager, a visit was paid to the Johannesburg automatic sub-station, Turffontein, on Saturday, November 6th, 1926. There was a good attendance of members and the visit was most interesting.

Mines and Works Regulations.

In October, 1926, the Institute received from the Government Mining Engineer a copy of the Suggested Draft Amendments to the Mines and Works Regulations, on which comments were invited. Your Council formed a sub-committee to carefully consider the proposed alterations to these Regulations. The committee is representative of many interests connected with the supply and use of electricity, and the greatest care is being exercised in studying the Regulations. Although the committee has met almost weekly since the beginning of November, 1926, the work of revision is not yet completed.

Annual Dinner.

The annual dinner of the Institute took place on December 11th, 1926, at the Carlton Hotel, Johannesburg.

On this occasion the Institute had the honour of the presence of Col. The Hon. F. H. P. Creswell, M.L.A., Minister of Defence, as principal guest. The Hon. J. H. Hofmeyer, Administrator of the Province of the Transvaal; Councillor Alf. Law Palmer, Mayor of Johannesburg, and Mr.

THE SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS (INCORPORATED).

BALANCE SHEET as at 31st DECEMBER, 1926.

Dr.

To Sundry Creditors			£167 11 8
,, Awards		£45 0 0	
,, Premiums	£55 0 0		
Paid during year... ...	5 0 0		
		50 0 0	
			95 0 0
,, Subscriptions Paid in Advance ...			1 11 6
,, Revenue and Expenditure Account—			
Balance as at 31st December, 1925		919 6 5	
Add Balance from Revenue and Expenditure Account		73 8 8	
			992 15 1
			£1,256 18 3

Cr.

By Union of South Africa 5% Local Registered Stock — Nominal Value, £800		£753 14 6
,, Furniture and Effects	£56 5 0	
Less Depreciation	5 12 6	
		50 12 6
,, Sundry Debtors—		
Subscriptions	227 19 0	
Advertisements, etc.	115 4 0	
Dinner Tickets	50 8 0	
		393 11 0
,, Cash at Bank		59 0 3
		£1,256 18 3

I have examined the above Balance Sheet and accompanying Revenue and Expenditure Account, with the books and vouchers of the Institute, and have obtained all the information and explanations I have required. In my opinion such Balance Sheet is properly drawn up so as to exhibit a true and correct view of the affairs of the Institute, according to the best of my information and the explanations given me and as shown by the books of the Institute.

(Signed) W. E. MOXLEY, Auditor.

Johannesburg, 21st January, 1927.

ASSOCIATED SCIENTIFIC AND TECHNICAL SOCIETIES OF S.A.,
Secretaries. Per A. H. SCOTT TAYLOR.

REVENUE AND EXPENDITURE ACCOUNT for the Year ended 31st DECEMBER, 1926.

To Salaries and Rent	£540 0 0	
,, Assessment (*re* Scientific and Technical Club)	301 7 0	
,, Stationery and Printing	98 1 0	
,, General Expenses	61 10 8	
,, Audit Fee	21 0 0	
,, Subscriptions Written Off	133 19 6	
,, Proportion of Cost of Exhibit—Johannesburg Birthday Pageant	20 0 0	
,, Loss on Dinner	0 7 0	
,, Depreciation—Furniture	5 12 6	
		1,181 17 8
,, Balance, being Surplus of Revenue over Expenditure		73 8 8
		£1,255 6 4

By Subscriptions		£1,121 10 0
,, Entrance Fees		35 3 6
,, Donations		25 0 0
,, Interest		40 0 0
,, Examination Entrance Fees		9 9 0
,, Transactions—		
Advertising and Sales	£774 2 11	
Cost of Printing, etc.	749 19 1	
		24 3 10
		£1,255 6 4

Certified as a correct extract from the Books.

Johannesburg, 21st January, 1927.

(Signed) W. E. MOXLEY, Auditor.

D. Christopherson, Vice-President of the Chamber of Mines, also honoured the Institute with their presence.

The following gentlemen spoke to the various toasts:—

"The King" .... The President.

"His Excellency The Governor-General," The President.

"The Union of South Africa," The Hon. J. H. Hofmeyr.

Response:
Col. The Hon. F. H. P. Creswell, M.L.A.

"The South African Institute of Electrical Engineers,"
His Worship The Mayor (Councillor A. Law Palmer).

Response: The President.

"Our Guests" ... Dr. H. J. van der Bijl.

Responses:
D. Christopherson, Esq.
Dr. A. J. Orenstein.

Mr. V. A. Bright (Vice-President): As Chairman of the Finance Committee during the past year, I have pleasure in proposing the adoption of the Annual Report and Financial Statements. There is little I can add to the report.

I would like to point out, however, that the amount of outstanding subscriptions at the end of December last was £227 19s. This is slightly less than the figure at the end of December, 1925. I would appeal to members to pay their subscriptions more promptly, as I think I may say that the amount of outstanding subscriptions is the only regrettable feature in the financial result of the year's working.

The Finance Committee has exercised every possible economy during the past year, and it is pleasing to record that we have a balance of over £73 on the right side, which is an improvement on last year.

As you will see from the Report, the Journal has cost considerably more this year, which is due to the longer and more profusely illustrated papers which have been published. The revenue from advertisements is very pleasing, and the Journal account shows a profit of over £24 on the year's working. This is a decided improvement on last year's revenue and expenditure.

Without delaying the meeting further, Mr. President, I beg formally to move the adoption of the Annual Report and Statements of Accounts.

Mr. G. K. Nowlan (Member): I have much pleasure in seconding the adoption of the Financial Statements and Report.

There being no discussion, the Annual Report, as read, was adopted unanimously.

Council, 1927.

The following gentlemen were declared duly elected as Members of Council of the Institute for 1927:—

Vice-President.—P. E. Gregson.

Members.—C. J. Monk, G. K. Nowlan, A. T. Rodwell, A. E. Val Davies and C. N. O. Dutton.

Associate Members.—E. Grafton, Jos. White and E. L. Damant.

Auditor.

Mr. W. E. Moxley was re-elected Auditor for the year 1927, on the motion of Mr. V. A. Bright, seconded by Mr. H. W. Clayden.

V.F.P. Awards.

The President: I have now great pleasure in asking Mr. French to present the awards in respect of papers read during the year 1925. Mr. French is a very busy man, and I can assure him that we all appreciate his kindness in coming here this evening. (Applause.)

Mr. Arthur French then presented the awards, as follows:—

£10 Premium to Mr. John Roberts.

£10 Premium to Messrs. V. A. Bright, E. Ehrenberg, J. Stewart Ross and C. Shaw.

£5 Premium to Mr. E. H. D. Brunner.

Mr. Arthur French (President, Transvaal Chamber of Mines): Mr. Chairman and gentlemen, I regret to see from a communication that I had from the Secretary to-day that no gold medal is to be presented on this occasion. I do not know why, but, having some regard for the electrical engineers on the Rand here, I can only suppose that they have all been too busy at their profession to have been in a position to read papers. Anyhow, we will leave it at that.

In the first place, as a representative of the financial side of the gold mining industry, I should like to compliment you on being in a very sound financial position, and I hope that the Club in whose premises we are gathered together to-night will be in an equally fortunate position in the next few years.

I am sure you cannot expect me to make a speech on this occasion, because, as my friend Mr. Denny would tell you, if he were frank enough, what I know about electrical engineering might be represented by zero. (Laughter.)

I have indicated that I have a very great regard for electrical engineers. One cannot go anywhere in the world, or out along the Reef here, without marvelling at the way the electrical engineers have harnessed the forces of Nature and brought about these wonderful productions that they have effected in almost every sphere of life. I do not know what we should have done without them. I hope, however, that those electrical engineers who happen to be associated with my group will not take that as a hint that their emoluments should be increased in the near future. (Loud laughter.)

Electrification seems to be all the go, both here and in the rest of the civilised world. There is electrification here, there and everywhere; in fact, I am told, on very good authority, that even in Natal, where they have the cheapest coal in the whole world, they are going to electrify the railways there!

Well, gentlemen, I have nothing more to say, except to thank you, Mr. Chairman, and your Council, for the honour you have done me in asking me to come here to-night to make these awards, and for the opportunity I have had of spending this evening with you.

The President: My next duty is a very pleasant one: that is to ask Dr. Van der Bijl to take this chair as President of the Institute for the year 1927. During the past year I have been fortunate in having Dr. Van der Bijl as senior Vice-President, and I can assure you that we have no keener member in the Institute. In saying that we look forward to a prosperous and useful year, I know I am only expressing the opinion of the Council and of the general body of members.

Dr. Van der Bijl, I have great pleasure in asking you to take this chair as President for 1927, and in doing so I should like to express my own confidence in the continued prosperity of the Institute under your guidance.

Dr. H. J. van der Bijl (Newly-elected President): Mr. Pickles and gentlemen, I very much appreciate the honour you have done me in electing me President of this Institute. I realise that, by accepting the chair, I take, perhaps, a little too much hay on my fork; but I was induced to do so for two reasons: the one is, that no matter how busy I may be, considering how much I have the interests of the Institute at heart, it must always be possible for me, with a little extra effort, to make that time which it will be necessary for me to make in order to carry out my duty as President of this Institute.

The other reason is that, considering the nature of our present state of civilisation and the means whereby we have arrived at that state, I am one of those who believe that engineers form a very important section of any modern community, and I believe that this Institute must necessarily play a very important part in the future development of South Africa.

I also feel that this Institute, or any institution like the South African Institute of Electrical Engineers, must be a valuable means of enabling engineers, by coming together frequently and discussing their problems and new developments and exchanging ideas, to perform the numerous functions which engineers are called upon to do.

I thank you, Mr. Pickles, for the kind remarks you have made. I can only say, gentlemen, that the year that I have served on the Council, under the guidance and direction of Mr. Pickles, has been a very pleasant year for me. Mr. Pickles has carried on the work very diligently, although I grant, and he will agree, that he had a very good Council. During the latter period of his office we saddled him with a very difficult task. I am referring to the work he did in his capacity as Chairman of the Committee to consider the revision of the Government Mines and Works Regulations. For myself, I will say that I am very glad that Mr. Pickles did not occupy that position in an *ex officio* capacity, so I hope he will be able to continue.

I also wish to express my appreciation of the Council you have elected for the coming year. In particular, I am very glad that you have elected Mr. Gregson as Vice-President. Mr. Gregson is one of the Foundation Members of this Institute, and ever since then he has taken a very keen interest in the Institute's affairs. I feel that with such a Council and such men to back me up, I can have a reasonable hope that I shall be able to acquit myself of my task in a manner not only satisfactory to myself but also to you, members of the South African Institute of Electrical Engineers. (Applause.)

The President: I will now ask Mr. Pickles to read his Valedictory Address.

VALEDICTORY ADDRESS.

By V. Pickles.

I have only one or two brief comments to make on the work of the year and on the Institute's position in general. Your attention has already been drawn to the accounts and balance sheet for 1926, and you have noted that on the year's work a credit balance of £73 is shown. Whilst, in view of the loss of £316 sustained during 1925, this may seem to be a creditable performance, I should like to emphasise the fact that it is chiefly due to the action of last year's Council in writing off a large number of defaulting members. Although there is a surplus this year, it behoves the Institute to carefully watch its finances, for not only is its revenue likely to be adversely affected —at least for a time—by the change in its constitution making entry more difficult, but I believe there are distinct signs that its activities are widening, which means increased expenditure.

I should also like to refer to the part of the report having reference to the greater interest in discussions taken by members. During the past year the general meetings on many occasions have continued beyond the usual hour of adjournment, and while to a president this is a matter upon which he may congratulate himself, it means that special provision for discussion of papers has to be made. It was chiefly for this reason that evenings were set apart for this purpose, and I think it will be agreed that these evenings were worth while. It is a duty which the Institute owes to authors of papers, not only to afford opportunity for, but also to organise discussions, and I trust that this practice will continue.

Apart from Institute matters, the year just past has witnessed considerable developments in Electrical Engineering in this country and in the world generally. To attempt to review progress, however, would take up a great deal of time, and I will, therefore, content myself by expressing the hope that these developments are merely a manifestation of the beginning of that era of renewed prosperity to which we have all looked forward for so long.

In my address to you to-night I propose to review some of the experiences of the Rand Power Company's Engineers from about the beginning of the year 1923 until the first set at Witbank Power Station was placed in commission.

It is known to most of you that, during the latter part of this period, the position regarding the supply of electricity on the Rand was a somewhat precarious one. During the early part of last year more than one mine electrical engineer in this room had occasion to discuss the question of power supply to his particular mine with the Power Company's Control Engineer, and the fact that these conversations were always amicable makes it something of a pleasure to me to describe, in some detail, the general position in regard to power supply at that time.

Directly after the strike in 1922, it became evident that the Mining Industry's demand for power would increase at a more or less rapid rate, and steps were taken without delay to investigate possible methods of extending the capacity of the Power Company's generating stations. As many of you know, it was first of all proposed to extend the plant at Vereeniging, and provisional schemes and estimates were prepared, based on this proposal. Two factors, namely, first, the probable magnitude of the increase in load to be met; and second, the economic advantages offered if power were generated on the coal fields, led later to the selection of Witbank as a site for a new power station. The overall considerations which led to this selection have nothing to do with the subject matter of this address, however, and the initial proposal is mentioned merely as a preface and perhaps as an excuse for the fact that, during a period of two years, the Power Company was put to a variety of expedients in order to maintain not an abundant, but a barely adequate supply of electricity to the mines.

As already stated, it was early in 1922 when it became evident that the increasing activities of the mines would entail a greater demand on the Power Company than had ever been made before. In this connection I have heard it expressed that the Power Company should have been in a position to meet this demand when it arose. To such an assertion it seems reasonable to reply, that to increase plant capacity when the demand was likely to diminsh could hardly be regarded as a sound policy, either from the Supply Undertaking's point of view or that of the mines. Even if no arrangement exists between an undertaking and its consumers, which gives the latter a direct interest in the success of the power supply business, it is ultimately to the consumer's benefit that capital charges and working expenditure should be kept at the lowest figure possible. Moreover, the Power Company was feeling the same retrogade forces which were rapidly bringing the Mining Industry to ruin, and, however optimistic its management might have been, it could not claim the gift of prophesy. When the outlook became clear, however, no time was lost in taking steps to meet the new position, and in these days impartial judges no doubt will acquit the Power Company of blame for delays which ensued between the decision to increase its generating station's capacity and the complete fulfilment of its obligations. It was realised, however, that even if new plant were laid down in record time there would be a period when the existing plant would be fully extended, and steps were early taken to prevent the operating staff from being caught unawares.

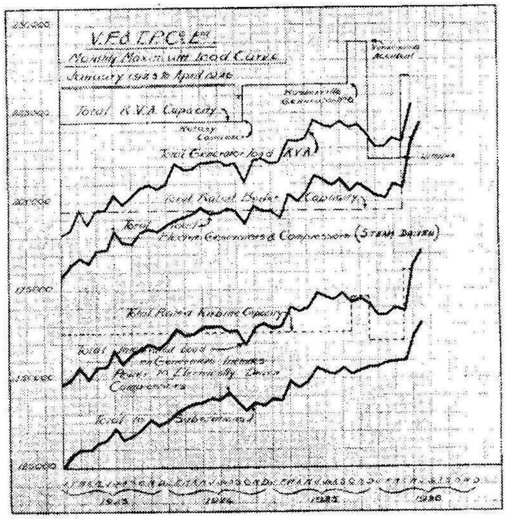

FIG. 1.

Up to the end of 1922 the maximum demand which had had to be met on the combined electric and compressed air systems was about 178,000 k.w., and the curve, Figure 1, shows graphically the increase in k.w. and k.v.a. demand from that time until April 1926, when the first Witbank generator was started up. The full straight line represents the total k.v.a. rating of the generating plant; the dotted line represents the nominal full load of the turbines; and the chain dotted line the rated boiler capacity of the system, all being given in terms of the manufacturers original rating. The steam driven air compressing plant is not included in these capacity lines, but the total load includes the compressed air output in order to show the relation of boiler capacity to the total load.

As was natural, the first step was to take a general survey of the plant as it then stood with the object of so operating and maintaining it, that the fullest use could be made of the available capacity, and in August, 1922, the generally accepted position regarding the availability of the boiler plant for service was as follows:—

At Rosherville 35 boilers out of 40 were regarded as always available for service.

At Simmerpan 21 boilers out of 24 were regarded as always available for service.

At Brakpan 15 boilers out of 18 were regarded as always available for service.

At Vereeniging 17 boilers out of 20 were regarded as always available for service.

This meant that out of 102 boilers installed it was considered wise to regard 14 as out of commission for overhaul, cleaning or involntary stoppage, and I do not think anyone would say that this allocation was unreasonable.

The cast-iron economisers over eight of the Brakpan boilers had very nearly reached the end of their life, and although, under normal circumstances, it would have been possible to delay renewal for a year or two, it was decided to cut out as many risks as possible, and new economisers for the eight boilers were ordered, the renewals being completed during the year 1925.

It was arranged at this time to re-organise the boiler maintenance work in such a way that the number available for service should be increased as follows:—

At Rosherville 36 would be available.

At Simmerpan 21 would be available.

At Brakpan 16 would be available.

At Vereeniging 18 would be available.

This number was not required for service at the time, but it was fixed then in order to bring into prominence the necessity for accelerating maintenance work. Boiler cleaning work and overhauls generally were speeded up, and brickwork was renewed before it was really necessary. The general idea was to maintain the boilers in first-rate condition, so that when the time came we could rely on pressing the maximum number into service without very much fear of involuntary stoppages.

The next step was to ascertain the possibilities of increasing boiler capacities by forcing over peak load hours. In the general loading scheme, Vereeniging and Brakpan were regarded as base load stations, while the daily variations were taken by the plant at Rosherville and Simmerpan. Figure 2 is a typical load curve of the period.

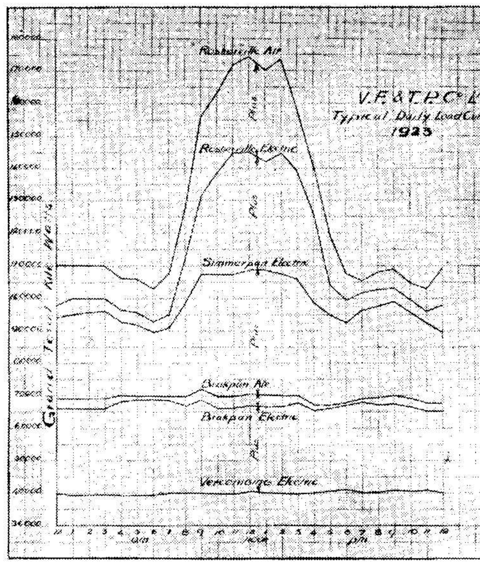

FIG. 2.

The tests made were as follows:—

(1) Rosherville was allowed to bring up its load one hour earlier than usual, Brakpan and Vereeniging load being reduced in order to enable this to be done.

(2) The boilers at Rosherville were forced during peak load time without reference to considerations of efficiency.

(3) The boilers at Simmerpan were forced during peak load times, preparation being made by allowing the station to bring up its load earlier than usual at the expense of the load on Brakpan and Vereeniging.

(4) Was a similar test to the preceding one, but in this case the station auxiliaries were separately driven from one of the small 3,000 k.w. generators. This was tried in order to find the effect of raising the speed of draught fans, condenser auxiliaries, etc., above their normal speed.

It ought to be explained that the object of allowing Rosherville and Simmerpan to bring up their load earlier than usual was to give the brickwork of boilers which had been banked more time to heat up. As is generally known, it takes a few hours to bring an ordinary chain grate stoker-fired boiler from nothing up to full load, and in the attempt to maintain a high boiler load factor at those stations, it was quite possible that a number of them would not reach full load during the actual peak hours.

Forcing boilers without reference to considerations of efficiency means that the fires were deliberately run through with heavy backs, thereby entailing an increased ash loss and higher maintenance costs of ash tipping gear, etc.

The object of making these tests at the time was chiefly educative. We wished to set a standard of maximum output for these two stations obtained in a definite way, so that, in the event of an emergency arising, we not only knew our capabilities, but the method of obtaining the maximum was a tried out thing. It was found that when necessary, and when due warning could be given, the combined capacity of the two stations could be increased by some 6,000 to 7,000 k.w. over the peak load hours, and the procedure thus understood and laid down was subsequently applied on innumerable occasions.

Similar tests were carried out at the Vereeniging Power Station, but, as will be explained later, other steps taken enabled us to obtain the maximum out of the turbine plant without recourse to inefficient methods of steaming the boilers.

It was very soon obvious that the steps already taken, or contemplated, would not be adequate for meeting the increasing load, and about the middle of 1923 it was decided to extend the use of a system of forced draught on the boilers which had been developed in the effort to eliminate the loss accounted for by the escape of unburnt gases to the chimney. A year or two before this time, a series of tests made on one of the boilers had revealed the fact that a very considerable loss was occasioned due to this cause, especially if attempts were made to force the boiler when burning a duff coal. With the object of avoiding this loss, experiments were made using pre-heated air injected over the fuel bed in a zone under the furnace arch. While this method gave every indication that it would be successful in attaining its object, practical difficulties in its application led to the abandonment of the idea. It was then suggested that we should try the principle of blowing air into the furnace from underneath the grate, and, although the initial apparatus was crude, the experiment was, in the result, so successful that a trial on a practical scale was made on two boilers at Brakpan, the air in this case being supplied from a fan placed in the ash basement. Tests made with this equipment showed that the gain in output when burning a Witbank coal was of the order of 12 per cent. to 15 per cent. and that a gain of the same order could be expected when burning a lower value coal if the ignition could be maintained.

About this time there was put on to the market in South Africa a ventilating fan known as the Schlotter Blower, which lent itself admirably to the design we had in mind. It was compact and relatively cheap to instal, and after a preliminary trial, which demonstrated that it would be a suitable fan to use for forced draught purposes, it was incorporated in the standard design.

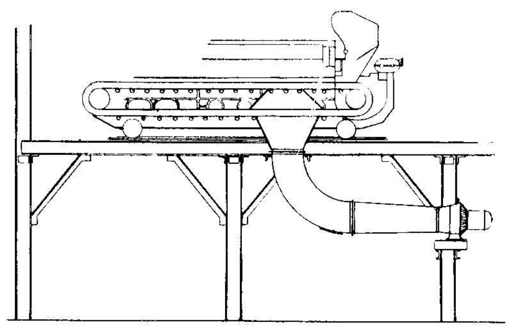

Fig. 3.

Figure 3 is a sketch of the arrangement, and it will be noted that it is so designed that air is blown into the furnace in a zone where the coal is well alight under ordinary circumstances, and where the rate of combustion can with advantage be accelerated. I might mention that this device was first tried in 1921, at the suggestion of Mr. T. G. Otley, and although in principle it resembles the Compartment Stoker since put in the market by boiler manufacturers, we out here at that time had no knowledge of the development of such an idea. We gave it the name of "Selective Forced Draught" to distinguish it from the "Closed Ash Pit" system of forced draught then becoming largely used.

The initial installation of these blowers provided for the equipment of nine boilers at Brakpan and eight at Simmerpan, and tests made under practical working conditions showed that the test results were borne out, that is to say the output of the boilers was increased by approximately 12 per cent.

All our calculations and actions were based on the assumption that one 10,000 k.w. set must be regarded as a spare, and it is clear that, when a number of stations are supplying a fixed demand, they must, as a whole, be in a position to take up the load of anyone of them which might fall short in its output. It was this point of view which dictated the order in which steaming capacity was expanded.

This point will be clearer if I give the actual figures of estimates of steaming capacities made in May, 1923, after the initial installation of blowers had been decided upon. These are as follows:—

With one 10,000 k.w. set out at	Total effective capacity will be
Rosherville	184,400 k.w.
Simmerpan	186,400 ,,
Brakpan	182,200 ,,
Vereeniging	184,900 ,,

From these figures it will be seen that the position was weakest when a generator was out at Brakpan, and, as a set may be out of service at any station, any steps taken to increase the total steaming capacity of the stations should endeavour to wipe out the inequality shown. As a result of this estimate, it was decided to expand the steaming capacity of Simmerpan, so that the output of this station could be increased if a set were out of commission at any other station, and a further eight boilers were equipped with blowers. This method of following up the load was adopted throughout the period.

So far I have dealt with the question of expanding boiler plant capacity only. It was equally important to consider the question of turbine room capacity, and the chief consideration in this regard was not how to increase actual capacity of individual machines, so much as to legislate for immunity from breakdowns. At this time it appeared probable that at least two years would elapse before relief could be expected, and it was, therefore, decided to thoroughly overhaul all the turbines, so that, in the event of the load increasing to such an extent that overhauls could not be properly undertaken, the condition of the plant would be such that it might reasonably be expected to run until relief could be afforded.

The weak spot in the system, however, was the k.v.a. capacity of the generating plant. Generator capacity is limited by temperatures, and in this country, during summer months, nominal ratings cannot usually be exceeded. We had already equipped 11 out of 13 large generators with air humidifiers, and there did not appear to be much margin left for increasing capacity. We were, moreover, faced by the fact that seven of these generators were in too poor a condition to be overloaded. They had been in service for many years, and breakdowns had become frequent enough to indicate that their life would not be indefinite. A rewinding programme was, therefore, decided upon, which, while it is easily anonunced, is not, in this country, quite so easily performed. Difficulties, which are too involved to deal with in this address, were encountered, and it was not until the midde of 1925 that the programme was completed. It will be understood, however, that the organisation of this work during a period of stress called for a deal of forethought in order not to denude us of our spare items of plant for longer than was essential. Latterly it was necessary to carry out the work on sections at a time (the generators are built in three sections) so as to reduce to a minimum the time when the spare stator was unavailable.

At the time of which I now speak there was a resonable amount of spare generating plant, but it appeared probable that the increasing load would quickly eat up that margin. The load on the eastern portion of the network was increasing rapidly, and while the k.w. demand could be met, it was clear that something would have to be done to supply the k.v.a. demand on this part of the system. We had already ordered a spare 18,000 k.v.a. generator of the type installed at Simmerpan and Brakpan, and it was decided to lay this down on a separate foundation at the latter station and use it as a power factor corrector.

Transformers were, therefore, ordered, and work on foundations and switchgear, etc., put in hand.

As already mentioned, 11 out of 13 of the large generators were equipped with air humidifiers. The exceptions were two of the generators at Vereeniging, which, on account of their position, had given no trouble due to overheating when run on normal full load, and, as cooler ventilating air would enable us to increase their normal rating, it was decided to instal air humidifiers on these sets. One of the small 3,000 k.w. generators at Simmerpan was also equipped with an external air duct, because, on account of extensions made subsequent to its installation, the original air intake was in such a position that air more or less heated depending upon the season of the year, was drawn into the machine. Naturally this could affect the position only to a very small degree, but I mention it to show that every step was taken to expand the available k.v.a. capacity.

There appeared to be no possibility of obtaining any further increase in actual generator capacity, and we, therefore, turned our attention to improving methods of supervision of generator loading. The limit in output was set by rotor temperaatures, and while all sets were equipped with temperature indicating instruments, these were situated in the engine rooms, and it was a comparatively tedious business to take the temperatures of several machines. The instruments were, therefore, transferred to the switchboards at each station so that observations could be readily made. From this time onwards it was made a standard practice to take the rotor temperatures often and adjust generator loading during the morning rise and on peak load accordingly. This practice reduced the risk of overheating to a minimum and enabled us to make the most of the available capacity.

As it was realised that we could hardly expect to run through a period, such as was likely to elapse before relief was available, without a breakdown of turbines, generators or transformers, the question of how best to expedite repairs in the event of such breakdown occurring was carefully gone into. As a result of this investigation, various expedients were devised. Lifting gear for turbine repairs was provided at each station, and at distribution points, like Robinson Compressor and New Era distribution stations, special tackle was devised for handling and lifting transformers as quickly as possible.

In January, 1924, on account of shortage of rain, the water position at the Reef stations became a cause of some anxiety. The level of Simmerpan was very low, and the concentration of the water with regard to calcium sulphate had reached saturation point. At Brakpan, where the water resources at the best of times are not great, it appeared that, unless rains still to come were such as to fill up the available storage dams, we should be in a tight position at that station. It was at Simmerpan, however, that the position was likely to cause us real trouble, and it was foreseen that, unless we had abnormal rains in the latter part of the season, extraordinary steps would have to be taken for meeting the position later on.

By February, 1924, the load had risen since May of the previous year by 11,000 k.w. Provisions up to this time had been made for carrying a total combined generated load of approximately 200,000 k.w., assuming that one 10,000 k.w. set was out of commission. The load had already touched 195,000 k.w., and it was, therefore, quite evident that the provisions made were inadequate, for not only was the increase in load greater than anticipated, but due to various causes the starting up of new plant had been delayed by at least 12 months. It will be remembered that, due to the opposition to the granting of the licence to build a station at Witbank, a great deal of valuable time was lost, which, but for good fortune, might have proved catastrophic to the Mining Industry.

At this date nine boilers at Brakpan and sixteen at Simmerpan were equipped with Schlotter Blowers, and it was decided to equip a further eight boilers at Simmerpan and sixteen boilers at Rosherville.

As a time lag must necessarily elapse between taking decisions of this nature and putting them into effect, we took the step at this time of carrying a stock of pea coal at Rosherville, which could be used in emergency. In order to make such a stock effective, the coal staithes opposite each boiler house were divided by brick partitions, and peas, to be used in cases of emergency, were conserved in two of the bays. By this means we knew that we could increase the steaming capacity of the station by some 5,000 or 6,000 k.w. if the necessity arose. Perhaps it should also be explained that peas could not be obtained in sufficient quantities for continuous use.

In November of this year (1924) the peak load had risen to 199,000 k.w., and we had reached the position when the failure of a large generator would put us in a very tight corner.

At Brakpan, where we were burning a relatively low value coal, while we could steam the full output of the turbine plant if the coal were of good burning quality, any falling off in quality was reflected in the loading of that station. Although this state of affairs had existed for two or three years, it now became of importance that we should be in a position to rely on the maximum load of the station at all times. Our investigation into the best method of burning these low value coals had resulted in the development of what we know as stoker screens. We had found that, when this coal was burnt in the grade known as slack, the output of the boilers was materially increased if it were dumped on the boiler house floor and then shovelled into the stoker hopper. This was because the duff and peas were intimately mixed, and consequently gave a more homogeneous fuel bed. Our earlier ideas, therefore, were directed to mechanically imitating this method of firing, and we first of all tried the effect of using a travelling coal chute, that is, a chute which slowly traverses the full width of the hopper. This trial did not give much promise of success, however, and we next tried separating the coal into peas and duff and distributing it in the stoker hopper in such a way that it was fed to the furnace in layers, with the peas at the bottom and duff at the top of the fuel bed. This experiment demonstrated that if the coal could be continuously fed in this way, ignition troubles would not exist, and the rate of combustion was appreciably greater than when the stoker was fed through a chute or by hand shovelling. We accordingly concentrated on the development of a device which would apply the principle in a practical and commercial way. It was necessary to screen the coal, and the initial problem was to feed it on to the screening plan just as required by the furnace, a difficulty which was overcome by the development of a feeding roller fitted to the bottom of the chute. The first device tried was crude, the screening being effected by small trommels revolving over the hopper and fed by two chutes taking coal from the feeding roller, a series of baffles guiding the two products, duff and peas, to the back and front of a partition in the hopper. This arrangement was only successful if continuously watched, and it was evident that whatever device was used for screening, it must be such that the products were distributed evenly across the width of the hopper.

The next development involved the use of a swinging chute containing the screen, and so arranged that the two products were delivered separately at the bottom. This arrangement was fairly successful, but difficulties still existed in distributing the coal evenly across the hopper, and eventually the present arrangement, which consists of a wide feeding roller fitted to the bottom of a splayed chute and feeding on to a fixed inclined screen, was evolved. The arrangement is shown in Figure 4.

feeding the coal to the furnace in such a way that there is a layer of duff coal on the surface is to initially seal it from ingress of excess air. Under these conditions the duff ignites and is consumed quickly, with the result that, two or three feet from the

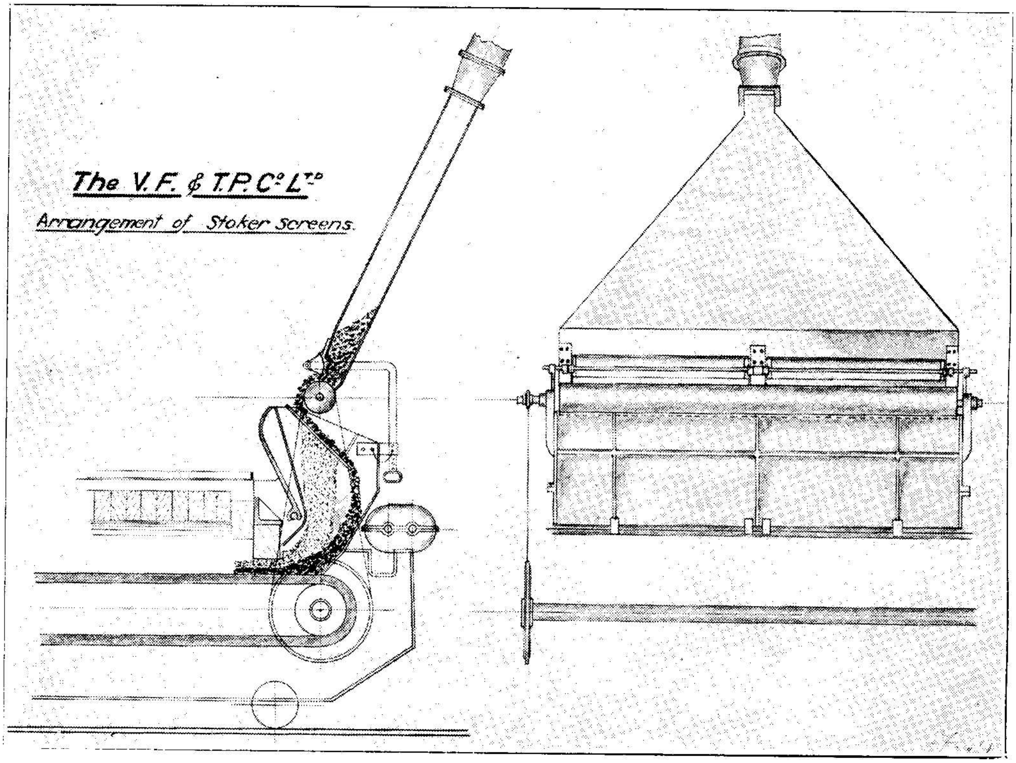

FIG. 4.

This design is not only simpler than the previous ones, but overcomes all the practical difficulties which previously had been met with. As I have already indicated, its special use is for burning slack coal of low value. With the ordinary chain grate stoker, the principle difficulty in burning such a coal is to obtain a free ignition. If cold air is allowed to be drawn through the green coal, ignition is retarded, and the speed of the grate is limited by this fact. For this reason the balanced draught system is better than a straight induced draught, and some stoker manufacturers design their plant so as to cause a current of air to flow through the fuel bed at this point in a reverse direction, that is, outwards from the furnace. The effect of feed door, the fuel bed consists almost entirely of pea coal well alight, giving ideal conditions for obtaining maximum rates of combustion. The combination of this device with what I have described as the selective forced draught is, when using a slack graded coal, especially a suitable one. The forcing in of air at a zone a little distance from the feed door has the effect of lifting the small particles of ignited duff into the combustion space under the arch, and they are then impelled forward into the high temperature zone and burnt almost like powdered fuel.

As a matter of interest, I give figures which represent averages of a number of tests made on several boilers, which show the increase in evaporation due, first, to the selective forced draught and, second, to the combination of the selective draught and hopper screens, the uptake draught and the coal used being the same in each case. These are as follows:—

	Average Hourly Evaporation.
(1) Coal hand-shovelled into stoker hopper	41,000 lbs.
(2) Coal hand-shovelled and using the selective forced draught	47,000 lbs.
(3) Coal fed through stoker screens and using the selective forced draught	53,000 lbs.

The leading dimensions of these boilers are:—

Boiler Heating Surface ...	6,200 sq. ft.
Superheater Heating Surface	2,333 sq. ft.
Economiser Heating Surface	3,610 sq. ft.
Grate Area	252 sq. ft.

Since its installation at Brakpan, the station has steadily carried the full load of the turbine plant, and variations in the quality of the coal have been completely discounted. Later, one of the Rosherville boiler houses was completely equipped, and at the present time it has been installed or is being manufactured for use on 34 additional boilers.

I referred earlier to the fact that we succeeded in obtaining the maximum output of the turbine plant at Vereeniging when steaming 17 boilers out of 20.

One of the modifications made, which enabled this to be done, consisted of a partial application of the principle just described. A coal of relatively low energy value (about 9,800 B.T.U.'s per lb.) is burnt at this station, approximately half of which is in the form of nuts and half slack which has been screened through a three-quarter inch wire mesh screen. The modification to which I now refer was made to the stokers of those boilers burning slack coal. A plate was fitted in the stoker hopper so as to form a slot through which the coal fell freely on to the grate at a point in front of the feed bar. It is well-known that if a coal of the grade known as slack is allowed to fall freely in a heap the larger pieces will segregate from the rest, and this principle is made use of in such a manner that the larger pieces tend to lie on the bottom of the fuel bed and the smaller pieces and duff on the top. A diagrammatic sketch of the arrangement is given in Figure 5. While it is by no means as effective as the stoker screen in this case, it accelerated ignition sufficiently to enable the boiler output to be appreciably increased.

An improvement in the fires under those boilers burning the nut coal was also effected by sealing the fronts of the stokers by plastic magnesia so as to prevent the ingress of coal air above the fuel bed at the front of the furnace. These are comparatively trivial modifications, but they enabled the dependable load on the station to be increased from 43,000 to 46,000 k.w.

Towards the end of 1924 the position became complicated on account of the concentration of the water in Simmerpan. As already mentioned, we had hoped that the rains during the latter part of the previous summer would have diluted the water sufficiently to prevent the deposition of a sulphate scale in the condenser tubes, but in this we were disappointed. The dewatering of the Rhodes Shaft of the Simmer and Jack Mines was then in progress, and for a time it had been necessary to run this water, which was heavily supercharged with calcium sulphate, into Simmerpan. This, of course, did not help matters, and in September, 1924, with the seasonal rise in water temperature scale began to form very rapidly in the condenser tubes; and, despite the most strenuous efforts made to remove it or keep it within bounds, it still continued to form at an alarming rate. As all of you know, scale in condenser tubes has a very material effect on both efficiency and capacity of steam plant, and in this case, although the set back was encountered at an inconvenient time, it was fortunate it occurred then and not a year later. Time does not allow me to give in detail the steps which were taken to overcome the trouble, but its effect at the time was to reduce the capacity of the station by some 7,000 k.w. In passing, it is worth noting that the water resources of the Reef are not sufficient to meet the power requirements of the mines. Steam driven power stations require large quantities of water for condensing purposes.

which must be kept comparatively pure, or, at any rate, below saturation point, in respect of scale forming salts. On the Witwatersrand we are dependent on storage dams for condensing water, and if, as events have proved, a succession of poor rainy seasons is experienced, the power stations located there may easily get into difficulties, due to insufficient flushing out of the dams. Had other considerations, therefore, not entered into the selection of Vereeniging and Witbank as suitable localities for the power stations erected there, there is no doubt that water difficulties would eventually have forced us off the Reef.

At the end of 1924 it became evident that no relief from Witbank could be expected for more than a year, and while, with good fortune, we might have managed to cope with the increasing load with the existing plant, the continued delay was something we had not taken into consideration. It was felt, therefore, that, in order to meet our obligations to the Mining Industry, still further action was necessary. The possibility of linking up with the Johannesburg municipal plant and taking benefit from the sandwiching of the peak loads on the two systems was considered, but it proved impossible to come to any arrangement on these lines. The Randfontein Estates power station was already fully loaded at the time of our peak load, and the only other possibility was to instal an additional generating set at Rosherville. In anticipation of such a step being decided upon, consideration was given to ways and means for still further increasing the output of the boilers at that station, so as to be in a position to provide the additional steam required. The decision to instal a 10,500 k.w. set was made in February, 1925, and work incidental to increasing the boiler capacity was at once put in hand. This was as follows:—

(1) Equipment of the remaining 24 boilers at Rosherville with Schlotter Blowers.

(2) To increase the draught on eight boilers by installing larger fans and motors, and to equip the boilers of one house with Stoker screens.

In regard to (2), it should be explained that the two extreme lines of boilers, known as No. 1 and No. 10 lines, were equipped with fans, the motors driving which restricted the uptake draught to 1·2 in. and 1·3 in. w.g. respectively. The No. 10 line fans were driven by 75 h.p. motors running at 930 r.p.m., while the No. 1 line fans were driven by 40 h.p. motors running at 730 r.p.m. The proposal was to replace the 75 h.p. by 120 h.p. motors and to transfer the 75 h.p. ones to the No. 1 line. Tests had shown that by doing this the available draught would be raised from 1·3 in. to 2·0 in. w.g. on No. 10 line and from 1·2 in. to 1·6 in. on the No. 1 line, and also that the gain in output to be expected would be of the order of 20 per cent. in the case of No. 10 line and 12 per cent. on the No. 1 line. Each line consisted of four boilers, the rated capacity being: No. 1 line 33,000 lbs. each and No. 10 line 36,000 lbs. each. These outputs had, however, already been exceeded by 4,000 or 5,000 lbs. per hour, and it was on the higher figures that the estimated figures of increase were calculated. It was also proposed that the motors liberated from the No. 1 line should be transferred to Simmerpan to replace certain 40 h.p. fan motors running at a speed of 590 r.p.m., two motors being coupled to each fan in this case. As there will be no occasion to refer to the effect of this latter proposal later, I may mention that it had the result of raising the draught on four relatively small boilers (20,000 lbs. per hour capacity) from 0·8 in. to 1·2 in. w.g.

The new 10,500 k.w. set, which was manufactured by the English Electric Company, was started up in October, 1925, or about eight and a half months after placing the order, and as the work on the boiler plant, already detailed, was well in hand, it appeared that we should be able to run through the remaining period without very much difficulty.

The load during the year had risen steadily, the maximum peak carried up to this time being 207,000 k.w. The evening load had also increased to such an extent that, from May onwards, effective sooting of the boilers had become something of a problem. Gradually, as the load rose, it had become necessary to carry out a larger part of the boiler sooting work during the week-ends. In order to carry out this work, as many boilers as possible were taken off on Saturday afternoon or evening so that they could be entered on the Sunday, but the growth of the evening load restricted the number which could be taken off early on Saturday evening, and some of them were too hot to enter on Sunday. As a result, we had to make a practice of cleaning a number of them on Sunday nights and early Monday morning, the work being finished only just in time to enable them to be steaming for the Monday morning load.

It was considered that, with the completion of the programme then in hand, we should have taken every possible step to ensure the carrying of the load until relieved by the commissioning of the first Witbank set. The maintenance of the boiler plant was in such a state that, during the summer months, when efficiencies are reduced through high temperatures, we could rely on steaming additional boilers at each station when necessary. Thanks also to the thorough manner in which the last overhauls of the turbine plant had been carried out by the Maintenance Department; we were fairly confident that this part of the plant would see us through the few critical months which remained. No particular difficulty was experienced in carrying loads which had now risen well above the nominal total capacity of the plant, but very little margin existed to discount any breakdown. As our organisation for dealing with breakdowns had been well thought out, however, we expected that any curtailment of demand which might have to be made as a result of such an event would be of short duration.

In December, 1925, the catastrophe at Vereeniging occurred, which, by the wrecking of two complete generators, left us in a worse position than ever before, both as regards k.w. and k.v.a. capacity. This was a contingency which we offer no excuse for not having provided for, but as a result of it, it became necessary to curtail the compressed air load and to cut off a small amount of electrical load. The taking on of new load had also to be deferred until the starting up of the first set at Witbank.

Fortunately, as has already been mentioned, the position in regard to boiler plant at Rosherville, Simmerpan and Brakpan was such that we could steam these stations at maximum capacity, and at Rosherville, in spite of certain initial troubles with the new turbo-generator, the station was good for a combined electric and compressed air output of 90,000 k.w., or some 15,000 k.w. more than two years before this time. Whenever anything occurred, however, to limit the output of the stations, the demand had to be curtailed during peak load hours, and in this connection I should like to mention here the assistance which the Power Company received from the Mining Industry. The shifting of some of their load from peak to off-peak hours was a very material help, and whenever we were in a very difficult position the mine engineers did their best to help us by staggering their winding loads, which enabled us to avoid cutting off load on many occasions. In fact, it can be said definitely that the sympathetic manner in which the Mining Industry realised and accepted the position we were in made it possible to run through what otherwise might have been an impossible situation.

This gives the history of the three years in a very broad way. It is by no means complete, confined, as it is, to a description of events concerning only the generating stations. The department responsible for the distribution network had its full share of the work in keeping things going, for the growth of the load, particularly on the eastern section of the network, meant that any faulty line had to be repaired at once, whether it was day or night.

Another matter worth mentioning is the development of the Neutral Protective device for generators, which was described in a paper written by Messrs. Penney and Monk, read before this Institute in July, 1924. The perfecting of this device prevented many disastrous breakdowns, as it had the effect of limiting failures to single bars, and on several occasions, when breakdown of generators occurred, the faulty bar was changed and the set placed in commission again on the following day.

It is also interesting to note that during the period that the output of the boiler plant was increased by something like 15 per cent. to 20 per cent. above its nominal rating, the quantity of low value coals burnt on the Reef stations rose from 39,000 to 57,000 tons per month, while, at the same time, certain well-graded Witbank coals, which used to be available, disappeared with the closing down of the mines producing them, and had to be replaced by duff coals.

The first machine at Witbank started up in May, 1926, and, fortunately, this station has behaved itself well, for, since it started up, its capacity at the moment has always been available for peak load.

By the end of the year three sets were available, at any rate for the peak load, and when the straightening out and re-arrangement of the system, rendered necessary by the additional point of supply on the east of the network, is completed, a cheap and abundant supply of electricity will always be available on the Reef.

I chose this subject for my address to you to-night because it is possible that the experience of the engineers of the Power Company during the period reviewed might be of some service to others who may find themselves in a like predicament.

As it appears to me, this general experience demonstrates two things, both of them more or less obvious, and for that reason, perhaps, often overlooked. The first is that, by foresight and careful organisation, it is possible to successfully tackle what at first-sight appears to be a hopeless proposition. The second is that, in order to do so, there must be freedom from the restraint of non-technical interference. Sympathetic principals and considerate consumers probably had more to do with whatever was achieved than any marked technical ability possessed by the staff. If one analyses the various methods which were adopted, either for increasing output or anticipating possible troubles, it will be seen that here is nothing extraordinary in any one of them, although some imagination and original work was called for. It was rather the knowledge that ideas and proposals were welcomed and would not be turned down without the fullest consideration, or be deferred pending some remote sanction, which enabled the staff of the company to carry through a difficult period. This knowledge led to the whole-hearted co-operation of the various departments, and the absence of red tape and irksome restraint had its result in the creation of the right team spirit so necessary if anything out of the ordinary is to be done.

A certain amount of freedom of action affects the efficiency of our work more, perhaps, than our technical attainments, a statement which applies to communities and nations as well as to individuals. One of my objects during the past year has been to drive this lesson home as much as possible, and if on the sundry occasions I have been able to express my views, others have been led to give this aspect of things some consideration, I shall consider that my year of office has had its uses.

In concluding, I wish to express my thanks to members of the Council for the support and consideration they have given me during the year. When, on occasions, it has been difficult for me to properly attend to Institute matters, I always found members willing to perform more than their usually accepted share of the work, and I wish specially to express my appreciation for the extra assistance so kindly given.

Mr. H. W. Clayden (Past President). I have been asked to propose a vote of thanks to Mr. Pickles, your retiring President, for the work he has done during his year of office, and also for the very interesting address that has been given us to-night. Mr. Pickles has, I believe, throughout the last year, attended practically every Council meeting that has been called. During the last few months he has been Chairman of the Mines and Works Sub-Committee, and I can assure you that the work the Committee has done is such that when we come to face the Government Mines Department the gentleman who drafted the proposed regulations will not recognise them as amended by the Institute Sub-Committee. Mr. Pickles put in a lot of time on this work, which is being very thoroughly done; every regulation is carefully considered, and notes are made as to the reason why and wherefore, so that any objections that may be raised by the Government will be easily met.

You have listened to-night to the worries and troubles of the Power Company Engineers, and you must realise that, in doing work for the Institute, he has done it in his own time and probably had to go home and continue his Power Company work in his other spare time.

Mr. Pickles has given us a very interesting address, and I would like to congratulate him and the Power Company Engineers on the way in which they have carried through during the last four years. (Applause.)

Mr. Pickles has told us that he has always found a spirit of co-operation between the Mines' Staffs and the Power Company. I think that is largely due to the fact that the Power Company seem to have the happy knack of selecting officials who come and discuss matters in a free and easy manner, and also they have always been willing to allow their officials to come to this Institute and give away certain figures. For instance, to-night. As Mr. Pickles was reading his address, it struck me that when the new Power agreement comes up for renewal in 1942—(laughter)—the younger members of this Institute may be in an executive position—probably when the present officials are not worrying very much about making a good bargain—it will be just as well to put in a clause making the stipulation that the boiler capacity has to be up to the turbine capacity.

I would wish to thank Mr. Pickles for the good work he has done for the Institute during the past year, and trust that he will still continue to give the Council the same assistance he has in past years. (Applause.)

Mr. Bernard Sankey (Past President): I have very much pleasure in seconding the vote of thanks to Mr. Pickles, not only for his most interesting address—which I regard as one of the outstanding contributions to our Journal—but also for a year of office which, I think, stands out prominently in the history of our Institute. (Applause.) As one of your Past Presidents and one who has attended not quite so many as I might, but quite a few Council meetings, I can also testify to the very hard work and earnest endeavour which our Immediate Past President has put in during his year of office. We, as an Institute, are very much indebted to him for the hard, quiet and, I might say, unseen work which he has put in. Only those who have been in contact with the work can appreciate what it means to carry on an Institute like this in the manner in which it has been carried on during the past year.

I need not refer to the work that has been done during that time, because that is referred to in the Annual Report and has been mentioned by other speakers, but I think the results speak for themselves and will speak more for themselves in the future.

Therefore, Mr. President, without taking up any further time, I will second the vote of thanks to Mr. Pickles for his most interesting address, and express to him, on behalf of everybody, our thanks for his year of office and the hard work that he has ungrudgingly put in on behalf of this Institute and its members. (Applause.)

The President: Gentlemen, I just want to add a few words. Mr. Pickles has given us a paper which is a fine testimony of the really wonderful efforts which the Power Company has made during a very difficult time. I think Mr Pickles' address will become a classic. As you know, classics are sometimes read long after they are written. As Mr. Clayden says, it may be read again in 1942. I ask you to accord Mr. Pickles a hearty vote of thanks for the very successful way in which he has carried on his year of office and conducted the affairs of this Institute. (Applause.)

Mr. V. Pickles (Immediate Past President): Mr. President and gentlemen: In saying "thank you" for the kind things which have been said, I can only say that the past year will always be remembered by me for its pleasant associations; it has been a pleasure to work with the Members of Council, and it has also been a pleasure to preside at the general meetings at which so many useful and instructive papers have been presented. Gentlemen, I thank you for the very kind way in which you have referred to the past year. (Applause.)

Mr. P. E. Gregson (Vice-President): Mr. President and gentlemen, it is usual, on this occasion, to propose a vote of thanks to the Scrutineers. Before doing so, I would like to thank you for having elected me Vice-President of this Institute, an honour which I greatly appreciate, and, at the same time, I should like to say there will be an earnest endeavour on my part, and, I think, on the part of the other Members of the Council, to give every assistance to our President, to enable him, at the end of his year of office, to record still further progress in the Institute. I now have pleasure in proposing a vote of thanks to Messrs. V. A. Bright, C. Shaw and R. W. Hayman, the Scrutineers. (Applause.)

The President: If there is no discussion, gentlemen, that finishes the business of the meeting. I thank you.

The meeting terminated at 9.45 p.m.