PROCEEDINGS

of the

Twelfth Convention

of the

Association of Municipal Electrical Engineers

(Union of South Africa and Rhodesia.)

HELD AT

SALISBURY,

SOUTHERN RHODESIA.

From Thursday, September 13th to Monday, September 17th,

1934.

Price Five Shillings.

MAYNE & GIBSON (PTY.) LTD., DURBAN.
"The Press of Kingsmead"

A. R. METELERKAMP, PRESIDENT
(Municipal Electrical Engineer, Bulawayo).

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ASSOCIATION OF

Municipal Electrical Engineers

(UNION OF SOUTH AFRLCA AND RHODESIA.)

Founded 1915.

EXECUTIVE COUNCIL, 1934.

President :

A. R. METELERKAMP (Bulawayo).

Vice-President :

G. G. EWER (Pietermaritzburg).

Past Presidents :

L. L. HORRELL (Pretoria).

R. MACAULAY (Bloemfontein).

Other Members :

G. H. SWINGLER (Cape Town).

J. H. GYLES (Durban).

A. RODWELL (Johannesburg).

T. MILLAR (Harrismith).

Secretary and Treasurer :

E. POOLE, A.M.I.E.E.

P.O. Box 147 — Durban.

Association of Municipal Electrical Engineers.

(UNION OF SOUTH AFRICA AND RHODESIA)

MEMBERS AND DELEGATES AT SALISBURY, 12th CONVENTION, SEPTEMBER 13th to 17th, 1934.

Seated.—C. H. V. Baskerville (Salisbury; Clr. R. L. Phillips (Salisbury); J. H. Gyles (Durban) Member of Council; L. L. Horrell (Pretoria) Past President; G. G. Ewer (Pietermaritzburg) Vice-President; Clr. L. B. Fereday (Mayor of Salisbury); A. R. Metelerkamp (Bulawayo) President; R. Macaulay (Bloemfontein) Past President; A. Rodwell (Johannesburg) Member of Council; H. A. Eastman (Cape Town); R. L. Pollett (Salisbury) Town Clerk; Clr. L. Braude (Salisbury) Deputy-Mayor.

Second and Third Row.—E. Gunther (Springfontein); H. Purves (Graaff Reinet); E. R. Smith (Visitor); R. H. Gould (S.A.I.E.E.); D. Ritson (Stellenbosch); J. L. Hill (Elec. Control Board); G. E. H. Jones (Mafeking); L. H. L. Badham (Visitor); R. W. Hayman (Visitor); C. H. Clutterbuck (Inspector Factories, Pretoria); Clr. J. J. Cook (Pretoria); R. Tubb (Salisbury); Clr. W. C. Adcock (Port Elizabeth); T. Jagger (Ladysmith); F. Castle (Cape Town); H. A. Tinson (Visitor); W. H. Bottomley (Union Elec. Engr. Pretoria); Clr. J. D. Low (Cape Town); R. F. Riley (Visitor); G. R. E. Wright (Benoni); G. H. Chaloner (Visitor); C. G. Heasman (Fort Victoria); Clr. C. J. Kloppers (Randfontein); J. S. Clinton (Salisbury); Clr. B. G. Fourie (Springs); W. Houreld (Randfontein); S. V. R. Lewis (Gwelo); A. E. Val Davies (Visitor).

Fourth Row.—T. R. Jephcott (Chief Engr. Post & Tel. Salisbury); T. M. Mocke (Piet Retief); J. Harris (Visitor); L. B. Proctor (Johannesburg); M. Wegener (Visitor); H. J. Relihan (Paarl); F. Rettie (Visitor); G. R. D. Harding (E.S.C.); J. Russell (Visitor); H. Shermer (Visitor); W. H. Milton (E.S.C.).

Fifth Row.—E. L. Jephcott (Visitor); Clr. A. Rankin (Johannesburg); H. L. Bull (Visitor); J. R. Bruce (Visitor); A. Q. Harvey (Springs); T. P. Ashley (Queenstown); B. Marchand (Witbank); W. D. Ross (Potchefstroom); W. P. Dormehl (Visitor); C. M. McComb (Springs); W. J. McCann (Visitor); Clr. E. E. F. Blackwell (Mayor—Gwelo); F. J. Lovatt (Local Convention Secretary).

Sixth Row.—J. H. Smethurst (Visitor); F. B. King (Visitor) D. B. Stewart (Gatooma): Clr. J. B. Dursley (Bloemfontein); Clr. F. Johnson (Durban); Clr. C. Peacock (Gatooma); Clr. D. Nelson (Paarl).

ASSOCIATION OF

Municipal Electrical Engineers

PAST OFFICERS AND MEMBERS OF COUNCIL.

	Past Presidents.		Sec. & Trea.
1915-17	J. H. DOBSON	J H. Burg.	F. T. Stokes: E. T. Price.
1917-19	J. ROBERTS	Durban.	E. Poole.
1919-20	B. SANKEY	Port Elizabeth.	E. Poole.
1920-22	T. C. W. DOD	Pretoria.	L. L. Horrell.
1922-24	G. H. SWINGLER	Cape Town.	H. A. Eastman.
1924-26	J. ROBERTS	Durban.	E. Poole.
1926-27	B. SANKEY	J H. Burg.	R. G. Tresise.
1927-29	J. M. LAMBE	East London.	P. Adkins.
1929-31	R MACAULAY	Bloemfonte'n.	E. Poole.
1931-32	L. L. HORRELL	Pretoria.	E. Poole.
1932-34	L. F. BICKELL	Port Elizabeth.	F. A. P. Perrow.

Past Ordinary Members of Council :

1915-17	J. Roberts: W Bellad Ellis: B. Sankey.
1917-19	W. Bellad Ellis: G. Stewart: T. C. W. Dod: T. Jagger.
1919-20	W. Bellad Ellis: G. Stewart: E. T. Price: A. S. Munro.
1920-22	L. F. Bickell: T. Millar: L. B. Proctor: E. Poole.
1922-24	L. F. Bickell: T. Millar: R. W. Fletcher: J. Roberts.
1924-26	T. Jagger: A. S. Munro: T. Millar: L. F. Bickell.
1926-27	L. F. Bickell: T. C. W. Dod: T. Millar: E. Poole.
1927-29	L. F. Bickell: R. A. Young: T. Millar: E. Poole.
1929-30	L. F. Bickell: T. Millar: F. C. D. Mann: G. H. Swingler: A. Rodwell.
1931-32	T. Millar: F. C. D. Mann: G. H. Swingler: A. Rodwell.
1932-34	T. Millar: J. H. Gyles: G. H. Swingler: A. Rodwell.

RULES AND CONSTITUTION

of the

ASSOCIATION OF

Municipal Electrical Engineers

(UNION OF SOUTH AFRICA AND RHODESIA.)

As submitted and passed by the full Meeting of the Association held at the Town Hall, Johannesburg, on Friday, 19th November, 1915. with amendments as submitted and passed at the Durban, Port Elizabeth, Pretoria and Johannesburg Conventions.

---

1. TITLE.—The Association shall be called the Association of Municipal Electrical Engineers (Union of South Africa and Rhodesia).

2. OBJECTS.—The objects of the Association are to promote the interests of Municipal electrical undertakings.

3. HONOURARY MEMBERS. shall be distinguished persons who are or who have been intimately connected with Municipal electrical undertakings, and who the Association especially desires to honour for exceptionally important services in connection therewith.

4. MEMBERS.—Members of the Association shall be Chief Electrical Engineers engaged on the permanent staff of an electric supply or tramway undertaking owned by a local authority in the Union of South Africa or Rhodesia, and any duly qualified assistants whom they may recommend for election. Should any member cease to hold his qualification, as above, his membership shall cease.

5. ASSOCIATE MEMBERS.—Any member resigning under Rule 4 shall be entitled to apply

for election as an associate member. Associate members shall not be entitled to vote on matters affecting the conduct and management of the Association, nor to hold office, but otherwise shall be accorded the privileges of ordinary membership. The Council shall have power to elect as an Associate Member any person in the employ of the Victoria Falls Power Co., or the Electricity Supply Commission, who may be engaged in the public supply of electricity to Municipal bodies.

6. CONTRIBUTIONS.— The membership subscription for Chief Engineers and their Chief Assistants shall be £2 2s. For other members £1 1s. Any member elected within six months after the Annual Congress shall pay the full subscription for the year, and if elected six months after the Congress shall pay half subscription.

7. OFFICERS.—The Officers of the Association shall consist of President, Vice-President, Secretary and Treasurer.

8. COUNCIL.—The Council shall consist of the President, Vice-President, the two immediate Past Presidents and four members to be elected at the Annual Congress.

9. ELECTION OF OFFICERS AND COUNCIL.—Officers and members of Council shall be elected by nomination and ballot at the Annual Congress, and shall hold office until the next Congress. In the event of a vacancy occurring during the year the remaining members shall have power to appoint a member to fill the vacancy.

10. All those who attended the Congress in Johannesburg in November, 1915, shall **ipso facto** be members of the Association.

11. ELECTION OF FUTURE MEMBERS.—The election of future members of the Association shall be vested in the Council and applications for membership must be made on the prescribed form.

12. The affairs of the Association shall be managed by the Council, who shall have power to incur any expenditure necessary for the objects of the Association.

13. The voting of the Congress shall be restricted to the members present at such Congress.

14. The financial year of the Association shall terminate on the first day of the Annual Congress, at which date all subscriptions for the ensuing year become due, and no member will be allowed to vote whose subscription is in arrear.

15. PRESIDENT.—The President shall take the chair at all meetings of the Association, the Council, and the Committees, at which he is present, and shall regulate and keep order in the proceedings.

16. In the absence of the President, it shall be the duty of the Vice-President to preside at the meeting of the Association, and to regulate and keep order in the proceedings. But in the case of the absence of the President, and of the Vice-President, the meeting may elect any member of the Council, or in the case of their absence any member present to take the chair at the meeting.

17. The local Press of the town in which the Congress is held shall be notified of the time and date of the readings of all papers, but the Association shall reserve to itself the right to resolve itself into Committee at any time during its proceedings; moreover, it shall be competent for any member to have his paper read and discussed in Committee if he so desires.

18. The Secretary and the Treasurer shall present a yearly report on the state of the Association, which shall be read at the Annual Congress.

19. The Treasurer shall be responsible for the funds of the Association, and shall present a Balance Sheet at the Annual Congress.

Twelfth Convention

SALISBURY.

PROGRAMME OF PROCEEDINGS.

THURSDAY, 13th SEPTEMBER, 1934.

9.30 a.m.—Meeting of Council, Meikle's Hotel.

10.00 a.m.—Reg'stration, issue of Programmes, etc.

10.30 a.m.—Official Opening of Convention by His Worship the Mayor of Salisbury (Councillor Leslie B. Fereday).

11.00 a.m.—Annual General Meeting.
(Municipal Delegates and Visitors may attend, but only Members are entitled to vote).

AGENDA :

1. Annual Report of Honorary Secretary and Treasurer.
2. Election of President.
3. Valedictory Address by Retiring Pres'dent.
4. Election of Secretary and Treasurer, and Officers. The following are the ret'ring Officers and Council:

President :

L. F. Bickell, Port El'zabeth.

Vice-President :

A. R. Metelerkamp, Bulawayo.

Past Presidents :

L. L. Horrell, Pretoria.
R. Macaulay, Bloemfontein.

Other Members.

G. H. Swingler, Cape Town.
J. H. Gyles, Durban.
A. Rodwell, Johannesburg
T. Millar, Harrism'th.

5. Place of meeting of next Convention.
6. Presidential Address.
7. Discussion thereon.

2.30 p.m.—Paper by Mr. G. H. Swingler (Cape Town) on "**The Development of Domestic Load in Cape Town.**"
Discussion thereon.

5 p.m. to 6.30 p.m.—Exhibition of film at Prince's Kinema showng various works and processes in the manufacture of electric cables, etc. (By courtesy of Prince's Kinema and the exhibitors, British Insulated Cables (S.A.), Ltd.)
Sundowners at invitation of His Worship the Mayor and Councillors of Salisbury.

FRIDAY, 14th SEPTEMBER, 1934.

8.30 to 9.30 a.m.—Meeting of Council, Meikle's Hotel.

9.30 a.m.—Official Photograph. To be taken in front of the New Municipal Offices.

10.00 a.m.—Paper by Mr. B. Tubb (Salisbury): "**Notes on Gaseous Discharge Lamps.**"
Discussion thereon.

11.00 a.m.—Paper by Mr. J. Clinton (Salisbury): "**Thermal Storage.**"
Discussion thereon.

2.30 p.m.—Paper by Mr. J. R. Bruce: "**A Short Description of Salisbury Wireless Station.**"
Discussion thereon.

3.30 p.m.—Visit to Beam Wireless Station at Salisbury and to the Salisbury Mun'cipal Power Station. Tea will be served at the Power Station.

8.15 p.m.—Guests of the Council at the Palace Theatre, Salisbury

SATURDAY, 15th SEPTMBER, 1934.

8.30 to 9.30 a.m.—Meeting of Council, Meikle's Hotel.

9.30 a.m.—Paper by Mr. I. J. Nicholas (Umtata): **"Electrical Development in a Small Town due to Low Tariffs, yet remote from Coal Fields and Industries."**
Discussion thereon.

11.00 a.m.—Paper by Mr. J. W. Phillips (Bulawayo): **"The Bulawayo Municipal Electricity Undertaking."**
Discussion thereon.

2.30 p.m.—Visit to Prince Edward Dam.
Tea will be served at the Dam.

7.30 p.m.—Guests of the Council at Civic Dinner and Dance (Meikle's Hotel).

SUNDAY, 16th SEPTEMBER, 1934.

This day may be utilised by Members and Delegates at their discretion for golf, tennis, etc. Motor trips to the Mazoe Dam and Mermaid's Pool will be arranged for the visitors who so desire.

MONDAY, 17th SEPTEMBER, 1934.

8.30 a.m.—Meeting of Council, Meikle's Hotel.

9.30 a.m.—Demonstration and paper by Mr. E. Jephcott: **"The Interference of Electrical Plant with Wireless Reception."**

11.30 a.m.—Consideration and discussion on the subject of Model Regulations." Introduced by Mr. G. H. Swingler (Cape Town).

2.00 p.m.—Consideration and discussion on "Amalgamation and Affiliation with the I.M.E.A. of Great Britain." Introduced by Mr. G. H. Swingler (Cape Town).

3.30 p.m.—Paper by Mr. H. J. Relihan (Paarl): Rural Distribution."
Discussion thereon.
General Business.

BULAWAYO.

TUESDAY, 18th SEPTEMBER, 1934.

11.40 a.m.—Arrive Bulawayo.

12.45 p.m.—Leave Grand Hotel—visit to Matopo.

1.30 p.m.—Lunch at Matopo. Guests of His Worship the Mayor and Councillors of Bulawayo.

4.30 p.m.—Tea and sundowners, Municipal Swimming Baths, by invitation of His Worship the Mayor and Councillors of Bulawayo.

WEDNESDAY, 19th SEPTEMBER, 1934.

9.30 a.m.—Visit to Bulawayo Municipal Power Station.
11.00 a.m.—Train leaves for Victoria Falls.
12.30 p.m.—Train leaves for Union.

ASSOCIATION OF

Municipal Electrical Engineers

MEMBERS AND DELEGATES ATTENDING THE CONVENTION.

Benoni—
G. R. E. Wright.

Bloemfontein—
R. Macaulay.
Clr. J. B. Dursley.

Bulawayo—
A. R. Metelerkamp.

Cape Town—
H. A. Eastman.
Clr. J. D. Low.

Durban—
J. H. Gyles.
Clr. F. Johnston.

Fort Victoria—
G. G. Easman.

Gatooma—
D. B. Stewart.
Clr. C. R. Peacock.

Graaff Reinet—
H. Purves.

Gwelo—
Clr. E. E. F. Blackwell (Mayor).
S. V. R. Lewis.

Johannesburg—
A. T. Rodwell.
Clr. A. Rankin.

Ladysmith—
T. Jagger.

Mafeking—
G. E. H. Jones.

Paarl—
H. J. Relihan.
Clr. D. Nelson.

Pietermaritzburg—
G. G. Ewer.

Potchefstroom—
W. D. Ross.
Clr. W. B. Barnard.

Pretoria—
L. L. Horrell.
Clr. J. J. Cook.

Port Elizabeth—
Clr. W. C. Adcock.

Piet Retief—
T. M. Mocke.

Queenstown—
T. P. Ashley.

Randfontein—
W. Houreld.
Clr. C. J. Kloppers.

Salisbury—
J. S. Clinton.
B. Tubb.
Clr. L. Fereday (Mayor).
Clr. L. Braude (Deputy-Mayor).
Clr. B. R. Cook.
Clr. J. M. Sinclair.
Clr. R. T. Anderson.
Clr. J. R. Rowland.
Clr. R. L. Phillips.
R. L. Pollett (Town Clerk).

Springs—
A. Q. Harvey.
Clr. B. G. Fourie.
Clr. W. J. McCann.

Springfontein—
E. Gunther.

Stellenbosch—
D. W. Ritson.

ASSOCIATE MEMBERS.

C. H. V. Baskerville, F. Castle, E. M. McComb, B. Marchand, L. B. Proctor.

VISITORS.

Electricity Supply Commission—
- A. M. Jacobs.
- W. H. Milton.
- G. R. D. Harding.

Electricity Control Board—
- J. L. Hill.

S. A. Institute of Electrical Engineers—
- R. H. Gould.

Union Government—
- C. H. Clutterbuck, (Chief Inspector Factories).
- W. H. Bottomley (Electrical Engineer).

S. Rhodesian Government—
- T. R. Jephcott (Chief Engnr. Posts & Telegraphs).
- E. L. Jephcott (Post & Telegraph Dept.).
- A. T. Harpham (Post & Telegraph Dept).
- N. B. Cran (P.W.D.)
- E. H. Collins (P.W.D.)
- W. H. Mumford (P.W.D.)
- F. Rettie (S. Rhodesian Rlys.)

Electrical Trades—
- E. R. Smith (Sec. S.A.C.M.A.)
- R. W. Hayman (Wilson & Herd).
- H. A. Tinson (S.A.G.E.C.)
- L. H. L. Badham (B.T.H.)
- H. L. Bull (B.G.E.C.)
- F. B. King (B.G.E.C.)
- R. F. Riley (B.G.E.C.)
- G. H. Chaloner (H. D. & Co.)
- M. Wegener (A.E.G.)
- A. Heydorn (A.E.G.)
- J. Harris (A.E.G.)
- J. E. Stone (Stone & Co.)
- J. Russell (Glovers)
- F. J. Culligan (Fraser & Chalmers).
- O. Thanning (O. Thanning).
- H. Shermer (Reynolds S & P)

Beam Wireless—
- H. le P. Heaume.
- J. R. Bruce.

Various—
- A. E. Val Davies.
- W. P. Dormehl.
- J. W. Elsworth
- A. W. Greathead.

The Press.

F. J. Lovatt,
(Local Convention Secretary).

PROCEEDINGS

OF THE

Twelfth Convention

THURSDAY, SEPTEMBER, 13th, 1934.

INTRODUCTORY.

The Twelfth Convention of the Association of Municipal Electrical Engineers (Union of South Africa and Rhodesia) was opened in the Private Lounge, Meikle's Hotel, Salisbury, Southern Rhodesia, on Thursday, September 13, 1934, and was attended by 25 Members, 20 Councillor Delegates and 37 visitors.

Mr. L. L. Horrell (Pretoria) (in the Chair): We are here this morning to start our twelfth Convention of the Association, and Mr. Fereday, the Mayor of Salisbury, has kindly consented to welcome us to Salisbury, and I will now ask him to say a few words to us.

CIVIC WELCOME.

His Worship the Mayor of Salisbury (**Councillor Leslie Fereday**) said: Mr. President, Ladies and Gentlemen, it is with real pleasure that on behalf of the citizens of Salisbury, I welcome you delegates to this Convention to our town. We members of the Salisbury Town Council are pleased to greet the delegates at this your

Twelfth Convention. This is the first time that your Association has held its Convention outside the borders of the Union of South Africa. We are conscious of the significance and the importance of this decision of yours to hold your convention in Salisbury, and we realise the magnitude of the honour conferred upon Rhodesia in general and upon Salisbury in particular.

For some years past we have sent our Electrical Engineer and Councillor delegates to attend your Convention at various towns in the Union, so that to-day Salisbury appreciates the opportunity of reciprocating in some measure for the splendid hospitality which our representatives have enjoyed in the past elsewhere. We realise in Salisbury that much as we love our town, it is a very small town and we know that the holding of this Convention in our midst must bring great benefit to us. The visit of such able men, representing the bigger towns of the Union, must bring with it a great benefit to Salisbury, and we very much appreciate this. We realise that we have a lot to learn from the bigger towns in the Union, and we, in Salisbury, regard as a most satisfactory feature the fact of your having decided to hold your Convention here, because surely a meeting of representatives from all parts of the Union with those of us who live in Rhodesia must contribute towards a better understanding between the two territories, and I trust that it will strengthen the bonds of brotherhood to the benefit of all. (Hear, hear). I think I am right in saying that every Municipal Electrical Engineer that we have had in Salisbury has come to us from the Union of South Africa, and on that score our thanks are due to you and to the Union. I think I must mention in this connection, if I may be excused, your President Elect, Mr. Metelerkamp. (Applause). Mr. Metelerkamp came to us about four years ago as our Electrical Engineer, and he has now been appointed as the Electrical Engineer at Bulawayo.

Every citizen of Salisbury will agree with me when I say that we in Salisbury owe a great deal to the services which we have received at the hands of your President Elect. (Applause.)

I should like to compliment this Convention upon the choice of its new President. I hope that, under his able guidance, his enthusiasm and energy, this Convention will be an outstanding success. You will understand that whilst our welcome to all the delegates is sincere and cordial, our welcome to your President Elect is a "peak load" welcome. (Applause.)

In conclusion, I trust that every delegate here will have reason to remember this Convention as a very happy event. On the business and efficiency side of the Convention I trust that it will be an outstanding success.

I have pleasure now in declaring this, the Twelfth Convention of the Association of Municipal Electrical Engineers, duly open. Applause).

REPLY TO CIVIC WELCOME.

The Chairman (**Mr. L. L. Horrell**): Mr. Mayor, Ladies and Gentlemen,—I thank you, Sir, on behalf of the members present for your very cordial welcome here this morning. I can assure you, that we have all looked forward to this visit to Rhodesia and in some ways felt we knew the country even before we came here, for at the last meeting at Port Elizabeth we had two worthy representatives of Rhodesia present, each vying with the other in extending a kindly invitation to visit Rhodesia. Well, Sir, we really did not know which invitation to accept. I think I am right in saying that Bulawayo believes that it has the finest swimming bath in the world. It certainly has beautiful, broad avenues and streets and, above all, it claims to have the best sanitary arrangements in the world. (Laughter). In regard to Salisbury I think it was mentioned, naturally, that it is the Capital of Rhodesia, and I can understand your happy position. I come from Pretoria and I know a little suburb called Johannesburg, (Laughter), so I can quite understand your feeling towards Bulawayo.

With reference to our President Elect I would like to congratulate him on the way in which he has developed your electricity undertaking. I have some figures here for the four years, 1929 to 1932, which are outstanding. In 1929 the units sold amounted to 1,500,000, while in 1933 they were just on 5,000,000. The annual expenditure in 1929 was £33,000, as compared with £37,000 in 1933. The cost per unit fell from 5d. in 1929 to 1·8d. in 1933 which, I think, is a laudable achievement, and the surplus was £31 in 1929 as against £10,000 in 1933.

Mr. Mayor, I thank you again for the cordiality of your welcome. (Applause).

WELCOME TO VISITORS.

The Chairman : Before proceeding further, I should like to extend a hearty welcome to our visitors. We have the Mayor and members of the Town Council of Salisbury, representatives of Government Departments in the Union and Rhodesia, members of the Electricity Supply Commission and the S.A. Institute of Electrical Engineers and representatives of the various Commercial firms. We welcome you all most heartily, Gentlemen, and trust that you will be able to remain with us throughout the whole of the convention. (Applause).

MINUTES OF LAST PROCEEDINGS.

The Chairman : The next item is the confirmation of the Minutes of the last proceedings. I would ask someone to move that they be adopted as reported in the Journal.

Mr. Rodwell: I move that the minutes be taken as read and adopted.

Mr. W. Houreld : I second the motion.

Agreed to.

ELECTION OF PRESIDENT.

The Chairman : The next item is the election of the incoming President. It is my pleasant duty to nominate Mr. Metelerkamp as President of the Association. (Applause). We have watched with interest his successful career during the past few years and believe that he will maintain and advance the prestige of our Association. I have therefore great pleaure in moving that Mr. Metelerkamp be elected as our President for the ensuing year. (Applause).

Mr. G. G. Ewer (Pietermaritzburg): I have pleasure in seconding the motion.

There being no further nominations, Mr. Metelerkamp was unanimously elected as President.

An adjournment was then made for tea, after which a few general announcements were made by the newly elected President who then took the chair.

TWELFTH REPORT AND BALANCE SHEET.

Mr. F. J. Lovatt (Convention Secretary) then read the Twelfth Report and Balance sheet, as follows :—

The Balance Sheet was presented at the meeting on Monday, September 17th but is included here for convenience together with the resulting resolution.

TWELFTH REPORT AND BALANCE SHEET OF THE ASSOC'N. OF MUNICIPAL ELECTRICAL ENGINEERS FOR THE PERIOD ENDING 4th SEPTEMBER, 1934.

Mr. President and Gentlemen,

I have the honour to present herewith the Twelfth Report and Balance Sheet, covering the work of the Association since the date of the last (Port Elizabeth) Convention.

MEMBERSHIP :

The Membership of the Association as at the date of the last report, and as at present existing, is set out hereunder :

	Last Report.	Present Report.
Honorary Members	1	3
Members	65	69
Associate Members	12	11
Total	78	83

RETIREMENTS :

The only retirement from Municipal Service that has come to the writer's notice is that of Mr. A. R. Campbell, late of Springs, Transvaal, Mr. Campbell has not yet intimated whether he wishes to retain contact with the Association as an Associate Member.

RESIGNATIONS :

Two resignations from the Association have been officialy received, viz., that of Mr. W. F. Bower, late of Innesdale, and also Mr. Julian Vowles of Kingwilliamstown.

NEW MEMBERS :

I am pleased to be able to report the election of **eight** new Members, and would also advise that four further applications for Membership have been received, but the Application Forms have not been returned in time for these elections to be confirmed by your Council.

SECRETARIAL :

The question of the Secretarial work of the Association has been dealt with in the form of a memorandum submitted for the consideration of the Council and will no doubt be reported upon to the Convention.

FINANCIAL :

The financial position of the Association may, I think, be considered very satisfactory. In accordance with the resolution of the last Convention a sum of £200 has been invested in Union Loan Certificates which on maturity in 10 years from date of issue will yield £300. The accumulated Funds standing to the credit of the Association at the Bank as at the 4th September are reflected in the Balance Sheet.

In this connection it must be borne in mind that the Subscription rate was amended at the last Convention, which resulted in a slightly lower return from this source.

It is unfortunate that the support afforded to the Association by the purchase of the Proceedings has not been maintained at quite the level of previous years, and Members are urged to induce their Councils to purchase sufficient copies to render them available to every member of the respective Committee, if not the full Council.

I should like to mention here that there are still a number of copies of the 11th Convention Proceedings available at the nominal charge of 5/- per copy.

OUTSTANDING ACCOUNTS :

There are unfortunately a number of outstanding subscriptions, and whilst it is confidently expected that some, at least, will be collected, there are some owing by members whose addresses are unknown, and whom it is impossible to trace; these will, no doubt, receive the consideration of the Council.

It should be pointed out that the delayed payment of dues involves the Association in unnecessary expenditure and adds very considerably to the duties and worries of the Secretary. Members are earnestly requested to reduce as far as possible the amount shown in the Balance Sheet under Sundry Debtors.

MEMBERSHIP :

I would commend to the earnest consideration of the new Council the question of so amending the Constitution as to widen the scope of membership, if at all possible, to bring in more of the senior Technical Officials of Electricity Supply Undertakings. The Chief Engineers might use their influence towards inducing members of their staffs to take an active interest in the affairs of the Association.

OFFICIAL JOURNAL: S.A. Electrical Review & Engineer.

The advantages offered by the Official Journal of the Association as a medium of keeping in contact with the general body of members and of letting it be known what is happening in your own particular area, do not appear to be fully appreciated by members. The benefits to be obtained from the more advantageous use of this journal cannot be too strongly emphasised.

With the submission of this report my period of office, as Honorary Secretary and Treasurer, is terminated.

I cannot, however, allow the occasion to pass without expressing my appreciation of the ready and willing assistance so freely rendered by members of the Council at all times; in particular I would mention Mr. L. L. Horrell who has been a very present help in times of trouble and difficulty.

My duties have at times been onerous, and the conditions under which they have been carried out somewhat peculiar, but I crave your indulgence for sins of omission and commission.

I shall look back on my period of office as one of very pleasant memories of friendliness and kinship with Fellow Engineers.

I am, Mr. President and Gentlemen,

Yours faithfully,

PERCY PERROW,
Honorary Secretary and Treasurer.

THE ASSOCIATION OF MUNICIPAL ELECTRICAL ENGINEERS.
(Union of South Africa and Rhodesia).

REVENUE AND EXPENDITURE ACCOUNT FOR THE PERIOD
28th FEBRUARY, 1933, to 4th SEPTEMBER, 1934.

EXPENDITURE.

	£	s.	d.	£	s.	d.
To Expenses at Port Elizabeth—						
Printing	10	4	0			
Reporter	18	13	4			
				28	17	4
„ Printing Proceedings				108	4	6
„ Honorariums				8	8	0
„ Statistical Tables				20	0	0
„ Bank Charges (less collected)				3	6	0
„ Sundry Printing, stationery, etc.				9	15	0
„ Convention Photographs				19	4	0
„ I.M.E.A.				5	13	10
„ W. W. Pittaway, late Actg. Hon. Sec. and Treas. Secretarial						
Expenses	6	14	0			
Honorariums	2	0	0			
				8	14	0

REVENUE.

	£	s.	d.	£	s.	d.
By Subscriptions—						
Collected	123	18	0			
Outstanding	26	5	0			
				£150	3	0
„ By sale of Proceedings—						
Collected	46	5	0			
Outstanding	3	10	0			
				49	15	0
„ Advertisements				30	1	7
„ Donation				2	2	0
„ By Statistical Tables—						
Collected	40	0	0			
Outstanding		5	0			
				40	5	0

	£ s. d.	£ s. d.
To Wreath		1 1 0
,, S.A. National Committee World Power Conference		5 0 0
,, Secretarial Expenses—		
Stamps	22 11 2	
Telegrams	1 1 7	
Rail and Transport Charges	2 16 11	
Sundry	19 6	27 9 2
		£245 12 10
,, Balance, being excess of Revenue over Expenditure		51 5 3
		£296 18 1

	£ s. d.	£ s. d.
By Convention Photographs—		
Collected	15 15 6	
Outstanding	1 12 0	17 7 6
,, I.M.E.A. Reports—		
Collected	6 18 0	
Outstanding	6 0	7 4 0
		£296 18 1

BALANCE SHEET AS AT 4th SEPTEMBER, 1934.

Liabilities.	£	s.	d.
By Subscription in advance	1	1	0
„ Photo in advance	0	9	6
„ Accumulated Fund as at 28th February, 1933	290	4	1
Excess Revenue	51	5	3
	£342	19	10

Assets.				£	s.	d.
By investments, purchase of £300 Union Loan Certificate for				200	0	0
„ cash at Bank	125	3	1			
„ less unpresented cheque	15	1	4			
				110	1	9
„ Cash in hand				1	0	1
„ Sundry Debtors				31	18	0
				£342	19	10

F. A. P. PERROW, A.M,I,E,E,
Hon. Secretary and Treasurer.

I have examined the books of the Association and I certify that the above Revenue and Expenditure Account and Balance Sheet are properly drawn up so as to exhibit a correct view of the affairs of the Association as shewn by the Book s and Audited Statement.

D. R. SAMUEL,
Chartered Accountant (S.A.).

11th September, 1934.

Mr. Rodwell (Johannesburg: I have much pleasure in moving the adoption of the revenue and expenditure account and balance sheet. In doing so I should like to pay a tribute to the Secretary, Mr. Perrow, and to the work he has put in not only in connection with the Balance Sheet but also in connection with the large amount of work undertaken during the year.

Mr. Horrell (Pretoria): I have great pleasure in seconding the motion. I know that Mr. Perrow has had a difficult time this year, and our thanks are due to him for carrying us forward to this position.

The motion was agreed to.

APOLOGIES.

The Chairman stated that the following apologies for absence from this Convention had been received, together with messages expressing the hope that the Convention would be a success :—

The Mayor (Bulawayo).
Town Clerk (Umtali).
J. Roberts (Durban).
E. Poole (Durban).
F. C. D. Mann (Worcester).
L. B. Sparks (Pietersburg).
J. Iverach (Grahamstown).
T. Millar (Harrismith).
F. A. Perrow (Port Elizabeth).
G. A. Stewart (Johannesburg).
F. E. Syers (Kroonstad).
H. Bahr (Klerksdorp).

The President (**Mr. A. R. Metelerkamp**) then delivered his Presidential address as follows :—

PRESIDENTIAL ADDRESS

A. R. METELERKAMP.
TOWN ELECTRICAL ENGINEER, BULAWAYO.

I wish to express my thanks and appreciation of the honour you have conferred upon me, and through me to the Towns of Southern Rhodesia. My election as President is due to the gesture of goodwill of the Association in deciding to hold

its twelfth convention in this Country. I am sure all the Rhodesian Towns, particularly Salisbury and Bulawayo, the two with which I am closely associated, will endorse the sentiments I have expressed. I will endeavour to uphold the dignity and responsibility of the position to which I have been elected.

Being the first occasion that members and delegates of the Association have officially visited this territory, a few notes on Rhodesia may be of interest.

The area of Southern Rhodesia is estimated to be about three times that of England, with a European population of 52,000, which is less than that of Pretoria. The five Municipalities of Bulawayo, Salisbury, Umtali, Gwelo and Gatooma have a total European population of only 27,000.

There is little recorded history of Southern Rhodesia. It is, however, particularly wealthy in items of world wide interest, which are responsible for increasing numbers of tourists and sightseers visiting the country. The numerous ancient ruins and gold workings of bye-gone people will never fail to create conjecture in the minds of those that visit them as to their period, origin, use, etc.

Numerous theories from different schools of thought with diverse opinions are advanced regarding the ancients. Whatever differences in opinion there may be, it must be unanimously agreed that the major problem of the ancients was, what this association is so closely connected with, that of Power Supply.

Had these ancients had some of the facilities that are possible to-day in connection with Power supply, one might easily visualise Rhodesia as a densely populated country, with numerous industries, due to the extraordinary mineral wealth of the country. It may be stated that the minerals found in the two Rhodesias consisting of gold, copper, coal, asbestos, mica, chrome, zinc, lead, tin and others, all of major importance to the electrical and power supply industries.

It is of interest to quote from F. P. Mennell's Mining in Rhodesia.

"It may be fairly claimed that the outputs of gold, asbestos, chrome, coal and copper from Northern Rhodesia, have already reached sufficient dimensions to more than justify the faith of Cecil Rhodes and those associated with him in the founding of the British South Africa Company, to whom the opening up of this vast territory is primarily due. It is evident, moreover, that the production of some of these minerals, particularly of copper, is only a foretaste of what is to be expected in the near future.

"Although our knowledge of the mineral resources of Rhodesia cannot be reckoned by any means complete, it is a very satisfactory feature, therefore, that few of the more important minerals are not altogether unknown, and that nearly all the leading commercial metals have been ascertained to occur in considerable abundance. There can be no doubt that Rhodesia has within its borders the mineral wealth which is essential for full modern industrial development."

With one exception, it is stated that all the larger mines in the country have been developed from ancient workings. The ancients abandoned most of their workings at a depth of 200ft. It is supposed that this was due to their inability to cope with the water at lower levels. A similar position may arise some thousands of years hence on the Reef, when it may be stated that the ancients abandoned the gold mines at depths of 15,000 ft. due to their inability to cope with the high temperatures and question of ventilation.

Apart from the mineral wealth, nature has been particularly kind with regard to the future possibilities of power supply as the country has more than its share of the world's source of potential power. It is a curious fact that the world's largest waterfall and one of the world's largest coalfields should be found in close proximity within the Colony.

The Victoria Falls are situated on the Zambesi, which river has an effective catchment area of some 110,000 square miles, over which the annual rainfall is said to be 30 to 50 inches. The rainfall in the catchment area extends approximately over the six summer months, with the result that there is a wide variation in the discharge over the Falls. The maximum flow of the Zambesi at the Falls is in the region of 150,000 cu. sec., this decreases to under 10,000 cu. secs. during the Winter months.

I would not dare to describe the Victoria Falls, their beauty and grandeur must be seen to be appreciated or realised It is sufficient to state that the available head is approximately 400ft., and that the level in the gorge below the falls varies over 40ft. during the maximum and minimum flow. It is interesting to note that the river has been known to rise over 8ft. above the falls where the Zambezi is over a mile in width.

A concession has been granted for developing 360,000 h.p. from the Victoria Falls. Any attempt to harness the Falls on a large scale would meet with considerable opposition as it is contended with this would detract from their beauty.

The coal fields of Rhodesia are extensive, but the Wankie Colliery, situated some 70 miles south of the Victoria Falls, supplies the total coal requirements of the two Rhodesias, Portuguese East Africa and the Bechuanaland Protectorate. The Wankie coal field is stated to be approximately 400 square miles in area, and is estimated to contain not less than six thousand million tons of coal. It may therefore be regarded as one of the most extensive coal mining propositions in the world.

The coal requirements of Municipal Power Stations in the Colony are not likely to affect the coal reserves at Wankie for many thousands of years.

The coal as supplied from Wankie is superior to the large majority of steam coals in the Union. The average calorific value of the coal is not less than 13,000 B.T.U. with an ash content between 8.5 and 10.5 per cent., and a sulphur content of approximately 2 per cent.

The pithead price of Wankie coal is 11s. 6d. per short ton. The cost of fuel F.O.R. at the five Municipal Power Stations, is as follows :—

Bulawayo	19/-	per short ton.
Gwelo	21/5	"
Gatooma	24/8	"
Salisbury	27/5	"
Umtali	31/-	"

As stated previously the five Municipalities in Rhodesia have a total population of only 27,000 Europeans, yet the consumption of electrical energy and the price at which it is sold compares very favourably with towns in the Union.

I have tabulated a few statistics of these towns :

	Bulawayo	Salisbury	Umtali	Gwelo	Gatooma	Total
Population (European)	12,600.	10,000.	2,096.	1,500.	587.	26,783.
Units Sold	12,199,121	58,091,114.	1,104,708.	807,011.	235,153.	20,155,107.
Revenue £	72,940.	50,807.	13,135.	10,389.	5,094.	152,365.
Consumption per head of population	970.	581.	505.	504.	400.	752.
Receipt per unit sold (pence)	1.40	2.09	2.85	3.1	5.2	1.88

It will be noted that the average consumption per head of population of 752 units is extraordinarily good, and the low average receipt of 1.88d. per unit sold, is a forecast of the future electrification of Rhodesia. It is a well-known fact that the price of the unit has a direct bearing on the consumption. The bogey of saturation point may be dispelled when it is pointed out that the Municipal System in Winnipeg which is not a monopoly, has a consumption of 2,000 units per head of population, and an average domestic consumption of 4,418 units per consumer with a receipt of less than a halfpenny per unit for the year 1932.

It is believed that the annual consumption in Bulawayo of 4,180 units per consumer is higher than any town in the Union. This is due to the fact that there are several large consumers which are not generally obtained in towns of the size of Bulawayo. Arrangements are at present being made to add another large consumer with a minimum of a million units per annum to the system, and with the possible increased domestic consumption in view, the future of electricity supply in Bulawayo is healthy.

Whilst considering domestic consumption the question of water heating immediately introduces itself.

The problem of waterheating has produced interesting discussions at each convention. I am of the opinion that until such time as we can put forward a scheme for hot water in the household which is acceptable to the householder from every point of view, there is no hope of fully developing the domestic load. It is of such major importance that I suggest that all the available data on domestic waterheating be collected, and the question be fully discussed at our next convention.

A point worthy of consideration by this Association is the fact that several countries have introduced legislation regarding the interference with wireless reception from electrical apparatus. The wireless section of the press advocates the abatement of this nuisance by the introduction of similar legislation in Southern Africa. Whilst I consider that a measure to obviate certain types of interference may be beneficial, no onerous conditions must be imposed upon electricity supply undertakings. The relative importance of the two essential services, "Communications" and "Power Supply" should receive individual consideration in each case, thus making suitable legislation almost impossible.

It is gratifying to note that in Great Britain and this country the yearly number of fatal accidents due to electrocution has not increased, whilst the use of electrical energy is rapidly growing. One interesting feature is the fact that many more fatalaties occur in homes due to falling down staircases than to electrocution, and the majority of the latter are due to the use of defective portable apparatus in bathrooms. Whilst the primary aim of our regulations should be to safeguard those utilising electrical energy, there can be no doubt regarding the safety and convenience of this form of power.

In conclusion let me say how pleased we are to see so many members, delegates and visitors present. We hope that this Convention will provide sufficient interest to compensate for the great distances you have travelled to attend it in Salisbury.

Mr. Rodwell (Johannesburg): I am sure that I am voicing the feelings of all present when I express our appreciation of the President's address. He has covered a very wide field and he has given us a great deal of food for thought. From the figures quoted in the address it is apparent that the local authorities in Rhodesia have a great deal to be pleased with on their achivements in the electrical world. When we have time to consider this address I am sure that we shall find in it a great deal to inspire us. It would appear that the foundations for future development in Southern Rhodesia at least have been well and truly laid, and I am satisfied that we shall see tremendous strides here within the next few years, more particularly in view of the tremendous asset that they have in the country's natural resources. We in this Association gather together for the purpose of an interchange of ideas and views, and that is a function of the Association for the advancement of electrical science and its applications. We are conscious, of course, of the ever-increasing duties devolving upon the President and the Council, but knowing, as we do, the previous efforts of our President in connection with the Association, we feel certain that his enthusiasm and energy will not fail in this instance, and that he will undertake a full share of the work of the Association. With these very brief remarks on your behalf I thank Mr. Metelerkamp very much for his presidenial address. We also wish him a successful year of office. (Applause).

VENUE OF NEXT CONVENTION.

The President : The next item on the agenda is the venue of the next Convention.

Mr. Horrell (Pretoria) : I propose that the next Convention be held at Pietermaritzburg. It sent us a very cordial invitation to go there this year, and some members thought that Salisbury would be too far away, but evidently those who suggested Salisbury are not at all disappointed with the big numbers present to-day. Pietermaritzburg very nicely gave way, and is was decided to come to Salisbury. Therefore, I think we should undoubtedly accept the very kind invitation that we have received from Pietermaritzburg, and I formally propose that the next Convention be held at Pietermaritzburg.

Mr. Clinton (Salisbury) : I second the motion.

Agreed to.

The President : On behalf of the Association I thank the Mayor and Councillors of Pietermaritzburg for their cordial invitation to hold the next Convention in their city.

ELECTION OF VICE-PRESIDENT.

The next item on the agenda is the election of Vice-President.

Mr. Rodwell (Johannesburg): I have much pleasure in nominating Mr. G. G. Ewer (Pietermaritzburg) as Vice-President of our Association.

Mr. R. Macauley (Bloemfontein): I second the motion.

There being no further nominations Mr. Ewer was unanimously elected Vice-President.

Mr. Ewer (Pietermaritzburg): Mr. President and Gentlemen, I thank you very much for the honour you have conferred upon me. I should also like to say that I am very glad indeed that you have accepted the invitation of my Council to hold the next Convention at Pietermaritzburg.

ELECTION OF MEMBERS OF EXECUTIVE COUNCIL.

The President : The next item is the election of officers to the Executive Council.

The following gentlemen were duly proposed and seconded :—

Mr. J. S. Clinton (Salisbury).
Mr. T. Millar (Harrismith).
Mr. G. H. Swingler (Cape Town).
Mr. A. Rodwell (Johannesburg).
Mr. J. H. Gyles (Durban)
Mr. A. Q. Harvey (Springs).

There being more than four nominations for four vacancies, a ballot became necessary.

Mr. G. R. E. Wright (Benoni) and Mr. H. A. Eastman (Cape Town) were appointed as scrutineers.

The ballot resulted in the following gentlemen being elected to the Executive Council :—

Mr. A. Rodwell, Mr. G. H. Swingler, Mr. J. H. Gyles, and Mr. Millar.

BRIEF NOTES ON GASEOUS DISCHARGE LAMPS.

By B. H. J. TUBB, Associate I.E.E.A.M.(S.A.)I.E.E.

SUMMARY :

No. 1 : Brief Description.
No. 2 : Erection.
No. 3 : Class of Illumination.
No. 4 : Local Experience.
No. 5 . Workshop Notes.
No. 6 : Comparison of Gaseous Discharge and Filament type Prices and Running Costs.
No. 7 : Advantages and disadvantages.
No. 8 : Other Applications apart from Street Lighting.
No. 9 : Final Conclusions.
No. 10 : Sketches of Fittings and various light-distribution curves.

Gaseous Discharge Lamps are the latest development of an electric source of illumination which was first invented nearly 200 years ago. To-day they are magic words on the lips of all Illumination Engineers who value progress and study efficiency.

They bring to you one of the most modern systems known to present day science.

The luminous discharge lamp, or tube, as it is called, gives performance, efficiency and economy, absolutely unapproached by incandescent filament lamps.

A brief description of this modern wizard will be helpful. There is no heated filament as with the ordinary type lamp, merely two electrodes and a metallic vapour enclosed in a glass tube. Immediately current is switched on the voltage is 220 and due to ionisation of the gas, and partly due to radio-active material, the gas which has a very small conductivity begins to operate. At this point the lamp takes only about 20 volts, the line voltage being almost entirely absorbed by a choke, which is placed in series with the lamp. Almost immediately the metallic vapour, in the tube, begins to vapourise, and with the rise of vapour pressure the lamp voltage rises proportionately. When the metallic vapour is entirely vapourised the lamp voltage becomes constant and is independent of the current flowing, which is controlled by the choke.

Due to distortion of the lamp voltage wave form, the lamp power factor is below unity (in fact all Neon lamps have a very low power factor), and, of course, the presence of the choke does not improve matters. The value of the power factor, when current is first switched on, is of the order 0.12, but rising to 0.6 when the lamp has settled to its work. A 20 microfarad condenser connected across the mains at each lamp will improve the power factor to 0.9.

In order to conserve heat the lamp has an additional sheathing of glass after the fashion of a vacuum flask, and if a sudden drop in voltage occurs, say 10 to 15 volts, the lamp may go out, and will not relight until it cools down sufficienty to allow the vapourised gas to cool down and condense, the time taken being 10 to 20 minutes.

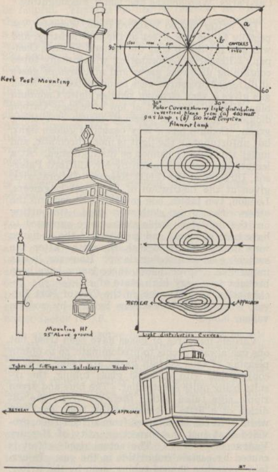
The lamp is fitted with a Goliath Edison screw cap, and with the addition of a choke and 20 microfarad condenser, is suitable for connecting to alternating mains of standard voltage.

With suitable fittings, glare has been reduced to a minimum, and better lighting obtained. Suggestions for use are Streets, Bridges, Railway

Yards, Factory Yards, Parks, Public Gardens, Car-Parks, Warehouses and lastly Floodlighting.

The writer visited Watford Road, Wembley, especially to see the effect of the new lighting, and was also invited to visit the General Electric Company's Research Laboratories, where many tubes containing different gases and mixtures of gases at different pressures were being tested out. Neon gas gives a very pleasing reddish light, Cadmium blue, Helium white, but of low efficiency, Carbon dioxide white, whilst Mercury makes everything green. Sodium has a very beautiful golden light, but unfortunately the light is monochromatic, and under this colours cannot be distinguished. At a lecture and demonstration by Mr. Clifford Paterson, Director of the G.E.C. Research Laboratories, given at the Institution of Electrical Engineers, London, two tables, one covered with red and the other with a green cloth were used. On putting out the lights the table cloths were supposed to have been changed, and members of the audience were invited to distinguish the cloths after the switching on of a sodium lamp. However, it was impossible. Nevertheless, these lamps have been brought to a very high state of efficiency. Incidentally, Park Avenue, in the City of Port Jarvis, New York, is entirely lighted by sodium vapour lamps.

Various mixtures of gases have been tried, but one gas always seems to predominate, so to obtain pleasing effects, certain gases are being used in conjunction with coloured glass tubing, the results being quite spectacular. The blue and green ripple sign tubes obtain their colour by the addition of a little mercury to the Neon gas. A white light can be obtained from a Neon Tube, provided that just the correct quantity of Mercury Vapour is present. The actual ripple effect is caused by certain impurities in the gas. In certain horseshoe shaped tubing, seen by the writer, very beautiful balls of coloured gas were chasing each other round the tubing, and there is no doubt



Examples of Fitting and Polar Curves.

that magnificent advertising signs of this nature will be seen in all the big towns in the future.

No. 2. ERECTION.

Care must be taken in the erection of Gaseous Discharge Lamps to see that the Glassware is correctly positioned. There is a definite approach and retreat side arranged in the glassware in some fittings, so that in travelling on the left side of the road no glare is experienced, but as the lamp is passed a long beam is shot ahead of one. This beam is so arranged that it does not inconvenience traffic coming the reverse way on its correct side of the road. In other words, the lighting is directionally controlled.

Fittings should be mounted at least 25 feet above the ground, and spaced about 130 feet apart. The poles may be staggered on either side of the road, the glassware being suitable for asymmetric light distribution.

If it is decided that poles will be erected down the centre of the roadway, or alternatively, that the lamps will be slung on suspension wire above the road centre, then fittings with suitable glassware to give an elongated beam, equal on both side of the light may be obtained. It cannot be too strongly emphasised that the glassware must be correctly inserted in order to obtain the scientific light distribution suitable to the **Position** of the fitting.

No. 3. CLASS OF ILLUMINATION.

The intensity of illumination usually required for street lighting is divided into eight classes, A, B, C, D, E, F, G and H, of which classes D, E, F and G, as follows, are those most generally used :—

Class	Foot-Candles	Recommended for
"D"	0.2	Commercial thoroughfares in large towns and in important commercial centres in small towns.
"E"	0.1	Shop areas in small towns, main arterial and suburban roads with dense through traffic.
"F"	0.05	Main suburban roads with through traffic.
"G"	0.02	Residential Roads.

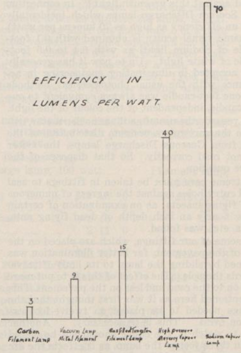
No. 4. LOCAL EXPERIENCE.

It was decided in Salisbury to give the Gaseous Discharge Lamps a trial, so last year a couple were erected merely for experimental purposes.

Now it is admitted that the effect of the light on the human countenance has a paralizing effect on the observer, and it was consequently not surprising when a man walked into the office a couple of days later and said : "For the love of Mike take those dam lamps down, I told my best girl exactly what she looked like, and she has not spoken to me since."

However, like everything else, the public have become reconciled to them, and after questioning many people and listening to various remarks, it was evident that the lighting effect was infinitely better than with the filament type lamp, so a few more were installed.

When first erected a great deal of trouble was experienced; sometimes the lamps would not become luminous for an hour or more after switching on; now and again one would not burn until about 9 p.m., and occasionally not at all. Many voltage readings were taken along the lines at night and the cause strenuously hunted for. Eventually the trouble was traced to the fact that the lamps supplied were for a 240 volt circuit, our voltage being 220. This is a small point, but serves to show how one can go astray.



In these brief notes there is one point that needs elaboration. A foot-candle meter was taken out at night and the highest reading obtainable under or in the vicinity of the gaseous lamp was 0.2. In the vicinity of filament lamps of various wattages, readings of 1.2, 1.5, 2 and 2.2 were obtained, yet by personal observation, the conclusion arrived at was that the discharge lamp gave better illumination. The efficiency of a discharge lamp is, at present, forty lumens per watt, as compared with fifteen lumens per watt for a corresponding tungsten filament lamp. The question arises, "Does the foot-candle meter operate correctly when being tested against this greenish light?" In connection with Sodium Discharge lamps which incidentally have an efficiency as high as 70 lumens per watt) the same visual acuity is obtained with 0.1 foot-candle of Sodium light, as with 0.4 to 0.5 foot-candle of white light. Up to now it has generally been accepted in illuminating engineering in accordance with the usual photometrical methods that one foot-candle was always equivalent to one foot-candle, independent of the colour of the light.

As regards the use of an illumination meter, owing to the particular spectrum distribution of the light from Gaseous Discharge lamps, the meter will not read correctly. So that disposes of the above question.

Extreme care must be taken in fittings to seal up all entry holes against the ingress of numerous small flying insects; as on examination of certain lamps, nearly an inch depth of dead flying ants, moths, etc., was found.

In some of our fittings, which are placed on the edge of the pavement, far better illumination was obtained by sliding the lamp to its limit of travel towards the pole. The effect of this is to put more light on to the road and less on the pavement. This is mentioned here as it was first thought that the fittings needed to be placed on twelve-foot extension arms. This is unnecessary. Another point to watch is, the choke should not be placed within three feet of the lamp, as it effects the arc discharge. It should be noted that rain must not drive on to the lamp, which will crack.

No. 5. WORKSHOP NOTES.

A few figures taken in our test room may be of interest.

Lamp No. I. 230v 400 watt, Gaseous type. Starting current 4 amps, dropping to 2.7 amps in seven minutes. KWH meter reading after one hour was .48 of a unit.

Lamp No. 2. 220v. 400 watt. Starting current 4 amps, dropping to 2.5 amps in six minutes. KWH meter reading after one hour was .46 of a unit.

Lamp No. 3. 220v 400 watt. Starting current 4.2 amps, after 20 minutes 2.8 amps. K.W.H. meter reading after one hour was .5 of a unit. Actual voltage 223 choke tapping on 220 volts.

Lamp No. 4. 220v 400 watt. K.W.H. meter reading after one hour was .44 of a unit.

Lamp No. 5. For comparison—220v 1,000 watt filament type K.W.H. meter reading after one hour was 1.08 of a unit.

No. 6 COMPARISON OF GASEOUS DISCHARGE AND FILAMENT TYPE : PRICES AND RUNNING COSTS.

Gaseous Type. Discharge lamp, 400 watt.		Filament lamp, 1,000w.	
Fitting	£10 10 0		£12 10 0
Lamp	2 5 0		12 8
Condenser	1 10 0		
Choke	2 11 0		
	£16 16 0		£13 2 8
Cable, 200 feet 7/036 —2 core:	£11 13 4		£11 13 4
Burning hours: 3,780 per annum 420 watts at 1d. per unit (choke taking 20 watts)	£6 12 3½	3,780 x 1000 watts	£15 15 0
Lamp replacements every 1,500hrs. (including one)	3 8 5	Lamp replacements every 1,000 hours	1 15 2½
	£38 10 0½		£42 6 2½

Cost of one fitting
plus cost of running
for one year ...... 38 10 0½ £42 6 2 ½
Being £3 16s. 2d. in favour of the gaseous.

The above figures are based on fittings which were recently purchased and erected here in Salisbury, Rhodsia.

Supposing it was decided to erect 100 new lamps, a comparison of the cost would be interesting.

Gaseous Type.			Filament Type.
100 fittings	£1,680 0 0		£1,313 6 8
Lamp replacements per annum	342 1 8		175 16 8
Current consumption per annum Burning hours, 3,780; watts, 420	378x420x100	Burning hrs., 3,780 Watts, 1,000 Quantity, 100	1,575 0 0
Quantity of Lamps, 100.	661 10 0		
	£2,683 11 8		£3,064 3 4

Being a saving of £380 11s. 8d. per annum in favour of Gaseous Discharge Lamps.

Cable and all other charges would be the same for both, and is not included.

No. 7. ADVANTAGES AND DISADVANTAGES.

Advantages.

(1) Provides approximately 2½ times more light for same energy consumption, thereby improving the existing standard of illumination which is what is wanted.

(2) The new fittings provide a more diffused light over a far greater area.

(3) There is no glare.

(4) The light is directionally controlled.

Disadvantages.

(1) Objections as to colour.

(2) High price of lamp replacements, £2 5s., as against 12/8.

(3) The inability of knowing when the lamp is dud, as we have 3 or 4 which will not burn.

(4) Due to the large starting current the same size cable has to be used as for the 1,000 watt filament lamp.

(5) The addition of a choke and condenser.

(6) And most serious of all, the possibility of the lamps going out at each heavy lightning discharge in storms, thereby leaving the streets in darkness, and possibly accidents resulting therefrom. The lamps take about 10 minutes to relight.

To date 52 towns in England and many places on the Continent and America are using Gaseous Discharge Lamps. The Chairman of one of the big manufacturing concerns reports that over 15,000 Gaseous Lamps are in use from his Company alone, so what the total number in use is from the other manufacturers needs some imagination.

Our own experience here now shows that they are being very favourably commented on.

No. 8. OTHER APPLICATIONS APART FROM STREET LIGHTING.

(1) Discharge tubes may be used to indicate that high tension electric lines are alive by being simply hung on the lines, or in cases of voltages varying, say, between 5,000 and 15,000 volts, they are suspended between two lines or between one line and earth.
We have used a combined link stick and discharge tube on our 11,000 volt circuits to indicate which high tension fuse had blown.

(2) Owing to the high penetrating power of the light it is suitable for aviation beacons and aerodrome boundary landing lights,

hangar roofs, power transmission towers, etc. Most modern Airports are equipped with some form of Neon Light.

(3) It is very useful for testing motor car sparking plugs, etc.

(4) Many fruit plants yield a considerable increased crop when exposed to Neon Light, and tomatoes exposed to a sodium vapour discharge tube showed a marked contrast to others not so treated.

(5) Some forms of discharge tubes can be used as a voltage reducer. Other forms as a rectifier, or a relay, and another application is a very simple and efficient means of current control. Some 6,000 kilowatts can be controlled by the expenditure of one microwatt of energy.

(6) It can also be used as a protective device in many electric circuits, such as :—

(1) Protecting a low voltage from damage by fouling with a high voltage circuit.

(2) Protecting a circuit from a small voltage rise.

The foregoing are only a few of the many applications of this very useful appliance.

No. 9. FINAL CONCLUSION.

(A). There is no doubt that in hundreds of small towns street lighting is looked upon as a necessary evil by the Municipal Authorities. Many Town Electrical Engineers know the futility of trying to obtain better facilities for the improvement of street illumination. Their votes are cut down and any experiments they make are ruthlessly criticised, and the result of this policy is seen in the very indifferent street lighting we have to-day.

First we have a blob of light, then a bigger one of darkness and so on, and the net result is, a series of distressful accidents.

To-day, the manufacturers have given us the opportunity of flooding our streets with light at a very reasonable price. This opportunity must be made use of. The standard of lighting needs to be greatly improved and Gaseous Discharge Lamps give a far better and more even source of light distribution than the filament lamp.

(B). The objection as to colour need not be considered. In the case of the Mercury Discharge Lamp the light on the road resembles that of a brilliant full moon.

(C) When the point is considered that the saving of a sum of money amounting to nearly £400 for current consumption alone on every 100 Discharge Lamps installed, then John Citizen will pay willingly and cheerfully.

(D). In conclusion, the writer is very definitely in favour of street lighting by means of Gaseous Discharge Lamps.

With acknowledgements to :

Messrs. The General Electric Co.,

" The British Thomson Houston, Co.,

" Phillips, Ltd.

DISCUSSION.

The President : I should like to thank Mr. Tubb for his paper, and I hope that it will produce some interesting discussions on gaseous discharge lamps. I am informed by numerous manufacturers' representatives that certain of the difficulties which we have experienced have been eliminated in the latest types of gaseous discharge lamps.

I am not in agreement with Mr. Tubb's comparison of the relative cost of operating the two types of lamps. It must be agreed that the cost of the fittings should not have been included, as this is capital expenditure. The economic point to be decided, apart from colour, chokes, condensers, etc., is whether the lower cost of consumption is not outweighed by the higher cost of lamp replacements. This point can only be decided when local conditions are known; it is obvious therefore that where energy is purchased in bulk, the gas discharge lamp has an advantage over the gas filled type.

The comparison is based on current at 1d. per unit. For an undertaking operating its own power station, this figure of 1d. may be reduced to somewhere between ¼d. and ½d., based on the fuel cost, plus whatever is considered equitable, which might then reverse the financial advantage of one type over the other. Until such time as the cost of the gas discharge lamp is reduced and its life is proved to be in excess of filament types, and taking into account its numerous disadvantages of colour, low power factor, chokes, etc., I am of the opinion that it has little advantage over the gas filled lamp for general street lighting purposes.

Mr. Rodwell (Johannesburg): Whilst I have read the paper submitted by Mr. Tubb I have not had an opportunity to study the authors' remarks and deductions on this subject. These comments are submitted, however, in the hope that they will prove of interest and may possibly amplify the remarks made by the author. These remarks deal largely with the results of tests made on an experimental installation recently erected in Commissioner Street, Johannesburg.

Three main points of enquiry were sought: firstly, the power factor of the circuit concerned; secondly, the effect of comparatively high initial demand, and, thirdly, a true comparison of the gaseous discharge lamp with that of the tungsten filament lamp. Tests were subsequently carried out, and, for this purpose, two sections of the road were selected, having a similar distribution of light points and the same average distance between them, measured parallel to the axis of the road. In each case, ten test points were selected, as laid down in the British Standards Specification 307-1931, and the mean test point illumination measured for gaseous discharge and tungsten filament lamps. As a result of the test the increase for the same output was 92 per cent. in favour of gaseous discharge lamps.

It may be of interest to mention that the manufacturers claim over twice the light output for the same power input, based on many laboratory tests by independent investigators. This claim is supported not only by the 92 per cent. increase in test point illumination, as a result of our tests, but also by the better all-round light distribution. There can be no doubt that there is a great future for gaseous discharge lamps, and, as the demand for this type of lamp increases, the cost of the reflector fittings and lamps is sure to be reduced considerably, leading to still more favourable results financially.

If the experiments with horizontal gaseous discharge lamps can be made a commercial success, even better light distribution will be obtained. Due to the colour of gaseous discharge lamps, I consider that they are not at present suitable for domestic use. Once this difficulty has been overcome, the user will have the choice of either reducing his cost for electric lighting charges, or obtaining 100 per cent. better illumination for the same expenditure. It is our duty to educate the public so that they will take advantage of the increased illumination to be obtained without increased cost to themselves.

Like many other radical departures that have been made of recent years, it is not anticipated that the use of the gaseous discharge lamp will materially affect the finances of supply undertakings, but that a higher degree of illumination intensity will be aimed at, thereby mitigating any tendency to decrease the consumer's monthly bill.

Passing reference is made to the monochromatic characteristics of the gaseous discharge lamps, including their use for domestic purposes. Experiments are, I understand, now in progress where it is hoped by the inclusion of other gases to overcome the colour defects. It is felt that the increase in efficiency of the gaseous discharge lamps, permitting of much wider spacing, certainly recommends their use for arterial road lighting. The question of the necessary "spread over" in trying to overcome the initial sudden high demand made on any street lighting system, is one of the main points which will need careful consideration.

It is essential that the focusing arrangements of the lamps are correctly carried out, otherwise the best results are not obtained, and with the types of equipment now supplied, very accurate focusing can be obtained. We were told that a volt drop may cause the lamp to go out, but no extinction occurs when the voltage at Johannesburg is lowered for the time signal. A further point of interest is that a slight rise will not affect the lamp.

I am in agreement that the British Engineering Standards Association has done excellent work relative to the recommendations of street lighting intensities, but I also feel that the question of visibility is an important one, and this is now receiving the attention of the British Standards Association. There is no question that a specification to meet this condition is difficult to lay down. Whilst it is possible to submit values for a road that is dry, the whole problem has to be tackled afresh for a wet road. The surface of roads has properties intermediate between a matt surface and a mirror, and as they become more polished so they reflect more and more light in the same plane as the incident light and less in other planes. Naturally, the state of polish is a fugitive thing, and good and safe lighting ought to receive consideration and collaboration from not only electrical departments, but also from the engineering departments who construct these roads.

That we shall have to go in for higher intensities and better distribution is unquestioned, and, when procurable at a reasonable cost, the electric discharge lamp will be largely used for street lighting purposes.

In conclusion, it may be stated that, in conjunction with the general movement that is now on foot in the Union regarding town planning, the question of improved street lighting is surely a very important component. The author is to congratulated on his most interesting paper, which it is felt will form a valuable contribution to these proceedings, and will have the effect of assisting to focus attention on this desirable form of arterial road lighting. (Applause).

Mr. G. E. H. Jones (Mafeking): Have you any experience of the behaviour of these lamps during electrical storms in Salisbury?

Mr. Tubb (Salisbury): Our experience has not lasted long enough to give you a reply. We shall get our experience during the coming thunderstorm season. In answer to the President, the life of the filament type is only 1,000 hours and the sodium type is 3,000 hours, a definite guarantee.

Mr. Rodwell (Johannesburg) : It might be interesting to state that we had our lamps erected during a period of extraordinarily severe thunderstorms over Johannesburg. That did not affect them in any way. I would not like to say that they would not be affected by severe atmospheric conditions. I should like to see them through a very heavy season before venturing an opinion.

Councillor W. C. Adcock (Port Elizabeth): A layman is rather chary about entering upon such a discussion as this. Unfortunately, I have not my engineer with me to explain, but we tried these lamps at Humewood, Port Elizabeth, because we were experiencing trouble. We used in the first place fittings of the reinforced concrete type because the sea atmosphere affects the cast-iron so much. The figure given us for the fittings and reinforced standards was £6 each, this was against £17 for the other lamps. Three of them were erected and they gave excellent results. I shall be glad to take back a copy of the paper and of Mr. Rodwell's reply to assist our committee down there in coming to a decision in regard to this new form of lighting.

Mr. Tubb (Salisbury) : In regard to the price I may say that these fittings were purchased and erected in Salisbury, and that was the price we paid for them here.

Mr. B. Marchand (E.S.C., Witbank) : Have you had any experience of these lamps causing any wireless interference?

Mr. Tubb : They distinctly do not. That has been proved. There is one point I should like to make. Some information came to hand after the paper was finished. That is with sodium lamps motorists need not use headlights on their cars at all at night, the illumination is so perfect.

Mr. Horrell (Pretoria) : I saw this lighting down the arterial road at Wembley and at Croydon, and, as Mr. Tubb has said, it is not necessary to have any lights at all on motor cars. The districts are so well lighted that it is practically daylight, and as perhaps you know, most of the cars in London run with their parking lights only.

In regard to the colour I understand that there is every possibility of the colour being rectified in the near future. I think that it is, undoubtedly, the lamp of the future.

The Convention then adjourned until 2.30 o'c. p.m.

AFTERNOON SESSION.

The Convention resumed at 2.30 o'clock p.m.

The President : I have much pelasure in calling upon Mr. H. A. Eastman (Cape Town) to read Mr. Swingler's paper on "The Development of Domestic Load in Cape Town."

The Development of the Domestic Load in Cape Town.

By C. H. SWINGLER
CITY ELECTRICAL ENGINEER, CAPE TOWN.

HIRE PURCHASE OF DOMESTIC APPLIANCES IN CAPE TOWN.

Introduction.

Sufficient experience has now been gained in the operation of the Council's hire purchase facilities in respect of domestic appliances for the working arrangements to be viewed in a true perspective.

Numerous enquiries have been made from time to time by Municipal Electrical Engineers and other interested parties as to details of its working, and although these have been replied to as fully as possible, it was felt that until quite recently such descriptions were somewhat premature. It appears, however, that the arrangements now worked to can be said to be of a permanent character—though subject to minor alterations in detail from time to time to suit special conditions and circumstances—and the opportunity has, therefore, been taken to compile these notes in order to place on record, both for the information of those now concerned in its operation and also for the information and guidance of others who may be interested in similar methods of bringing about an increase in the sales of electric energy for domestic purposes, the troubles and difficulties which have been met with in the early stages, and the means by which they were either surmounted or avoided.

When first considering the introduction of these arrangements information was gathered on the working details of the hire purchase arrangements in vogue in overseas undertakings and also on the scheme which had been in operation for some time previously in a large South African undertaking, but it was felt that they all embodied one or more features which were undesirable for adoption in Capetown.

The principal objections were either that the other schemes investigated did not go far enough, for instance, in arranging for the complete installation of the larger appliances, or that they interfered in one way or another with the trading rights of local firms by the supply authority, by for example, taking upon itself to purchase the appliance direct from manufacturers and/or actually to install it itself.

The primary intention was that the arrangements of the Capetown hire purchase scheme would be such as to make it a Non-Trading proposition. The obvious advantages of this were that since the Council would not be directly trading in any appliance to the disadvantage of dealers in approved appliances or of electrical wiring contractors in reference to the installation of appliances, the active co-operation of those firms would automatically be brought about when the greater amount of business in sales of electrical appliances under its aegis, which was confidently anticipated, materialised.

To what extent the hire purchase arrangements have been successful is shown by the results.

Mainly because those responible for the inauguration and working of the scheme had to feel their way on new ground it was inevitable that troubles would occur. These at one time appeared to be of such a nature as to necessitate either discontinuing the scheme altogether or altering the basic non-trading principles, but happily this was avoided, and the scheme is still being operated on the principles on which it was first planned.

The scheme was developed from an unlimited faith in the future of electricity for domestic purposes in Capetown, and if these notes are of assistance to other Municipal Electrical Engineers in avoiding pitfalls when developing hire purchase arrangements to meet local conditions and circumstances they will have served one of the chief pur poses for which they have been compiled.

The notes are being presented in such a way, by describing separately the relations between the Council and the dealers, electrical wiring contractors, consumers, etc., as to make the subject matter the more understandable by readers coming under those various headings. By so doing it is impossible to avoid a certain amount of repitition, for which apologies are offered to those desirous of obtaining a comprehensive view of the scheme as a whole.

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SECTION B.

SECTION C.

SECTION D.

SECTION E.

CORRIGENDA.

Text page 16 para. 5 Appendix 12 clause 2 Appendix 15 page 2	As from 14th June, 1934, the purchase price of water heaters installed by the Council includes :— 150 feet of electrical circut. 20 feet water piping for push-through heaters. 150 feet water piping for multiple-outlet heaters.
Appendix 8 Example 6.	Para. (b) Substitute 30 feet for 20 feet. Para. (c) Substitute 30 feet for 20 feet, 25 feet for 35 feet and £1/11/3 for £2/3/9. Substitute total of £9/1/3 for £9/13/9.
Appendix 8 Example 8.	Para. (b) Substitute 116 feet for 100 feet. Delete para. (c) and £1/-/-. Substitute total of £16/13/9 for £17/13/9.

SECTION A.

Early Encouragement of use of Electricity for Domestic Purposes.

During the greater part of the period which elapsed since the unification of a number of neighbouring Municipalities with the City of Capetown Municipality in 1913 it was not possible to develop to any great extent the use of electricity for domestic purposes in the enlarged Capetown Municipality owing to the necessity for reconstructing the whole of the transmission and distribution systems comprising the combined systems of several small independently-owned undertakings which were in exitence before the unification. These systems, besides differing in their electrical characteristics, had been designed primarily to supply a purely lighting load and could not have been expected, therefore, to carry much of the load that would result from the installation of domestic electrical consuming devices on a large scale.

An attempt to encourage the use of electricity for cooking purposes was made first in 1912 by introducing an arrangement for hiring out electric ranges at a monthly rental. This arrangement, however, met with little support principally because of the dissatisfaction experienced by the hirers through the damage which occurred to the appliances mainly through misuse.

It must now be admitted that this effort was premature having regard to absence of facilities for instructing the hirers in the use of the appliances coupled with the more or less experimental nature of the design of the apparatus and the materials used as heating elements. The Undertaking, therefore, was soon burdened with comparatively heavy expenditure in carrying out repairs, and the arrangement was dropped entirely during 1916 when difficulty was experienced because of conditions arising out of the Great War in obtaining the necessary replace parts.

Incidentally, it might be observed that the scheme, apart from becoming a liability to the Undertaking, was actually tending to undermine the purpose for which it was inaugurated, namely to popularise the use of electricity for domestic purposes.

The use of electricity for domestic purposes was encouraged indirectly, however, by frequent reductions in the tariffs, and by the introduction in 1912 of facilities on the instalment plan for the fixing of electric installations in premises under the so-called 'Free-Wiring' and 'Assisted Wiring' schemes.

It should be mentioned here that facilities for the purchase of electric motors on the instalment plan were introduced in 1909 and have fulfilled very satisfactorily their intended purpose of encouraging the greater use of electricity in industrial establishments.

Reconstruction of Transmission and Distribution Systems.

As mentioned previously, the City Electricity Undertaking for some time subsequent to 1913 comprised a large number of different systems of transmission and distribution, and it was realised that although a large field for development would be found in the supply of electricity for domestic purposes, successful results in cultivating it could not be attained unless and until the transmission and distribution systems were so reconstructed and extended as to enable supples to be given to all and sundry irrespective both of their requirements and of their location.

The work involved in this consisted of the standardisation of primary transmission at 12,000 volts, 3-phase through underground cables with overhead distribution on the 380/220 volts, 3-phase, 4-wire system, and involved the elimination of direct current supplies (except for a small number of consumers in the centre of the City) and other non-standard systems of supply previously in use.

This work was commenced in 1920. It was carried out in such a way as to provide firstly for an immediate considerable growth in supplies for industrial purposes, which was encouraged by offering low tariff rates, and when good progress was being made with this part of the work the remainder and greater part, because of the scattered nature of the area of supply, was commenced.

The success obtained from the steps taken to encourage the use of electricity for industrial purposes is evidenced by the fact that since about 1927 electricity has been used in Capetown for industrial purposes to the exclusion of any other form of motive power, but this fact necessarily brings about the circumstance that the consumption of electric energy for industrial purposes is dependent entirely upon the state of trade.

While these developments were proceeding reductions were being made from time to time also in the tariffs for domestic supplies with a view to encouraging the greatest use of electricity for such purposes, and propoganda to that end, through the medium of the press, by advertisements and other publicity matter was commenced and electricity showrooms, particulars of which are given later, were inaugurated.

A considerable increase in the use of electric energy occurred during that period and a still greater increase was anticipated when hire purchase facilities should be made available, but the introduction of these facilities was deferred until it was certain that fully satisfactory supply and service could be given to consumers throughout the supply area.

The reconstruction and standardisation work on the transmission and distribution systems were not sufficiently far adanced for this until towards the end of 1930, by which time saturation point could be said to have been reached in the industrial supplies.

Hire purchase facilities for domestic appliances were inaugurated on the 1st September, 1930, and as will be seen later, have proved of inestimable benefit to consumers, the Electricity Department, electrical dealers, electrical wiring contractors and to the district as a whole.

Position prior to the introduction of the Council's Hire Purchase Facilities.

Concurrently with the rapid improvement made during the past ten or twelve years in the design and materials of construction of electrical cooking and heating equipment an increasing number of makes and types of electric ranges, kettles, irons and other domestic appliances were made available to the public in Capetown by dealers in electrical appliances comprising not only the firms closely associated with the manufacturers or who had been in the electrical trading business for some considerable time, but also firms who previously had exclusively handled merchandise of an entirely different type.

There was thus a wide choice of appliances open to the public, but apart from such spontaneous action by dealers as might be dictated by trade competition, little or no appeal was made to consumers to purchase the larger appliances although in 1930 a few firms were prepared to grant facilities for the deferred payment of electric ranges over a period not exceeding twelve months. Electrical contractors, for instance, frequently acted as agents on commission for electrical dealers, receiving up to as much as 25% of the retail price of the appliance, and other commonly used steps were taken to promote sales, but the meagreness of the results obtained by the dealers in these ways is indicated by the fact that upon the introduction of hire purchase facilities by the Council there were only 1,050 electric ranges of 3,500-watt loading connected to the Council's mains, and electric water heaters and refrigerators were scarcely used at all.

There is little doubt but that this result was due partly to the absence of co-ordinated effort inherent in the system of competitive trading, partly to the high prices prevailing at the time both for the appliances and for installing them, and to some extent to suspicion on the part of potential purchasers that the dealer was more interested in the sale of the appliance than in its subsequent performance.

Trading Powers of the Undertaking.

In common with other electricity undertaking in the Cape Province, the City Electricity Undertaking was operated under the Cape Provincial

Electric Power Ordinance (No. 6 of 1911) and had carried on for years hire and hire purchase arrangements for electric motors and electric installations under powers set out in a Regulation promulgated under the Ordinance reading :

> "An undertaker may sell or let for hire, or for payment by instalments, electric lines, fittings, apparatus or appliances to private persons under conditions to be approved by the Administrator.'"

At about the time, however, that it became known that the Council proposed to introduce hire purchase arrangements for domestic electric appliances the question as to the validity of this regulation was raised and the legal advisers to the Provincial Council on being asked for their opinion held it to be ultra vires the Ordinance.

If the matter had been allowed to rest at that it would have had far reaching consequences, not only in preventing the introduction of the measures contemplated by the Council, but also to the electrical trade in Capetown through the necessity which would then ensue, of discontinuing the "Free" and "Assisted Wiring" arrangements under which about 1,000 new connections were made each year with consequent restriction in the subsequent sales of appliances.

It was, therefore, all the more surprising when, after the main points in the Council's plans had been disclosed to Capetown electrical dealers showing that it had no intention of interfering in any way with their trading rights by, for example, importing electrical ranges for sale in competition with them, but proposed actually to purchase in Capetown all appliances sold (provided that the prices asked were reasonable), to find the dealers endeavouring to have an amending Ordinance rejected through representations made by the Chambers of Commerce of all the principal towns in the Cape Province. The Capetown City Council accordingly took every possible step to ensure that also, in the case of the larger appliances, for its installation, and would be responsible to the consumer for carrying out every stage in the process of its purchase, delivery and installation, including the carrying out of all necessary alterations to the existing wiring installation to which the appliance would be connected.

A further fundamental principle incorporated in the scheme was that it should include the servicing of the appliance throughout the repayment period and that assistance and advice by the Department in its operation should be available at all times. The underlying object in this was that every purchaser should become a permanent asset to the Council through being relieved of all grounds for dissatisfaction.

In conjunction with this development scheme it was decided also to pursue a more vigorous policy for bringing to the notice of consumers the advantages of the use of electricity in the home by means of intensive advertising in the press and by means of bioscope slides and by means of exhibitions, lectures, demonstrations, inspired articles and so forth.

It was decided also to establish, in addition to three showrooms that had already been inaugurated in the residential areas of the City, a showroom situated in the heart of the City to be fully equipped to permit of lectures and demonstrations being given for the benefit of consumers desiring advice on methods of cooking by electricity.

As mentioned previously, the electrical dealers had been informed as to the general principles on which the Council proposed to launch its hire purchase arrangements, and after the difficulty of the trading powers had been overcome they were informed of the further details of the arrangements and were invited to co-operate.

In particular it was proposed to purchase all the appliances to be sold under the scheme from local dealers and to give out the whole of the installation of the appliances to approved electrical wiring contractors at schedule rates to be agreed.

The dealers on their part were required to place at the disposal of the Council free of charge at least one sample of each type and make of approved appliance for exhibition at each of its showrooms, and in addition a sample for use as a demonstration appliance.

They were also required to guarantee fully the satisfactory working of the appliances purchased from them by the Council for resale under the hire purchase scheme and to grant to the Council mutually agreed discounts from the retail selling price of such appliances.

The plan of working prepared at that time is still being worked to in all essentials and was described in a letter sent to local electrical dealers in July, 1930, but notwithstanding this, when the scheme was launched three months later in September, 1930, it was significant of the general lack of confidence in the Council's ability to improve upon the efforts of the dealers themselves in promoting sales of appliances that only one firm had increased its stock of cooking ranges with a view to coping with a considerable increase in business. The result was that practically all orders placed during the first few months of the operation of the scheme were secured by that firm, and it is worthy of mention that the sales of the make of range concerned have exceeded the sales of any other make.

Basis of Scheme at Inauguration.

Appliances for which deferred payment facilities were granted in the first instance were dealt with under two main classes, viz :—

Class A. Washing Machines.

Refrigerators of 5 cu. ft. or more capacity.

Water Heaters of thermal storage type of not less than 60 gallons capacity arranged for two or more heating elements, at least one of which would be used for operation on the limited-hour tariff.

Class B. Domestic Electric Ranges.

Roasting or Baking Ovens.

Electric Kettles, Saucepans, Irons, Coffee Percolators, provided that these smaller appliances are fitted with automatic temperature control mechanism to break the circuit on overheating.

The deferred payment periods for Class A appliances were either 12, 18 or 24 months at the customer's option, and 12 months only for Class B appliances, provided that in the case of electric ranges and ovens the period would be extended to not more than 18 months under favourable conditions.

The basis of repayment at the time the scheme was introduced was :—

1/– per month per £1 of the retail selling price of the appliance for 24 months.

1/4	ditto	for 18 months.
2/-	ditto	for 12 months.

The scheme also made provision for consumers purchasing appliances for cash, in which case they obtained a discount of 5% from the retail selling price, but they were required to make their own arrangements for the installation of the appliance. In such cases, however, the appliances were serviced by the Council free of charge for twelve months.

For the purpose of arranging for carrying out installation work and for determining the amount of the discount from the retail price received by the Council the appliances were dealt with under the headings "major" and "minor" appliances.

"Major" appliances comprised electric ranges with a total connected load of or exceeding 3,500 watts and costing £10 or more, refrigerators of not less than 5 cu. ft. capacity, domestic washing machines, and water heating apparatus; while all other apparatus was classed as "minor" appliances.

Modification of Scheme—Facilities for deferred Payment of Ranges to 24 Months.

In course of time it was found that a large class of potential purchasers was being excluded from participation in the scheme, particularly in regard to the purchase of electric ranges, through their inability to afford to pay the instalments due on the 12 months repayment period for that type of appliance. In December, 1932, therefore, greater facilities for the purchase of electric ranges on the instalment plan were introduced by giving purchasers of that type of appliance the option of a repayment period of either 12 or 24 months. At the same time new arrangements with the dealers were entered into in regard to discounts,* which permitted of the appliances being handled under only the two classifications "Major" and "Minor" appliances, namely :—

"Major" Appliances.	"Minor" Appliances.
Ranges having a total loading of not less than 3,500 watts and costing not less than £10.	Kettles, Saucepans, Irons. Coffee-Percolators etc. — fitted with automatic temperature control mechanism to break the circuit in case of overheating
Refrigerators with not less than 4 cubic ft. capacity.	
Water Heaters of the thermal storage type of not less than 60 gallons capacity.	
Domestic Washing Machines.	

(*) See page 80.

The original arrangements for repayment by instalments were modified at the same time as follows :—

Repayment over 24 months :
1/– per month per £1 of the retail selling price of the appliances plus 5% (*).

Repayment over 12 months :
2/– per month per £1 of the retail selling price of the appliance.

Repayment periods of 12 months or 24 months were made available for all "major" appliances, but the repayment period for "minor" appliances was restricted to 12 months only. The arrangements in regard to cash sales applying previously were continued under the modified scheme.

Further experience during the following twelve months showed that although satisfactory progress was being made in the sales of ranges and refrigerators and other appliances the limitation of water heaters sold on deferred terms to a minimum capacity of 60 gallons was restricting sales of this type of apparatus and that there was a large potential market under this system for smaller water heaters.

A further revision was, therefore, brought about as from January, 1934, under which the terms "major" and "minor" were dropped as being unnecessary and water heaters down to 2½ gallons capacity were brought within the scope of the hire purchase arrangements, and whereas the purchasers previously had had to arrange for the carrying out of all plumbing work for the installation of water heaters, this work, if desired by the consumer, was included in the repayment price for all water heaters of not less than 10 gallons capacity.

Basis of Scheme as now being worked to.

Under this revised arrangement, which is now being worked to the appliances are grouped as follows :—

(*) The retail price plus 5% was referred to as the "basic" price.

Group "A" Appliances.

(a) Domestic Electric Ranges and Ovens whose retail price is not less than £10 0s. 0d. and/or whose total connected load is not less than 3,500 watts.

(b) Electric Refrigerators.

(c) Electric Water Heaters of not less than 10 gallons hot water storage capacity.

(d) Washing Machines.

(e) Such other appliances as may be agreed from time to time.

Group "B" Appliances.

(a) Domestic Electric Ranges and Ovens whose retail prices is less than £10 0s. 0d. and/or whose total connected load is less than 3,500 watts.

(b) Water Heaters whose hot water storage capacity is less than 10 gallons.

(c) Such other appliances as may be agreed from time to time.

Group "C" Appliances.

These comprise Electric Kettles, Irons, Percolators, Steamers and similar small portable appliances as may be approved from time to time for sale under the Council's hire purchase scheme.

Repayment Periods.

The periods for the repayment of the purchase price are :—

Appliances :	Repayment Periods.
Group "A" Appliances. (i) All appliances including water heaters where the cost of plumbing work is **not** provided for in the cost of the appliance installed.	12 months or 24 months as may be agreed between the Council and the consumer.

(ii) Water heaters including plumbing work where cost of same is provided for in cost of appliance installed.	
(a) "Push through type.	27 months.
(b) "Multiple Outlet" type.	30 months.
Group "B" Appliances.	12 months or 24 months as may be agreed between the Council and the consumer.
Group "C" Appliances.	12 months.

Repayment Amounts.

From the commencement of the scheme the principle was worked to that where the purchaser of a "major" appliance did not desire the Council to install it the monthly repayments would be reduced by 15%. This arrangement was continued under the first revision described previously, but in the present-day stage, instead of deriving the amount of the monthly instalment for group "A" appliances when installed by the purchaser by adding 5% to the retail price and then deducting 15%, the amount, for the sake of simplicity, has been fixed at (*) 10d., per month per £1 of the basic price for instalments spread over 24 months and (*) 1/8d., per month per £1 of the basic price for 12 months.

The amounts of the instalments payable in the case of ranges where their installation is made by the Council, however remained unaltered at 1/– or 2/– per month per £1 of the basic price for 24 and 12 monthly instalments respectively.

The basic price of appliances under the present-day system is the same as the retail selling price when the appliance is sold on the 12-month in-

(*) These figures are slightly less than the corresponding amounts paid previously.

stalment plan, and is the retail selling price increased by 5% when the appliance is sold on 24 monthly instalments.

A further amendment in regard to the amounts of the repayments was the introduction of a flat rate charge of £2 for the cost of the Council providing and installing the necessary electrical wiring material for connecting up an electric refrigerator or washing machine provided that the run of the wiring does not exceed 50 feet.

In the case of water heaters where the repayments do not include the carrying out of any plumbing, the instalments are calculated in the same way as for ranges, but where they include the plumbing work the instalments are at the rate of 1/- per month per £1 of the basic price for 27 months in the case of "push-through" heaters, and 1/- per month per £1 of the basic price for 30 months for "multiple-outlet" heaters, the basic price in each case being derived as described above.

For all water heaters installed by the Council the purchase price includes 50 feet of electrical circuit, and plumbing work included is limited to *20 feet for "push-through" types and to *100 feet for "multiple-outlet" types of heaters. Electrical and plumbing work exceeding these figures must be paid for by the purchaser as an extra to the hire purchase price, but this limitation may have to be removed, or the number of feet increased to make the scheme more popular.

Cash sales of any appliance are made with a discount of 5% off the retail selling price.

Servicing.

As mentioned previously, the Council is responsible to the consumer for servicing, throughout the instalment repayment period, all appliances and installations supplied and fixed by it under the hire purchase arrangements. The means under which this arrangement is put into effect are described fully in Section F.

(*) Amended, see Corrigenda.

Early Difficulties.

When the scheme was first introduced the Council received a discount of 15% off the retail selling price in respect of each "major" appliance as defined above and a discount of 20% in the case of all other apparatus.

At that time any electrical wiring contractor employed by the Council for carrying out work under its "Free Wiring" scheme who was instrumental in bringing about the sale of any apparatus under the scheme—the proof of which was his signature as a witness to the completion of the hire purchase agreement between the consumer and the Council—was granted one half of the discount received by the Council from the dealer and was entitled also to carry out the wiring work and installation of the appliance at the prescribed schedule rates.

It was thought that the payment of a commission would induce contractors actively to canvas people to procure appliances through the deferred payment scheme, and although it was realised from the first that these privileges were open to abuse, it was hoped that these fears would not materialise. The trouble in this connection was that collusion between dealers and contractors would result in depriving the Council of funds which were essential to the successful prosecution of the scheme, and it was therefore, made clear that only business genuinely canvassed by the wiring contractors would be paid for.

In spite of warnings and threats of severe penalties, however, it was found that certain wiring contractors were influencing the sale of particular makes of appliances in preference to others, so defeating one of the objects of the arrangement that all dealers should have equal opportunities of effecting sales through the medium of the hire purchase scheme, and canvassers employed by certain firms frequently misled prospective purchasers of appliances by making promises impossible of fulfilment, which, besides causing annoyance to the purchaser, involved the Council in a great deal of trouble.

As a further example of the difficulty into which the Council fell through the grant of commissions to wiring contractors, it should be mentioned that although a considerable number of sales were credited to their legitimate efforts, there was little doubt but that in fact a number of such sales had not actually been canvassed by the contractors at all. Indeed in many cases it was known definitely that the prospects of a sale had been given by a dealer to a favoured contractor in return for the contractor having recommended to the prospective purchaser the make of range handled by that dealer.

It need scarcely be mentioned that for the majority of sales brought about by the efforts of contractors where circumstances indicated that the spirit in this regard underlying the hire purchase arrangements was being contravened it was found to be almost impossible to obtain proof of such dealings, and purchasers having knowledge of them naturally were reluctant to make statements involving those concerned. Indeed, it was found in may cases that the purchasers themselves had accepted inducements from contractors such as, for instance, the first instalment on an appliance, an additional plug point a lamp shade, and even a proportion of the contractor's commission.

It was generally the case that where electrical contractors pushed the sale of certain ranges in preference to others this was due to their being genuinely of the opinion that those makes were the best, but it was obvious that some did so for very different reasons by inference from the fact that certain of them were found to be pushing the sales of ranges represented by the dealers on whom they were dependent for the supply of material on credit. Furthermore, it appeared that some dealers were paying secret commissions to canvassers employed by wiring contractors and even to some of the wiring contractors themselves.

These practices naturally tended to undermine the progress of the Council's scheme. Consequently on the revision of details at the end of 1932 the payment of commissions to contractors by the Council was discontinued, so leaving the dealers to arrange for the employment of selling agents and for the payment of commissions on sales, and in view of the fact that henceforth the Council would be relieved of that expense the discount of 15% from the selling price previously allowed by the dealers to the Council on "major" appliances was reduced as described in page 80.

SECTION B.

Relations between the Council and Electrical Dealers.

Capetown Electrical Association.

As indicated previously, the Council, before introducing any important arrangement or modification to existing arrangements in the hire purchase scheme which would affect the dealers in appliances approved by the Council for re-sale to consumers, had consistently carried out the policy of first consulting such dealers with a view to obtaining their assistance and co-operation, and it is pleasing to be able to record that the spirit of co-operation and assistance evinced by them from the inception of the scheme has contributed materially to the success which has been obtained.

In furtherance of this spirit the dealers, in June, 1931, formed "The Capetown Electrical Association" whose objects are :—

(a) To promote the sale of all appliances accepted by the Council.

(b) To stabilise discounts, conditions of sale, and to co-operate with the Council regarding service arrangements and other matters of mutual interest.

It need scarcely be said that the formation of this Association facilitated contact with the dealers as a body and has permitted of working arrangements being come to in a manner more satisfactory to all concerned than was possible previously when considerable difficulty was sometimes experienced in determining a line of action reasonably acceptable to a number of concerns with individual interests.

The basis of the arrangements is that the consumer is at liberty to select any type and make of approved appliance from those handled by local dealers, whereupon on completion of the hire purchase agreement, the Council purchases the appliance outright from the dealer and recovers the cost thereof from the hire purchaser as described previously, and, as mentioned before, the Council was entitled in the first instance to a discount of 15% of the retail price in the case of "major" appliances and 20% for all other appliances.

As will be shown later, the amount of the discount received by the Council, together with the excess of the actual payment made by the purchaser over the retail price, by no means covers the Council's total expenditure, so that there is no need to stress the importance to the Council of its receiving its dues in full on every transaction. An essential condition in this regard, therefore, was that the Council having given approval to any type and make of appliance at the selling price specified by the dealer, that price should not on any account be altered without the prior knowledge and consent of the Council. Unfortunately it must be said that information was received on several occasions that appliances were purchased by consumers from dealers at lower prices than those appearing, in accordance with the approval of the appliance, on the same ranges belonging to the dealers and exhibited in the Council's showrooms. The immediate result, as will be understood was distrust of the Council's scheme by would-be purchasers.

Matters of this kind received special consideration upon the revision of the hire purchase arrangements at the end of 1932, and since at that date the Electrical Association was in existence to represent the views of the dealers as a whole it was possible to come to a clearer understanding on the question with all concerned than before.

Among the more important of the matters which were reviewed at that time should be mentioned the abolition of the payment by the Council of commissions to electrical contractors, the extension of the repayment period of electric ranges to two years (involving an extension of the dealers' guarantee of maintenance to two years) and the reduction of the discount received by the Council for "major" appliances from 15% to 12½% for sales on 12 instalments and to 10% for sales on 24 instalments.

Agreement entered into between Council and Dealers.

It was also mutually agreed that each individual dealer should enter into an agreement with the Council as a condition precedent to the approval of any of his appliances for sale under the hire purchase arrangements with the object once and for all of putting the system as concerned the relationships between the Council and the dealers on a sound basis.

The agreement which took effect as from the 1st January, 1933, embodied the revised arrangements of discounts referred to above, and provided for the Council receiving a preferential discount of 2½% over any other customer purchasing from the dealer and also limited the commission payable by the dealer to electrical wiring contractors who introduce sales to 5% of the basic price of the appliance.

This form of agreement was duly signed by all dealers concerned, but proved disappointing insofar as its object was to direct a line of conduct scrupulously fair to all, so that on its termination by effluxion of time at the end of 1933 a new agreement drafted in such a way as to profit by the experience gained in the previous twelve months was drawn up and entered into between the Council and the dealers for the year ending 31st December, 1934.

Revised Agreement.

The main provisions of this revised agreement, a copy of which is appended marked 1, are briefly as follows :—

(a) The retail price of every appliance for which application is made for approval under the hire purchase scheme must be clearly stated by the dealers and approval of the appliances includes approval of the retail prices quoted in the application.

(b) The retail prices so quoted must not be altered except with the consent of the Council, which consent will not be unreasonably withheld, and the dealers must not sell or offer or expose for sale any approved appliance for use in the Council's authorised area of supply except at the retail price as approved from time to time.

(c) The Council receives a preferential discount of $2\frac{1}{2}\%$ in respect of all appliances resold by it whether or not they have been aproved for resale under the deferred payment scheme.

(d) Any applianes that have been accepted for resale by the Council may not only be sold or offered or exposed for sale by the dealer for cash or on open account provided that such sales are made on the same terms and conditions as apply to cash sales made by the Council.

Further, dealers must not sell or offer or expose for sale under defered payment terms or the like any appliances which have been accepted by the Council for resale.

(e) The agreement provides, however, for a lower price being quoted than the retail price stated in the application for approval of an appliance (subject always to the prior consent of the Council having been given to such alteration) where such appliances are to be obtained by the dealer by special import to fulfil a specific order for approved appliances to be installed at one address. This arrangement however, is subject to the proviso that no such order shall be placed by the dealer until the Council itself has obtained quotations for the required appliances in accordance with the Council's practice in regard to calling for informal tenders, and it is subject to the further proviso that appliances so imported by dealers may be sold only for cash or on open account.

Moreover, the Council does not give any guarantee in respect of the appliances, nor undertake any responsibilities for servicing them.

For such purchases the Council is entitled to receive a preferential discount of $2\frac{1}{2}\%$ only calculated on the amount of the price at which the appliance is actually sold.

(f) The dealer is requied to guarantee the satisfactory performance of the appliances purchased from him by the Council and is required to bear the cost of carrying out all replacements which may be required due to defects or in which defects develop in the course of working conditions during the repayment period, particulars of which are given on page 74.

(g) The granting of commissions or the like by the dealer to anyone not in his regular employ in respect of the introduction of any prospective puchaser or in connection with the effecting of any sale of any approved appliance is prohibited.

(h) The Council has the right to cancel the agreement in the event of failure by the dealer to observe any or all of the terms of the agreement whereupon all appliances of whatsoever description belonging to him in any of the Council's showrooms or depots will be removed therefrom.

(i) The agreement also provides for a sliding scale of discounts to the Council according to the number of appliances ordered at the same time for installation at one address as described below :—

Number of Appliances ordered at the same time for installation at one address.	Deduction from Retail Price.	
	Discount (Trade 10% plus Preferential 2½%)	Discount, Quantity
1 to 5.	12½%	—
6 to 11	12½%	2½%
12 to 17	12½%	5%
18 or more	12½%	7½%
Groups " A " and " B " (See definition above).		
Group "C" Appliances. (See definition above).	(Trade 20%) 22½%	—

The "quantity" discounts described in the table are passed on to the purchaser by the Council.

In explanation of the discrimination in the agreement between appliances for resale and approved appliances it should be mentioned that a large number of appliances have been approved for resale by the Council and are exhibited in the Council' electricity showrooms for which hire purchase facilities are not granted, such as, for example, electric fans lighting fittings, vacuum cleaners and other small domestic appliances.

To give effect to the condition in regard to the maintenance of the appliances during the repayment period the dealers are required to provide to the Council an adequate number of spare parts liable to damage, quantities of which, such as, hot plates, thermometers, fuses, switches, etc., are kept at each of the Council's principal depots from which servicing is carried out as described in Section F.

It will be understood that it was necessary to prevent the working arrangements from becoming too unwieldy, to limit the number of different makes of appliances dealt in under the hire purchase arrangements so that, for instance, only twelve makes of ranges are handled at any one time, although a greater number of makes are obtainable in Capetown. Particulars of the makes and types of appliances sold under the deferred payment scheme during 1934 are given in appendix 2. This schedule is reviewed by the Council at the end of each year upon the recommendations of a Committee specially appointed for the purpose of dealing with applications from dealers for the approval of their goods.

Needless to say, the Council reserves the right at any time to discontinue the sale of any type or make of appliance which may prove unsatisfactory or which may be handled by a dealer with whom the above mentioned agreement has been cancelled as a result of his infringement of the terms and conditions thereof.

Since approval of any particular type and make of appliance is limited to one year the opportunity arises, when considering applications for approval of appliances for the ensuing year, to remove from the hire purchase list such appliances as have not proved popular or which have developed unsatisfactory features or of which, for any reason, only a small number of sales has been effected. The Council has, therefore, stipulated that to justify the re-inclusion of a particular make of appliance on the yearly revised list of approved appliances at least 36 models of each make of electric range must have been sold during the previous 12 months, while in the case of other appliances the corresponding minima have been fixed at 24 water heaters, 18 refrigerators, 6 washing machines and 12 irons and kettles, etc.

Since the Council is responsible to the purchaser during the full repayment period for the satisfactory performance of the appliance the Council will accept for resale under the hire purchase arrangement only appliances manufactured by reputable firms which are known to have been in use successfully for a reasonable time elsewhere and which are apparently suitable for local conditions and which, on being tested by the Department, indicate a high standard of electrical and mechanical construction.

Moreover, since the Council relies upon the dealers in approved appliances supplying all spare parts and replacements required during the repayment period, it gives due consideration when going into the question of approving of appliances to the standing and stability of the dealer therein, who, from this point of view, must not only be reasonably well established in business but must be prepared to interpret as liberally as the Council the Council's policy in regard to the degree of service to be provided to the purchasers.

While not an essential condition of the approval of electrical appliances, the Council nevertheless looks to the dealers to support the official Electrical Bulletin, described later in these notes, by the regular insertion of advertisements to the extent of either a full page or two half pages of advertisement each month where a variety of approved appliances is handled, while those dealing in either ranges or refrigerators or water heaters only are expected to provide at least one half page advertisement per month.

From the foregoing it will be appreciated that the Council has gone a long way in providing consumers of electricity with facilities to purchase domestic appliances of first-class quality at a reasonable cost and of ensuring as far as possible that entire satisfaction is obtained from those appliances, and further, that the dealers are encouraged to market only the best types of appliances and to retail them at the lowest possible figure consistent with economic trading.

SECTION C.

Installation Work—Relations between Council and Electrical Wiring Contractors.

An important feature of the scheme lies in the fact that it provides for consumers procuring the larger domestic appliances **completely installed ready for work** in their homes.

The necessary work is carried out by local electrical wiring contractors approved by the Council for performing such work. The essential quaification for the grant of this approval is that the firm must be well established in business and not merely a "carpet bagger."

In the first instance all electrical wiring contractors approved as such for the carrying out of installations under the Council's "Free Wiring" scheme were automatically approved as contractors for the wiring work involved in installing "major" appliances under the hire purchase scheme. In the course of time however, it was found desirable to compile separate approved lists for these two purposes.

Soon after the scheme was inaugurated it was found that some approved contractors, while content to carry out installation work under it which was placed in their hands, were not—as was expected of them—taking any steps to obtain new business of this nature. All approved contractors were, therefore, notified that unless each carried out at least 24 installations under the hire purchase scheme each year his name would be removed from the approved list and this is now a condition of their approval.

The list of approved contractors is revised at the end of each year and the name of any contractor who has not carried out 24 installations is automatically struck off to make way for others who, during that year, may have made application to be put on the list. At the commencement of 1934 the approved list contained the names of 38 electrical wiring contractors out of a total of 116 registered electrical wiring contractors in business as such in Capetown at the present time.

Purchasers of appliances for which the hire purchase terms include installation work, are permitted to select any one of these approved contractors to carry out such work, but if they have no particular choice the Council hands this out to approved contractors taking their names on the register in rotation.

Work included in Installation of Appliances.

Installation work of this nature to be carried out by a contractor includes :—

(a) The removal of all unsuitable internal service connections and the replacement of such service connections.

(b) In the case of electric ranges with a total connected load of or exceeding 3,500 watts (or costing £10 or more) the removal of all unsuitable main switches and main fuses from the main distribution board and the installation and connecting up of a combined main switch and distribution board supplied by the Council, including, if necessary, supplying and fixing a new meter board.

(c) The supply and connecting up of the electrical wiring work required between the main distribution board and the appliance, including the connecting up of plugs and sockets supplied by the Council in the case of electric ranges, refrigerators and washing machines.

(d) Erecting, connecting up and setting the appliance to work.

A copy of the specification to which this work must conform is appended marked 3, from which it will be seen that the Council has adopted the principle that all appliances with a total connected load of or exceeding 3,500 watts must be wired on the three-phase, four-wire system, but that all equipment with a lower total connected load may be connected on the single-phase system.

The specification prescribes a high standard of workmanship and materials, a point to which the greatest importance is attached in view of the necessity of avoiding as far as possible any likelihood of complaint or dissatisfaction arising out of the use of electric energy for domestic purposes.

The whole of the wiring installation work is paid for at schedule rates described later

Main Switch and Distribution Board.

Figures 1, 2 and 3 (Plate 1) illustrate the type of main switch and distribution board supplied by the Council to the contractor for installation with each electric cooking range with a total connected load of or exceeding 3 500 watts; while figure No. 4 shows this apparatus together with the service fuses, meter and other apparatus arranged on a hard wood board forming typical control equipment for an all-electric house.

As will be seen from the illustration and from the diagram of connections on the last page of appendix 3 as well as on the diagrams of connections for typical domestic wiring installations (appendices 4A and 4B), this main switch and distribution board consists essentially of a triple-pole, metal-clad, quick-break, air-break, main switch controlling the supply to three 30-ampere fusible cut-outs of the Home Office pattern for the supply of electricity on the three-phase system to the range and controlling the supply also to three 30-ampere single-phase circuits, as well as a neutral isolating link, the whole of this equipment being enclosed in a substantial, metal case with hinged covers.

In small installations the three single-phase circuits would be used to protect lighting circuits or one or two wall socket circuits without using sub-distribution boards for these purposes, but the intention primarily is that these cut-outs should be used as main cut-outs for sub-distribution boards using, for example, one pair for the lighting circuits and the other two for heating plug points as shown on the diagrams marked appendices 4A and 4B.

An important feature of this apparatus is that although that portion of the cover over the cut-outs controlling the supply to the range is interlinked with the switch so that it cannot be opened unless the switch is in the "off" position, the cover over the "power and lighting circuits" is not so interlinked so permitting of the replacement of fuses on those circuits without interfering with the supply to the range.

A complete specification of this apparatus is appendix 5.

These combined main switch and distribution boards are purchased by public tender in lots of upwards of 1,000 and the price at which the last lot of 4,000 were obtained worked out at £1 2s 5d., each delivered in the stores of the Electricity Department.

Method of Connecting up Cooking Ranges.

The Council also hands over to the wiring contractor a metal-clad, four-pin (three phases and neutral) plug and socket for the connection of each electric range to the range circuit together with three feet of flexible metallic cunduit to protect the conductors between the plug and the range terminals, and the contractor is required to mount the socket on an approved hard wood block with the face of the socket facing vertically downwards in a position conveniently near the place at which the range will be used.

These plugs and sockets and the flexible conduit are illustrated in figure 5 (Plate 1) and are described in detail in the specification appendix 6. The complete installation of an electric range showing the use of the sockets and flexible metallic conduit is shown in figure 6.

The current carrying parts of the plugs and sockets are nominally of 15-ampere rating. Where the loading of the range exceeds 15 ampere per phase the connection to it is usually made directly by conduit terminating at the range without the use of a plug and flexible conduit, but ranges of this size are seldom applied for under the hire purchase scheme.

The plugs and sockets used for two-wire connections are generally similar to those used for three-phase connections except that they are of the two-pin and neutral pin type.

As will be seen from the specification and the illustrations, the apparatus used provides for continuous metallic connection between the range and the circuit conduit or metallic covering over four-core cables, if such are used, by means of a back nut on the thimble entering the range in which is screwed the flexible metallic conduit and through a corresponding screwed coupling at the other end of the conduit entering the plug, the earthing connection being completed through the screwed connection coupling between the plug and socket portion and thence through the screwed connection to the circuit conduit. Glands are used at the inlet to the sockets to make connection between the armouring of cables and the body of the socket.

This method of connecting up ranges has been prescribed in order to ensure that a thoroughly reliable job is made, and this type of plug and socket, of which at the present time approximately 8 000 are in use in the Capetown area of supply, has been standardised to ensure that when a range is moved from one premises to another the consumer will be put to no more trouble in reconnecting the appliance than merely to "plug it in" to the socket previously used for the connection of an electric range in the new premises.

Plugs and sockets of this type introduced in Capetown under the hire purchase arrangements have been standardised for a similar purpose by the Electricity Supply Commission and also by other Municipal Electricity Undertakings in South Africa.

These appliances are also purchased in lots upwards of 1,000, and the last lot of 4,000 were purchased at 8/– each delivered to the stores of the Electricity Department.

Schedule Prices for Installation Work.

In the first instance the schedule rates which were paid for the carrying out of installation work were based upon estimates for the cost of materials ruling at the time with the intention of revising them as may be shown to be necessary in the light of experience. The prices fixed were found to be higher than could be justified, and since that time reductions and revisions have been made in conformity with the ruling prices for labour and materials, particulars of which are given in appendix 7. At the present date the schedule rates are as follows :

Minimum Payment.

The minimum amount payable to a contractor for any installation work carried out by him on on one contract is £2 0s. 0d.

Service Connections.

For the service connection the contractor provides, installs and connects up the necessary 7/.064", four-core, galvanised-wire-braided, lead-covered, V.I.R. cable or alternatively four 7/.052" V.I.R. conductors in screwed conduit up to a length of 20 feet run for the minimum sum of £2 0s. 0d. Any length above 20 feet is paid for at a flat rate of 1/9d. per foot run.

Cooking Range (four-core cable or four conductors in conduit.

For installing, connecting up and setting to work a range with a total connected load of or exceeding 3,500 watts the contractor receives the sum of £1 10s. 0d., for the carrying out of all work other than providing, installing and connecting up the conductors between the socket outlet to the main switch and distribution board.

For this part of the work he is paid at the rate of 1/9d. per foot run of circuit (provided always that the total amount payable for the complete installation be not less than the agreed minimum of £2 0s. 0d.)

Installation of Other Appliances.

For installing and connecting up other appliances such as washing machines and water heaters, for which the instalment repayments include installation by the Council, the wiring contractor receives payments at the following rates :

(a) For connections requiring 7/.064" and 7/.052" four-core cable or four conductors in conduit — 1/9 per foot run of circuit.

(b) For connections requiring 7/.036" twin cable or two 7/.036" conductors in conduit — 10d. per foot run of circuit.

For installing and connecting up washing machines and refrigerators the wiring contractor is paid a minimum of £2 0s 0d., each, which sum includes a plug and socket outlet and wiring up to a length of 50 feet run. Lengths in excess of 50 feet are paid for at the above mentioned rates, i.e., 10d., per foot run.

(Examples of the operation of this schedule are given in appendix 8).

Installations in Blocks of Flats.

When installations of electrical appliances are made under the hire purchase scheme in a block of flats the electrical contractor is required to install conductors for the main service connection of a size which will be sufficient to carry the load on the assumption that heavy current consuming appliances, i.e, cooking ranges, will eventually be installed in all of the flats.

In calculating the size of the connection required a diversity factor of 0.75 is allowed.

The schedule price for the service connection in such cases quoted on page 34 is increased by ten per cent. per flat for every flat exceeding two, e.g. :

NUMBER OF FLATS IN BLOCK.	Schedule Rate for making INTERNAL SERVICE CONNECTION.
For the first two flats	Ordinary rate, i.e.— £2 0s. 0d., for 20 feet plus 1/9d. per foot run over 20 feet of circuit.
For three flats	Ditto ...... plus 10%.
For four flats	Ditto ...... plus 20%.
For five flats	Ditto ...... plus 30%.
For six flats	Ditto ...... plus 40%.

etc., in steps of ten per cent.

Procedure regarding carrying out and completion of Installation Work.

Notwithstanding the fact that a hire purchase agreement may have been entered into for the purchase of an appliance, for the installation of which the Council is responsible, no installation work is commenced until the owner of the premises, or his agent, in which the installation will be made has given his consent to the carrying out of such work and has undertaken that the appliances installed therein under the hire purchase arrangement shall be free from seizure for arrears of rent. If this consent and undertaking has not been received the selected wiring contractor for the installation work is required to obtain these consents before commencing work, and the failure to do so involves a refusal by the Council to make payment for any work carried out by him in that connection.

Instructions to the contractor to carry out installation work and to obtain the above-mentioned consent and undertaking by the owner are given on the appended form marked 9. That portion of the form which relates to the owner's consent must be detached and returned to the Electricity Department as soon as it has been completed, and when the contractor has completed his work he returns the remaining portion of the form on which he is required to state particulars of the work carried out by him. Upon receipt of this an inspector employed by the Electricity Department is instructed to inspect the appliances and installation and to enter upon the appended form marked 10 the lengths of the wiring circuits as measured by him independently of the contractor. All measurements are made to the nearest foot.

Authorisation of Payment for Installation Work.

The lengths of the various circuits as measured by the inspector are then checked against those claimed by the contractor, and when the two are in accord the usual office routine is followed in making payment in the same way as applies to payments for any other work or material.

Upon the inauguration of the scheme the Council retained 10% of the amount due in respect of any installation work for twelve months as security against the cost of maintenance or repair that may be required during that period as a result of faulty workmanship or material. This, however, involved so much additional accounting work that the system has been discontinued, and instead of retaining 10% of each contract amount for twelve months, each contractor is required, as a condition of his approval under the hire purchase scheme, to lodge with the City Treasurer a deposit, the amount of which is left to the discretion of the City Treasurer, but is usually £100 in the form of Capetown Municipal or other Government Stock or other approved security for the proper fulfilment of their contracts, in consideration of which payment is made in full on the completion of every contract.

External Service Connections.

In every case where it is necessary to alter the external portion of an existing service connection suitably for the three-phase supply required for the premises this work is carried out by the Council free of charge to the consumer.

Before the inauguration of the scheme the great majority of the supplies to consumers' premises were given by means of single-phase service connections, and it will, therefore, be appreciated that in most instances where electric ranges have been installed in old premises it has been necessary for the Council to make this alteration. Indeed, it was found that so many of the older single-phase connections have had to be replaced by three-phase, four-wire connections that the Council proposes to obtain the necessary powers by regulation, as a means of saving cost in the long run, to require installations in all houses of three or more living rooms to be wired for the three-phase, four-wire supply system whether or not the actual load requirements at the time of installations require that system of supply.

SECTION D.

Arrangement between Council and Purchaser.

It will be gathered from the foregoing that the hire purchase arrangements provide for everything possible being done to smooth the way for a prospective user of domestic electrical appliances to obtain such appliances with a minmum of trouble and a maximum of satisfaction. Indeed, it may be confidently claimed that no stone is left unturned to ensure that the appliances purchased give every satisfaction, and attendance to this part of the arrangements is one of the major features of its working.

While the Departmental arrangements are such as to protect the Council's interests financially as far as possible, it is not insisted upon that purchasers are registered owners of property, so that any consumer of electricity to whom objection is not taken by the City Treasurer on financial grounds may take advantage of the hire purchase arrangements.

Where the financial standing of a would-be purchaser is such that the City Treasurer deems it desirable that a guarantee or other suretyship for the due fulfilment of the terms and conditions of the agreement in respect of the payment upon instalments of the appliances is necessary to safeguard the Council's interests, the provision of such guarantee or suretyship is required before delivery of the appliance will be made.

Copies of the forms of agreements for the hire purchase of electrical appliances (other than water heaters) and for water heaters are appended marked 11 and 12 respectively. These forms of agreements are on the usual lines and do not call for special comment.

The accounts for monthly instalments for appliances purchased are included with the monthly accounts for electric energy consumed, and these instalments are subject to an increase of 10% in the event of payment being made after the due date. In conformity with the accounts rendered for electric energy consumed the due date of payment is fifteen days aftr the date of rendering the account.

The Council has suffered little or no loss through failure on the part of hire purchasers to complete their contracts, and the popularity of the scheme, as evidenced by the numbers of appliances purchased, particulars of which are given later, is an indication of the good relationships which are maintained between the Council and those taking advantage of these facilities.

SECTION E.

Appliances,

As stated previously, no appliance or make of appliance is approved for sale under the Council's hire purchase scheme until the Council is entirely satisfied from inspection and tests carried out by its own officials, supplemented by reports as to its use elsewhere, that it is a thoroughly reliable piece of apparatus. It must also be of pleasing appearance. As a further safeguard the dealer in the appliance is required to guarantee its satisfactory performance.

The types and makes of appliances approved for sale under the hire purchase scheme for the twelve months ending 31st Decmber, 1934, are dscribed in appendix 2.

Refrigerators.

The refrigerators sold under the hire purchase scheme are of various sizes upwards of 4 cubic feet capacity and all are guaranteed by the dealers to give satisfactory operation for the same period as that given by the manufacturers (usually four years).

Water Heaters.

Water heaters are obtainable under the hire purchase arrangements in the following sizes :—2½, 5, 10, 20, 30, 40, 60, 100 and 200 gallons. They may be installed for either a "push-through" or "multiple-outlet" system, but the last-mentioned system is restricted to heaters of 30 gallons and more capacity.

The heaters must conform to the requirements of the appended specification marked 13.

The Council has recently introduced an "off-peak" water heating rate on which supplies of electric energy may be given to water heaters to the specification set out in appendix 13 provided always that they are of sufficient storage capacity and are fitted with elements of sufficient loading for the probable hot water requirements.

Subject to these conditions being met deferred payment facilities will be extended to water heaters for use on the "off-peak" rate of charge.

The "off-peak" water heating rate is 0.375d. per unit for the first 500 units per month and 0.25d. per unit for all units in excess of 500 per month.

The introduction of this rate followed the development of a type of control apparatus to give effect to a proposal originating from the Council's Electricity Department that supply to the water heater might with advantage be controlled by the current in the neutral service conductor. A description of this control equipment, which is on the point of being delivered in large numbers, is given in appendix 14, and the method of connecting "off-peak" water heaters to the supply service connections is indicated in appendix 4B.

The Council will, if so desired carry out the electrical installation work for all sizes of water heaters, and will also, if so desired, carry out the plumbing work required for installing water heaters of not less than ten gallons capacity.

When the Council first undertook responsibility for the plumbing work it employed for the purpose local registered plumbers, and the electrical and plumbing contractors were then separately responsible to the Council for the proper and expeditious carrying out of the two parts of the installation. Trouble was soon experienced with this arrangement, however, mainly through difficulty in obtaining co-operation between the two contractors, and the arrangement now come to is that the electrical contractor is made responsible for the carrying out of all installation work, including the plumbing work, but is required to employ only registered plumbers for that part of his contract. It will be seen, therefore, that the Council will arrange for the installation of both electrical and plumbing work or electrical work only, but that the scheme does not provide for the Council undertaking plumbing work exclusive of electrical installation work.

In the event of the Council undertaking responsibility for the installational work, the amount of the repayments instalments is 1/- per month per £1 of the basic price of the appliance which is determined by adding 5% to the retail price of the break-pressure tank. If the purchase is made on 24 monthly instalments the electrical installation only is included, but where the repayments are made over 27 months (in the case only of "push-through" types of water heaters) the instalments will include for the carrying out of the plumbing work also subject to the limitations of material referred to below. Where the purchase is made on 30 monthly instalments (in the case only of "multiple-outlet" systems) the purchase price includes the plumbing installation in addition to the electrical installation subject also to the limitations of material described below.

Schedule Rates for Plumbing Work.

The schedule rates for the plumbing work are as follows :—

(1) **"Push-through" Systems.**

For supplying all necessary piping to a maximum of 20 feet, valves and other material, including connecting up to existing cold water service, installing an open outlet to the water heater, and making good all damage for :—

One water heater of not less than 10 gallons but less than 30 gallons capacity ....£3 10 0.

One water heater of 30 gallons capacity and more up to 200 gallons capacity .... £5 0 0.

(2) **"Multiple-Outlet" Systems.**

For supplying all necessary piping to a maximum of 100 feet, valves, and material, including not more than three taps, and including connecting up to existing cold water service, and expansion piping, and installing and connecting up supply cistern (if any) required, and making good all damage for :—

One water heater of 30 gallons capacity and more up to 200 gallons capacity .... £11 10 0.

All plumbing work must be carried out strictly in accordance with the Council's Waterworks Regulations and must comply with the Electricity Department's specification for water heaters mentioned above.

All piping used in the plumbing work must be of copper of not less than ½" internal diameter.

If more than the above-stated maximum lengths of piping or outlets are required for any installation the cost of extra piping is paid for at a flat rate of 1/3d. per foot and 7/6d. per outlet with tap.

Ranges and Ovens.

Any size of cooking range may be purchased on the instalment plan, but, as mentioned previously, the repayment instalments do not include the installation of ranges with a loading of less than 3,500 watts costing less than £10 0s. 0d.

In selling a range, as with any other appliances the Council's staff makes a point of advising purchasers to buy a range that will be large enough to satisfy his or her present or future culinary needs so as to obviate any risk of disappointment in the appliance later.

On the recommendation of the Electricity Department, after going into the merits of each case, these facilities may be extended also to heavy duty types of equipment such as may be required for cafes, hotels, hospitals and institutions generally. Where two or more items are required to make up a complete heavy duty installation the whole of such equipment must be purchased either inclusive or exclusive of the wiring installation work. It is not permissible for a purchaser to acquire under deferred terms part of the appliances **with** the wiring installation and the remainder **without** the wiring work, it must be either one thing or the other.

Washing Machines.

The washing machines sold under the hire purchase arrangements include makes representative of all of the well-known principles applied to this purpose, namely, those relying on stirring motion, others operating by rotation of the articles and allowing soapy water to pass through the material. Others again are washing machines only without means for drying; while some include wringers or produce a drying effect by centrifugal force. There is thus a wide variey of apparatus of this kind open to prospective purchasers, and sales of these are increasing gradually as their advantages become better known.

Kettles, Irons, Etc.

Only those makes of kettles, irons and perculators are sold under the deferred payment scheme which are fitted with special means of automatically opening the supply circuit in the event of the appliance becoming dangerously overheated. Each of the appliances of this type mentioned in appendix 2 are protected against destruction in this way.

Repayment Instalments.

The amounts of the repayment instalments for the various classes of appliances and the work included therein are shown in condensed form in appendix 15.

SECTION F.

Servicing of Appliances.

Considerable care has been taken to build up an efficient servicing organisation whose primary function is to attend promptly to every complaint and to give advice on matters concerning the use and operation of all electrical domestic appliances whether purchased under the hire purchase scheme or not.

This service is exercised by a sub-division of the Installation Division of the Electricity Department, making use of the services of the electrical wiring installation inspectors of that branch in co-operation with the mains superintendents of the districts into which the supply area is divided as shown in the map forming appendix 16.

Complete sets of spare parts, such as hot plates for ranges, heating elements, fuses, switches, thermometers, plugs, etc., for every make and type of appliance sold under the scheme are kept in readiness at servicing depots established in each of these districts for the immediate replacement of any part of any appliance that may become defective. Any such hot plates, elements, etc., are immediately replaced by complete new similar parts and the defective parts are returned to the dealer who is required to hand over to the Council at once identical sound parts to bring the spares held at that depot up to full strength.

A complaint in regard to an appliance or installation may be made either verbally or in writing to any of the depots or showrooms, and in either case is immediately passed on to the head offices of the Department in the City. Upon its receipt there a "service report" of which a sample is appended marked 17, is completed in triplicate, setting out as fully as possible particulars of the complaint, two copies of which are forwarded to the servicing depot in the district concerned whence a man is sent immediately to the address given on the form with such spare parts as are thought to be necessary to rectify matters. At the same time the serial number of the "service report" and the date of the same are entered on a consumer's service record card, illustrated in appendix 18, to which a 'red' tap is attached denoting that that consumer's appliance is being "serviced."

On completion of the investigation by the service man he fills in in duplicate on his copies of the "service report" particulars as to what action he has taken and of the parts, if any he has replaced, one copy of which is returned to the service division at the head offices of the Departmnt, the duplicate being retained at the district depot for record purposes. All particulars are then entered on to the consumer's record service card by a clerk in the service division.

If, however, the service man finds that a defect in an appliance is such that it cannot be rectified by a replacement from the sets of spares at the depot he notifies the servicing division who then get in touch with the dealer requesting him to effect the necessary repair or replacement. This is also entered up on the consumer's record service card referred to above and a 'blue' tab is affixed showing that the appliance is to receive the attention of the dealer.

All defective parts which have been replaced are returned to the dealers under cover of the appended form marked 19.

In order that no complaint may be overlooked the service record cards are periodically scrutinised and notes are made of any service reports that are not returned to headquarters within a reasonable time. If a service report has not been returned within that time the servicing depot is communicated with and asked to give reasons for the delay.

When service reports are returned from the depots they are forwarded to the Hire Purchase branch described in Section H to be attached to the respective agreements under which the appliances have been purchased.

A record is also kept of all the defects that occur and replacements that are made in respect of every appliance serviced so that it can be seen at a glance how the various makes of appliances are behaving as to reliability and trouble-free operation.

The depot is required to furnish to the service division every month on the appended form marked 20 a complete schedule of complaints attended to during that month.

On the expiration of a hire purchase agreement the appliance is given a final inspection, during which it is thoroughly overhauled—any defects being rectified— and left in good working order prior to it (and the responsibility for its maintenance) being handed over to the consumer. A report of the final inspection is entered up on the appended form marked 21 which the consumer is requested to sign. This form is forwarded by the depot to the service division who then sends to the consumer a stereotyped letter pointing out that the guarantee by the Council under the hire purchase agreement has expired and that any future repairs must be undertaken at his or her own expense, but offering such advice and assistance as may nevertheless be required and can be given.

SECTION G.

SHOWROOMS

ADVERTISING and PUBLICITY METHODS.

Although a considerable amount of advertising and other propaganda matter dealing with the use of electricity for domesic purposes had been used before the deferred payment scheme came into being these activities have been greatly intensified since its inauguration.

The media adopted for bringing home to the prospective consumer the advantages of running a home by electricity are many and varied and cover a wide field.

Showrooms.

One of the most valuable means of keeping consumers informed of the uses of electricity for domestic purposes has been the showrooms, one of which has been established in each of the main residential areas outside the central city area, with a central showroom in the principal business part of the City. Photographs of the showrooms in the principal residential areas are shown in figures 1 to 4 (Plate 2).

The showrooms serve the purpose primarily of centres for the display and demonstration of the various makes and models of appliances that are obtainable under the Council's deferred payment scheme and also of smaller electrical appliances and labour-saving devices as well as lighting fittings which, although not procurable under the scheme, are nevertheless sold for cash. All the appliances on exhibition in the showrooms are loaned to the Council for the purpose by the various dealers and contractors in the City.

One of the great advantages of these showrooms to the public lies in the fact that consumers and prospective purchasers of appliances may go there to inspect and compare the merits of different makes and models of appliances procurable under the scheme to suit their requirements and purses without feeling under any obligation to buy anything.

The showrooms also serve as depots for the payment of electricity and water accounts, rates and other Municipal revenue, and by this means the availability of all kinds of domestic appliances is brought to the notice of many ratepayers who otherwise would probably never consider using any appliances beyond the usual electric iron and kettle.

The extent to which the showrooms are used as receiving depots for all kinds of Municipal revenue and incidentally their value for propaganda purposes will be realised from the figures given in the following tables which show the amount of revenue collected and the number of receipts issued to people who have visited the showrooms to pay their accounts since the first showroom was inaugurated in 1927.

Receipts Issued at Showrooms up to and including February, 1934.

Year.	Sea Point Showroom. (Opened—20/1/27).	Wynberg Showroom. (Opened—7/2/29).	Woodstock Showroom. (Opened—13/7/29).	Central Showroom. Strand St. (Opened—27/10/30).	Mowbray Showroom. (Opened—5/5/33).	Total.
	£	£	£	£	£	£
1927	2,697	—	—	—	—	2,697
1928	4 824	—	—	—	—	4,824
1929	7,803	3,270	680	—	—	11,753
1930	10,703	7,222	4,612	173	—	22 710
1931	13,983	12,329	11 633	2,631	—	40,576
1932	15,623	17,182	16,920	9,419	—	59,144
1933	16,428	20,921	19,757	26,864	6,049	90,019
1934 (2 months)	3,055	3,984	3,614	6,363	2,858	19,874
TOTAL	75,116	64,908	57,216	45,450	8,907	251,597

Cash received at Showrooms up to and including February, 1934.

Year.	Sea Point Showroom. (Opened—20/1/27).	Wynberg Showroom. (Opened—7/2/29).	Woodstock Showroom. (Opened—13/7/29).	Central Showroom. Strand St. (Opened—27/10/30).	Mowbray Showroom. (Opened—5/5/33).	Total.
	£	£	£	£	£	£
1927	7,208	—	—	—	—	7,208
1928	12,020	—	—	—	—	12,020
1929	18,454	4,933	760	—	—	24,147
1930	24,557	10 032	7,566	412	—	42,567
1931	33,122	20,053	20,573	6,602	—	80,350
1932	38,291	24,651	22,135	21,949	—	107,029
1933	40,244	30,017	28,190	66,958	11,014	176,423
1934 (2 months)	4,599	4,744	3,567	12,976	4,072	29,958
TOTAL	178,495	94,433	82,791	108 897	15,086	479,702

The staff at each showroom consists of one lady attendant in charge and a native cleaner. All five showrooms are supervised by one lady assistant. All attendants are qualified to demonstrate and advise on the use of the various appliances, and it is, of course, a strict rule that any advice given by any members of the staff of the Electricity Department must be absolutely impartial.

The principal showroom in the centre of the City also contains a demonstration hall seating approximately 150 persons where free demonstrations and lectures are given in the evening at least once a week by a lady demonstrator. Cooking demonstrations are given on the various makes and models of ranges that may be purchased under the deferred payment scheme. An important feature of the demonstrations is the provision of means of enabling members of the audince to see for themselves how much electricity is being consumed during the preparation for and cooking of a dish and what it is costing. This is done by means of two meters each fitted with a large scale suitably calibrated in kilowatt hours and pence respectively and having a pointer which can be seen from a distance. The meters are connected in the circuit supplying the range and, as will be seen from figure 5 (Plate 2), they are erected in a conspicuous position on the platform where the demonstrations are made.

At the end of each demonstration the dishes prepared by the demonstrator are available for sale at a nominal cost to members of the audience. A record is kept of the attendance at each demonstration and of the value of the dishes prepared and disposed of. Recipes of the dishes that are to be prepared during the demonstrations are distributed to members of the audience on typewritten forms.

The demonstrations are given by a lady demonstrator and an assistant lady demonstrator who are also required to attend as may be desired at the houses where ranges have been installed to show consumers how to make the best use of their appliances.

The central showroom is at present housed in an old building which is to be pulled down shortly to make way for a new building to be known as "Electricity House" which will be the future headquarters of the Electricity Undertaking of the City. The new building will, in the first instance, be only of four storeys, but provision is being made to extend it to ten storeys at a later date. A perspective view of the proposed new building when built to its full height is shown in figure 6 (Plate 2).

The greater portion of the ground floor will be used for exhibiting modern domestic appliances. Accommodation will be provided on this floor also for clerical assistants who deal with records of consumption of electricity, electricity accounts, and other matters of that nature, and a counter will be provided at which consumers can transact any business relating to electricity supply. At this counter also ratepayers will be able to pay all manner of Municipal accounts in the same way as is done at the present time electricity showrooms.

The first and second floors will be used solely as office accommodation for the Electricity Department, while the third floor will be used mainly to accommodate a drawing office and a demonstration hall for the carrying out of public demonstrations in the use of electricity for cooking and other domestic purposes. Adjoining the hall a model dining room, model kitchen, etc., will be fitted out as actual examples of the use of electricity in the home. The demonstration hall will have seating accommodation at third floor level for approximately 125 persons and will be surrounded by a gallery at fourth floor level accommodating a further 75 persons.

Exhibitions.

With the co-operation of electrical dealers and wiring contractors the Electricity Department has also organised public exhibitions of domestic appliances which take the form of displays by the various dealers and contractors of the different makes and models of all kinds of electrical appliances put on the market by them. It also gives strong support to similar exhibitions organised by others, the latest of which was a Modern Home's Exhibition organised by a leading Capetown newspaper. Public demonstrations are given during the course of these exhibitions in the use of the different appliances, and lectures are given by specialists on the many uses that can be made of electricity in the home for lighting, heating, cooking, refrigerating, etc., purposes.

Lectures to Ratepayers and Public Bodies.

Among others methods used for keeping the public informed on electrical matters generally and more particularly on the work of the Electricity Undertaking itself should be mentioned the lectures and addresses which have been given from time to time by the City Electrical Engineer under the auspices of ratepayers' associations and other public bodies. The lectures are illustrated by lantern slides, of which a large number have been prepared to illustrate the activities of every branch of the Undertaking.

Advertising.

Extensive use is made of the daily press as well as of popular weekly and monthly journals circulating in the City to bring prominently to the notice of the public the advantages of the use of electricity for domestic purposes and the availability of the hire purchase scheme. The local newspapers themselves also help considerably in this matter through their regularly featuring lengthy articles of an educative and instructive nature on electrical matters, "copy" for which is supplied by the City Electrical Engineer as and when desired. These pages also contain advertisements by electrical dealers and wiring contractors.

Another popular and effective means of advertising adopted by the Council is the exhibition of slogans in prominent places, many of which take the form of illuminated signs at the electricity showrooms and at the offices of the Electricity Department.

Cinema Slides.

The Council also makes use of the exhibition of lantern slides at the commencement and during the interval of the programmes of the local cinema shows. Each slide is thrown on the screen for an interval of approximately ten seconds at each showing, for which the cinema proprietors charge from £1 10s. 0d. to £8 0s. 0d., per month according to the standing of the cinemas at which they are exhibited.

Electrical Bulletin.

Another effective means of keeping consumers advised and interested in electrical matters which the Council has adopted is the monthly issue of a small booklet containing instructive articles on the use of electricity for various purposes, and also articles of general interest, cooking recipes and advertisements.

A copy of this booklet is enclosed with each consumer's electricity account.

It is compiled, edited and published by a local publishing firm free of charge to the Council. The publisher supplies the Council with as many copies as are required for distribution among domestic consumers who, at the commencement of the year 1934, numbered close on 22,000.

The front and back covers of the Bulletin are reserved by the Electricity Department for printing thereon slogans and illustrations descriptive of the merits of electricity for domestic use.

In addition, a handbook has been published by the Electricity Department for the information and guidance of consumers dealing comprehensively with matters relating to the supply and use of electricity for domestic purposes, while another booklet has been issud by the Department which deals particularly with the hire purchase scheme.

The Council is a Dominion Member of the Electrical Development Association of Great Britain and as such receives copies of pamphlets, advertising matters and booklets issued by the Association of which every advantage is taken in promoting the greater use of electricity for domestic purposes in Capetown.

SECTION H.

Administration of Deferred Payment Scheme.

Organisation of Sales Division of the Electricity Department.

The Council's hire purchase scheme is administered by the Sales Division of the Electricity Department. For the convenience of the public the work of the Division is centered in the same building as that housing the Council's central showroom in the heart of the City in preference to the principal offices of the Department which are still located at the Power Station site.

The working of the Sales Division is superintended by an Assistant who is directly responsible to the Commercial Assistant of the Electricity Department. This Assistant in charge has the undermentioned staff under his immediate direction :—

(1) A clerk and junior clerks.

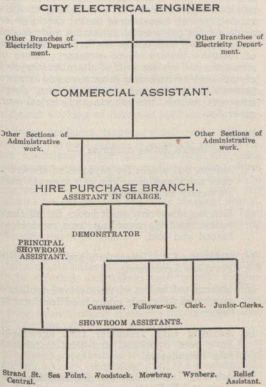
(2) A follower-up and home demonstrator (female).

(3) A canvasser (male).

(4) A principal showroom assistant (female) who in turn is in charge of female assistants in the individual showrooms, including a relief assistant, and cleaners.

(5) A demonstrator (female).

The organisation of the Hire Purchase branch is represented graphically in the following "tree" diagram :—



The duties performed by this staff briefly are as follows :—

Assistant in Charge of Sales Division./

This official is held responsible for the efficient running of the division. He has general supervisory duties; deals with correspondence and checks Hire Purchase Agreements and advices; attends to statistical records; interviews consumers, dealers and wiring contractors; organises and directs drives, demonstrations, etc., to obtain new business; assists with stocktaking at showrooms and with adjusting of books; checks orders made out for payment of appliances sold; records sums retained and makes out orders for paying of retention monies where necessary; issues instructions and advises staff of alterations in prices of appliances; circularises consumers and arranges propaganda work, such as, exhibitions, checks transport records, time sheets and clerical work generally.

Clerk.

The clerk's duties comprise :—

(a) Making out orders for payment of showroom cash sales and recording of payments made on weekly sales returns.

(b) Keeping showroom stock books for all showrooms, involving recording items received, returned and sold.

(c) Obtaining City Treasurer's approval to Hire Purchase Agreements.

(d) Making out orders in payment of appliances purchased for resale under the Hire Purchase Scheme.

(e) Advising City Treasurer that agreements have been completed and that instalments may be collected.

(f) Advising Installation and Distribution Divisions and Follower-up of sales completed.

(g) Keeping records of Hire Purchase sales.

(h) Keeping bus and tram ticket records.

(i) Attending to consumers' requests regarding delivery of goods from dealers and wiring contractors regarding special requirements.

(j) Interviewing prospective purchasers in the office when required, and assisting generally with office work.

Junior Clerks.

The junior clerks perform such minor duties as indexing, filing, envelope addressing, sending out circular letters, etc., and generally assist the clerk and other officials mentioned above.

Follower-up.

This employee is experienced in cookery and keeps in touch with consumers and gives such instruction and advice as will lead to the most efficient working of domestic appliances.

Every appliance, large or small, sold under the deferred payment scheme is inspected under working conditions by her, and in addition she visits consumers who purchase appliances direct from dealers. She also pays visits, when desired, to consumers who purchase appliances under the scheme for the purpose of giving practical demonstrations in cookery, and she also carries out routine inspection of cooking appliances during the repayment periods.

She reports the defects, if any, noted on her visits, drafts letters to dealers if replacements are to be effected, and follows this up with further visits to ascertain if the adjustments or replacements have been made. She also advises the Servicing Branch of any matters needing adjustment by that branch.

She deals with correspondence received from consumers appertaining to faults in appliances and follows up such complaints until the consumer obtains satisfaction.

Canvasser.

This employee is employed as a canvasser of new business. He calls on consumers who are unable to attend a showroom for the purpose of completing the form of Agreement and generally acts as the Department's out-door representative. He interviews prospective purchasers in their homes on receipt of written or telephonic communication and attends to business introduced by dealers or wiring contractors. He assists with correspondence dealing with requests for particulars relating to the hire purchase scheme.

Principal Showroom Lady Assistant.

This employee is responsible for the work performed in the showrooms in as far as it affects the showrooms themselves. She is required to maintain stocks up to strength; to inspect new appliances and fittings and report on their suitability for sale; arranges the window displays and the setting out of the showrooms; sees that price tickets and display cards are provided for each showroom, and acts as showroom assistant when not otherwise engaged; supervises showroom work generally. In addition she also acts as canvasser for new business under the hire purchase scheme and calls on consumers to give advice and instruction in the use of appliances.

Showroom Lady Assistants.

There are five showrooms, viz, Round Church (Sea Point), Wynberg, Woodstock, Mowbray and Strand Street central showroom, the duties of the assistants in charge of which consist of :—

(a) Receiving, banking, recording and issuing receipts for any monies paid by ratepayers in respect of rates, electricity and water accounts, etc.

(b) Receiving, recording in the stock books and giving receipts for all goods sent for exhibition or sale.

(c) Returning, recording and obtaining receipts for all goods returned to dealers.

(d) Selling appliances not included under the hire purchase scheme, including the receiving of cash, issuing of receipts, advising dealers by means of a "Sale Form" and recording the transactions in the stock book in the event of articles being sold from showroom stock.

(e) Selling appliances under the deferred payment scheme which includes preparing Hire Purchase Agreement Forms and receiving first instalments.

(f) Preparing—for Head Office—weekly returns of goods sold.

(g) Giving information and advice regarding various appliances, electricity tariffs, and other electricity supply matters. Demonstrating the larger appliances, if necessary.

(h) Attending to the completion of application forms for new supplies of electricity or for the extension of existing supplies, etc.

(i) Receiving complaints of failures of supply and transmitting such reports to the proper quarters for attention.

(j) Performing such duties as are usually carried out in the suburban offices of the City Treasurer in regard, for example, to issuing dog licenses, arranging for special refuse removals, attending to queries as to Municipal accounts, etc.

Lady Demonstrator.

The duties of this employee are to arrange for and give public cookery demonstrations and lectures at the central showroom, and, when required, in other showrooms and public halls. She carries out tests on appliances and submits reports on their merits; visits consumers in their homes for purposes of demonstrating ranges and gives advice regarding methods of electric cooking; assists at Strand Street central showroom when not otherwise engaged on above work.

Routine Work, Records and Statistical Forms.

When the hire purchase agreement has been signed by a consumer an "Instructions" form, a copy of which is appended marked 22, is completed by one of the clerks and serves the purpose of recording all particulars to which reference is likely to be made in the purchase, delivery and installation of the appliance.

If the purchaser intends to make his own arrangements regarding the installation of an appliance and purchases the appliance on terms exclusive of this work he is required to obtain the owner's consent to the installation and use of the appliance in the premises on the prescribed form referred to on page 94, and the Council reserves the right to refuse to make delivery of the appliance until such consent has been obtained. (As mentioned on page 94, the wiring contractor is made responsible for obtaining the owner's consent when the appliance is purchased inclusive of the wiring installation).

All matters relating to the purchase of appliances and the completion of the forms of agreements take place in the showrooms, and agreements when duly signed by the purchasers and witnesses are forwarded daily by the showroom assistants to the office of the Sales Division where they are carefully scrutinised and checked.

Inquiries are then made of the City Treasurer's Department whether, in the City Treasurer's opinion, the agreement can be completed on behalf of the Council without the purchaser providing a guarantor. If the reply is in the affirmative the form of agreement is completed, and the necessary steps are taken immediately to deliver and instal the appliance. Alternatively, this work is delayed until a guarantor acceptable to the City Treasurer has been provided.

An advice note (appended marked 23) is then issued, on receipt of which the necessary steps are taken to see that the appliance is properly connected up and that supply will be made available. This is made out in triplicate, one copy being handed to the Installation Division, one to the Distribution Division, and one is retained by the Sales Division.

Upon receipt of advice from the installation and Distribution Divisions by the medium of the "Daily Return of Hire Purchase Appliances connected to the System" (appndix 24) showing that this appliance has been installed and connected up, the original copy of the advice note (appendix 23) is handed to the "Follower-Up," who, on inspecting the appliance on site, notes on it in the space provided for the purpose any complaints concerning the appliance and particulars of any matters requiring attention.

The complaints or other matters requiring attention are reported by the "Follower-up" to the dealer who supplied the appliance, and when they have been attended to to her satisfaction she returns the form to the clerical staff of the Sales Division who take the usual steps for making payment of the amount due to the dealer, employing for the purpose the routine used in making payment for any other purchases.

The City Treasurer is advised of each hire purchase agreement that has been entered into. A copy of the form used for this purpose is appended markd 25. The form which acts also as an advice note as to the particulars essential to the collection of the repayment instalments, is made out in duplicate, the copy being retained by the Sales Division for record purposes.

After an appliance has been in operation for several months a letter, accompanied by a stamped addressed postcard for reply, is sent to the purchaser asking whether any difficulty is being experienced in obtaining satisfactory results from the appliance, or if any assistance or advice is required.

Canvassing for New Business.

As mentioned previously, an official is employed in the Sales Division to canvas new business. It is his duty to look out for, and to make contact with, prospective purchasers of appliances using all possible means of obtaining information to that end, and in this connection it might be mentioned that the Building Plans section of the City Engineer's Department is a valuable source of information concerning proposals for the erection of new houses, blocks of flats, and other premises.

A record of prospective purchasers is kept on a form, of which a copy is appended marked 26, and close touch is kept with them by letters and interviews until the desired object has been attained.

Removal of Appliances from one Address to another.

The permission of the Council to the removal of an appliance to another address during the repayment period is sought by the purchaser completing a form, of which a copy is appended marked 27. Ordinarily no objection is taken to such removal, but the grant of permission is conditional upon the purchaser obtaining and lodging with the Sales Division the consent of the owner of the new premises to the installation of the appliance therein, using for the purpose the form described previously.

Statistical Records.

Accurate records are kept of the amount of business, and details in connection therewith, done through the deferred payment scheme. The essential details of every hire purchase agreement are entered up in a loose leaf binder on a special form, a copy of which is appended markd 28. This form is closed off at the end of each month and is the source from which all statistical data relative to the operation and progress of the deferred payment scheme are obtained.

A specimen of the register of the spares supplied by the dealers and of the amount of servicing carried out on all appliances sold through the scheme is appended marked 29. A record is also kept of the complaints amount of servicing and details thereof performed on the appliances during the life of each agreement on a form similar to appendix 30, information as to which is extracted from the various documents, service reports, copies of letters, cards, advices, etc., referred to previously relative to each agreement filed with their respective agreements.

SECTION I.

Results of Hire Purchase Scheme.

The results achieved in the sale of appliances under the hire purchase scheme and the subsequent increase in the domestic load of the Electricity Undertaking have far exceeded the most sanguine expectations.

Before the scheme was introduced in September, 1930, only 1,050 cooking ranges were in use throughout the Electricity Undertaking's system. Over 200 cooking ranges were purchased during the first month of its operation and continued to be purchased at an average rate of 125 per month until December, 1932 when the instalment period was extended to two years, and from that date the average rate of sales has amounted to 225 per month. Altogether 7,046 cooking ranges, with a total retail value of £190,889, and a total connected load of 47,225 kw., were purchased during the 3½ years ending 28th February, 1934, that the scheme was in operation.

During the same period 1,203 other major appliances, such as refrigerators, water heaters, washing machines, boilers, large toasters, having a total retail value of £62,302 and a total loading of 703 kw., were purchased; as well as 750 minor appliances, such as kettles, percolators, irons, etc., with a total retail value of £1,622 and total loading of 610 kw.

The following table shows the numbers, retail value and total loading of the various types of appliances purchased year by year.

Quantities of Appliances sold under the Deferred Payment Scheme since inception of Scheme, 1st September, 1930.

YEAR (1st Sept. 31st Aug.)	TYPES OF APPLIANCES						Retail Value of Appliances. £	Total Loading of Appliances. K.W.
	Cooking Ranges. (Stoves).	Refrigerators.	Water Heaters.	Washing Machines.	Miscellaneous Major Appliances. (*)	Kettles, Irons, Percolators, Etc.		
1930-1931	1,567	171	67	15	1	187	59,336	11,057
1931-1932	1,631	196	87	44	4	220	61,905	11,515
1932-1933	2,479	192	69	55	6	243	84,022	16,893
(6 months) (to 28/2/34) (1933-1934)	1,369	213	61	17	6	100	49,550	9,074
Totals	7,046	772	284	131	17	750	£254,813	48,539

(*) Note : "Miscellaneous Major Appliances" comprise :— Large Boilers, Large Toasters, Coffee Urns, Grillers, etc.

The tabulation appended marked 31 gives more complete particulars of the business transacted under the scheme for the first 3½ years' working.

From the last-mentioned appendix it will be seen that the electrical trade of the City has benefited in respect of all the appliances purchased under the scheme to the following extent :—

Amount paid to dealers	£221,612
Amount paid to wiring contractors (Including commission)	£75,234
Cost of switches and plugs purchased from local agents for ranges	£19,415
Total	£316,261

Of the total amount of £316,261, by which the trade has benefited, £258,675, or 82%, has been paid to dealers and contractors in respect of cooking ranges alone. The average cost to the Council of installing a range, which includes the cost of the wiring, metal-clad main switch and fuse distribution board and plug, was reduced from £16 3s 0d., during the year 1930-1931 to £12 7s. 8d. at the present time, mainly through reductions in the schedule rates for wiring work and in the cost of distribution boards and plugs.

During the year 1930-1931 the Council's contribution to the cost of installing a range, taken on an average over the year, amounted to £7 12s. 7d. on each range installed, which amount has now been reduced to £2 12s 0d. The average contribution per range, taking into account the ranges purchased and installed by the purchasers themselves over the 3½ years the scheme has been in operation is £3 8s. 0d.

On the basis of the connected loading of the ranges the Council's cost was £1 0s. 4d. per kilowatt of connected load of each range during the first year, which contribution has now been reduced to 4/10d. per kilowat. Taken over all the appliances sold during the 3½ years the scheme has been in operation the average cost per kilowatt of connected load amounted to 7/4d. This expenditure is, however, looked upon as good business, having regard to the fact that each appliance sold increases the sales of electric energy for years to come, the outlay of, say, 7/6d. for each kilowatt of load so purchased is considered low.

The appended diagram marked 32 shows the monthly sales of electric ranges since the inception of the scheme, while that marked 33 shows how steadily the increase in the number of appliances and the total loading has been maintained. The curve giving the increase in the number of refrigerators purchased is interesting in showing how the demand for these appliances is a seasonal one which fluctuates between the summer and winter months of the year, October to March and April to September respectively.

Cost of Running a Home by Electricity in Capetown.

An analysis of the records of 3,513 consumers who purchased ranges during the period 1st September, 1930, to 31st December, 1932, was made to ascertain from practical experience how much electricity was being used by them for cooking and heating, exclusive of water heating, and also to obtain a record of the actual cost of electricity to domestic consumers, both in the midwinter (June) and mid-summer (January) months of the year.

The results of this analysis are shown in the following table, in which they have been classified according to the sizes of houses occupied, viz :—

No. of Consumers.	Size of House	MID SUMMER. Average Consumption per Consumer. January. Units.	Total Amount of Account. January. £ s. d.	Total No. of units consumed. January.	MID WINTER. Average Consumption per Consumer. June. Units.	Total Amount of Account. June. £ s. d.	Total No. of units consumed. June.
486	3 rooms	194	12 9	94,487	256	15 7	126,604
777	4 ,,	224	15 8	174,578	295	18 7	229,295
672	5 ,,	255	18 6	171,759	349	1 2 6	234,695
640	6 ,,	281	1 1 0	179,773	388	1 5 7	248,886
407	7 ,,	323	1 4 4	131,609	464	1 9 7	182,883
228	8 ,,	399	1 8 10	90,807	539	1 14 0	123,089
116	9 ,	414	1 11 0	48,105	583	1 18 0	67,747
60	10 ,,	478	1 15 3	28 731	645	2 2 2	38,699
48	11 ,,	457	1 16 2	22,017	641	2 3 10	30,784
79	12 ,,	544	2 1 4	42,855	848	2 14 2	67,024
3,513				984,721			1,349,706

The tariff for electric energy supplied for domestic purposes is now 1/6d. per room per month plus an energy charge of ½d. per unit to domestic consumers who are resident within the Municipality and for supplies outside the Municipal boundary, e.g., at Simonstown, these rates are subject to a surcharge of 25%.

The foregoing table includes 223 consumers outside the Municipal boundary, but it will be interesting to observe that at present-day rates the average householder living in a house of from 3 to 6 rooms in Capetown pays no more than from 5d to 8d. per day and 6d. to 10d. per day in summer and winter respectively to do all his lighting, cooking, heating and refrigerating by electricity—water heating excluded.

It may be mentioned that the City of Capetown has a temperate climate, the average minimum and average maximum temperatures in the shade recorded in the winter and summer months over the last 24 years being respectively 47°F. and 80° F. The temperature in the winter falls occasionally as low as 29° F. and rises in summer to as high as 104° F.

Scope for Increased Business.

At the end of February, 1934, the total number of consumers in the area of supply was 33,800 (*), of which about 22,000 may be taken as coming under the category of domestic consumers. The average consumption per domestic consumer, taken over all domestic consumers, in 1933 was approximately 2,300 units whilst the analysis of the consumption given in the above table by 3,513 consumers who have purchased an electric range on the Undertaking's deferred payment system and who may be considered as using electricity for domestic purposes in the real sense of the word, shows an average annual consumption per consumer of 4,000 units. If water heating supplies were included, as in the case of a fully 'all-electric' house, the average annual consumption would amount to at least 8,000 units.

(*) See also appendix 7.

The difference between the average consumption per domestic consumer and the consumption by those in "all-electric" houses indicates clearly the scope for increase in the sales of electricity to domestic consumers quite apart from the increases which will be brought about through further sales of heating and cooking appliances. When, however, it is taken into account that at the present time the shortage of houses in Capetown to meet the requirements of the population runs into thousands and that at the most 7,000 consumers out of more than 20,000 domestic consumers have installed ranges, saturation point will not, if ever, be reached for years to come.

At the present-day rate of growth of the load it is necessary to add continually to the generating, transmission and reticulation plant capacity. The development programme for the immediate future contemplates sales to consumers connected to the Council's mains rising from last year's figure of 105.5 million to a total of 200 million units per annum within six years, practically the whole of which increase will be due to the increased use made of electric energy for domestic purposes.

An idea of the extent to which the deferred payment scheme has built up the load of the Electricity Undertaking will be seen from the following table :—

Growth of Domestic Load.

Year.	Units used for All Purposes.	Units used for Domestic purposes.	Proportion DOMESTIC All units.
1928	51 376,879	5,958,201	11.6%
1928	58,793,865	8,765,936	14.9%
1930	65,171,659	12,430,042	19.1%
1931	78,711,163	22,002,245	27.9%
1932	91,211,052	35,036 008	38.4%
1933	105,494,807	48,720,653	46.2%

Whereas in 1929 the amount of electricity sold for domestic purposes represented only 14.9% of the total amount sold for all purposes, this percentage rose to 46.2% in 1933. The increase in the total output of the Undertaking is now being maintained almost entirely by the growth which is taking place in the use of electricity for domestic purposes, which fact is shown clearly by the appended diagram marked 34. The increase in the demand for electricity for domestic purposes is further shown by the appended diagram marked 35, from which it will be seen that the number of units sold per month for domestic purposes has increased over fivefold during the last five years.

Steps have already been taken to provide sufficient plant capacity to meet the increasing domestic load in the installation of new generating plant to the extent of 20,000 kw., whilst a further 20,000 kw. generating set will be installed by the winter months of 1934 and another one by May of 1935.

APPENDICES.

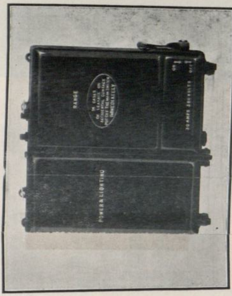
It is very much regretted that owing to the high cost involved it has not been found possible to reproduce the Appendices of this most interesting and instructive paper.

SCHEDULE OF APPENDICES.

	Appendix No.
Agreement with Dealers	1
List of Approved Appliances	2
Specification for Installation Work	3
Diagram of Typical Domestic Wiring Installaton (Water heating supplied at Domestic Rate)	4A
Ditto (With "off-peak" water heater	4B
Specification for Combined Switch and Fuse Distribution Boards	5
Specification for Wall Plugs and Sockets	6
Statistical Data, Costs of Labour and Materials in Capetown and Rates of Charge for Electricity	7

PLATE I

Fig. 1.

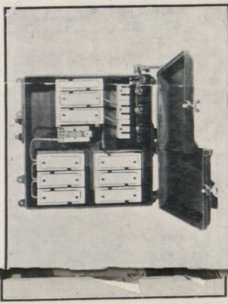


COMBINEMAIN SWITCH AND FUSE DISTRIBUTION BOARD FOR DOMESTIC INSTALLATIONS.

Fig. 2.

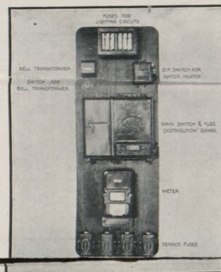
COMBINMAIN SWITCH AND FUSE DISTRIBUTION BOARD FOR DOMESTNSTALLATIONS SHEWING COVER OVER SUBCIRCUIT FUSES OPEN.

Fig. 3.



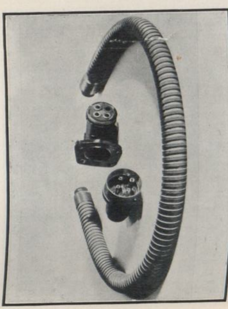
COMBINED MAIN SWITCH AND FUSE DISTRIBUTION BOARD FOR DOMESTIC INSTALLATIONS SHEWING MAIN SWITCH, COOKER FUSES, NEUTRAL LINK AND SUBCIRCUIT FUSES.

Fig. 4.



METER BOARD FOR TYPICAL "ALL ELECTRIC" HOUSE (ALL WIRING OBSCURED IN SPACE BEHIND BOARD.)

Fig. 5.



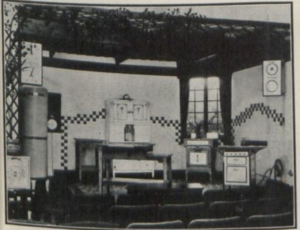
STANDARD METAL CLAD WALL PLUG AND SOCKET AND FLEXIBLE CONDUIT USED FOR COOKING RANGE CONNECTIONS.

Fig. 6.

METHOD OF CONNECTING UP COOKING RANGE TO WIRING INSTALLATION.

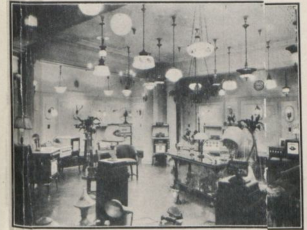
PLATE II

Fig. 5



DEMONSTRATION KITCHEN SHEWING COST INDICATORS.

Fig. 3.

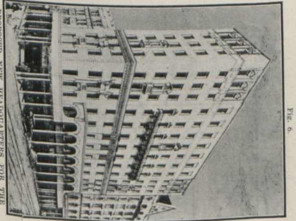


WYNBERG SHOWROOM—INTERIOR.

Fig. 1.

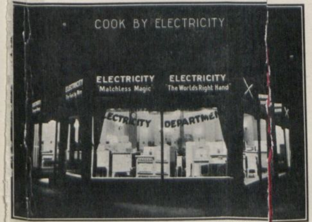
ROUND CHURCH SHOWROOM.

Fig. 6.



PROPOSED NEW HEADQUARTERS FOR THE ELECTRICITY DEPARTMENT. "ELECTRICITY HOUSE."

Fig. 4.



MOWBRAY SHOWROOM ILLUMINATED AT NIGHT.

Fig. 2.

WYNBERG SHOWROOM

Schedule of Appendices. (Continued)—

DISCUSSION.

Mr. L. L. Horrell (Pretoria) : I should like to congratulate Mr. Swingler on the excellent paper read by Mr. Eastman on the subject of "The Development of Domestic Load in Cape Town." The presentation of a paper on such a subject is most opportune, and is one which we in South Africa and Rhodesia have awaited with eager anticipation. I can safely say that our expectations have been exceeded.

Not the least interesting feature of the paper is that dealing with the dificulties met with from time to time in the functioning of the scheme, and the explanation of how these difficulties have been overcome. The Author's difficulties have been by no means small as those among us who have desired to launch similar schemes will appreciate. Apart from having to convince his Council of the soundness of the scheme and obtain their blessing for it, he had, at the very outset, to negotiate amendments of the Provincial laws in the face of stout opposition from the commercial interests in the Cape Province.

We in Pretoria, have experienced similar opposition where the City Council have, for several years, had a loan scheme in operation under which property owners can obtain advances of up to £100 to cover the cost of purchase and installation of electrical appliances. While this scheme was, to some extent, satisfactory, it was felt that, by establishing a showroom, in which appliances could be exhibited and cookery demonstrations held, greater benefit would result. The principle of having a showroom was given effect in conjunction with an Industrial Exhibition held in Pretoria some 18 months ago, and proved so successful that the establishment of a permanent electrical showroom was suggested.

Immediate objection was, however, taken to the suggestion by the local electricial contractors, who maintained that the department's new venture meant the thin edge of the wedge towards Municipal trading, and they opposed it tooth and nail. The success of the Cape Town scheme was quoted and acknowledged in a letter received from the Cape Town branch of the Master Builders' Association, but the local people maintained that circumstances were different in Pretoria. We, however, gained our point and established an electrical showroom under the the name of "Electricity House." It has been fairly successful, and the public have shown their appreciation, particularly in regard to the cooking demonstrations held there.

As regards the showroom, Pretoria dealers are permitted to exhibit their appliances and are required to contribute the following monthly sums which go towards the cost of running "Electricity House" :—

Electric Ranges	20s.	per month.
Refrigerators	20s.	do.
Water Heaters	20s.	do.
Radio Sets	10s.	do.
Small appliances and fittings	10s.	do.

or a composite fee of £2 10s. 0d. per month which entitled the dealer to exhibit all types of appliances. Since sales of appliances are not effected through the showroom itself, but through the dealers concerned, it is dificult to gauge the exact effect of the showroom in this respect. It is, however, significant that since Electricity House was established the number of appliances installed in consumers' premises has increased, the monthly number of ranges installed, for example, being now practically double.

In regard to the loan scheme operating in Pretoria, only 75 per cent. of the cost of the appliances and installation thereof was advanced originally, the consumer making his own arrangements in regard to the remaining 25 per cent. During the last year, however, the amount advanced has been increased to the full 100 per cent., and this has undoubtedly influenced the increased number of ranges installed. Unfortunately, at the present time in the Transvaal, only property owenrs can take advantage of the scheme. We have, however, requested the Transvaal Municipal Association to approach the Provincial Council with a view to having the Local Government Ordinance amended to permit of advances being made to tenants as well as to property owners, and it is anticipated that, should this eventuate, the number of ranges, etc., installed under the scheme will, at least, be doubled.

Returning to the author's scheme, it is noted from Appendix 31 that, of £316,456 paid out to dealers and contractors in respect of appliances installed under the scheme, the Council have contributed £17,670, or, approximately 5.6%. In addition, there are the administrative costs, costs of alteration to the external portions of the service connections, and labour costs in servicing the appliances during the repayment periods. It is quite clear, therefore, that the Council makes a substantial contribution towards assisting consumers to acquire and use electrical appliances, and it disproves the argument that Cape Town have adopted municipal trading to the detriment of the commercial community. This, I think, should be emphasised, for the general conception among dealers is that Cape Town are definitely trading in opposition to the dealers.

While on my recent visit to England, I was greatly impressed by the fact that every town, large and small, had one or more showrooms and gave facilities for the purchase and hiring of electrical appliances. In Liverpool, for example, it is possible to hire electric ranges for the following quarterly charges :— Kitchenette pattern—3s. 6d.; Standard pattern—5s.; Table pattern—7s. 6d.; These quarterly charges cover the cost of installation, including up to 50 feet of wiring. All appliances are purchased out of revenue, and the quarterly charges barely cover the interest on the capital outlay, but the authorities consider the load to be so valuable that the moneys expended are regarded as good business.

The growth of the domestic load in Cape Town, as illustrated by the table on page 127 of his paper, must be extremely gratifying to the author, and shows in no uncertain manner the benefits accruing to those Councils who adopt the bold policy of offering every possible assistance to consumers to use electricity to the fullest extent. The appended table gives the figures for Pretoria :—

Year	Units used for all purposes	Units used for domestic purposes	Proportion (Domestic) All Units
1928	19,557,561	4,332,929	22.15%
1929	22,360,331	5,919,062	26.47%
1930	27,613,732	7,661,798	27.74%
1931	35,460,774	9,083,599	25.61%
1932	37,947,329	9,918,454	26.13%
1933	38,863,010	10,738,936	27.63%

While these figure do not compare too favourably with those given by the author, they do at least indicate that the growth of the domestic load has exceeded that for other purposes.

The question of servicing is exceedingly interesting, particularly the methods of putting it into effect. There are probably some who do not agree that the Council should provide the organisation for this, but, I personally agree with the author that, if the Council offers such a hire purchase scheme to its consumers, then they will have greater confidence in the appliances they are purchasing if they know that the Council itself is responsible for the servicing, and it would be interesting to know whether account is kept of the time the staffs devote to the servicing of hire-purchasd appliances and, if so, to what the approximate cost of such servicing has amounted. In conclusion, I again congratulate the author on the highly interesting and useful paper which he has placed before us, and thank him for the complete details he has given of the Cape Town scheme.

The President : In thanking Mr. Eastman for giving a synopsis of a very lengthy paper, I should like to express this Association's gratitude to Mr. Swingler for the comprehensive and interesting work of reference on Hire Purchase. This paper will, undoubtedly, become the "Hire Purchase Bible," and its value cannot be exaggerated, as it is a complete record of the successful development of the domestic load in Cape Town. It is an example of what can be accomplished by the adoption of a bold policy. By a careful study of the complete record and data, as given, engineers should be able to avoid pitfalls, and launch a bolder and more successful campaign of assisted purchase. It will be of especial interest to all town treasurers and councillors on finance and electricity committees. I predict that Mr. Swingler's contribution will greatly increase the sale of copies of the proceedings, and this will benefit the Association. The fact that Cape Town correctly looks upon their hire purchase system as a direct benefit to their electricity undertaking, and imposes as few onerous restrictions as good business will allow, will be of special interest to some of our councillor delegates. Many councillors are averse to granting hire purchase facilities to trading concerns, and advocate such exacting financial enquiries as would embarrass any applicant. The development of the domestic load is of vital importance to any electricity undertaking. The information and data contained in Mr. Swingler's paper will be of very valuable assistance to most municipalities in Rhodesia and the Union. (Hear, hear.)

Mr. Rodwell (Johannesburg): The President has already paid a tribute to Mr. Swingler for his very comprehensive paper, and I should like to add that our thanks are due to Mr. Eastman for so ably describing and elucidating that paper. It is one of absorbing interest to practically every member of this Association.

The domestic load is one which is being actively pursued by all City Councils, a service of infinite value to the public, and is sometimes of value in filling up the valleys in the load curve. I notice that one of the reasons raised by the writer of the paper for developing this load in Cape Town was that saturation had been reached in industrial loading. This is a sweeping statement and rather a contradiction of the usual attitude of muicipal electrical engineers towards industry. Saturation as regards industrial loading is practically never reached in most areas, there always appears to be something further that can be manufactured locally. Johannesburg is an example of this, and at present, no doubt due to the gold boom, enquiries from South African manufacturers and overseas agents are coming in continuously for premises, land on which to build factories, and the cost of power and other essential services.

The secondary industry position has been barely scratched on the Witwatersrand, and it will be many years before the industrial load will in any way reach such magnitude that development along industrial lines will have to be curtailed. In this respect, possibly Cape Town is not in a comparable position to Johannesburg, which is the centre of a comparatively thickly populated mining area. The writer, however, pointed out that the domestic load was the best line of development at Cape Town, as all existing industries were practically 100% electrical. As a load on the average local authorities' central station, the domestic demand has certain drawbacks. It is not only seasonal, but also has a marked tendency on some systems to increase the evening peak. This position has been very clearly shown at the Johannesburg station in recent years, and it is assumed that, as during the winter months in Cape Town, the hours of daylight are less than up-country, the cooking load would coincide not only with the peak lighting load, but with the transport peak as well. It would be interesting to know what effect the cooking load has had on the winter daily load curves. From a purely financial point of view, it would appear that the cooking load at the necessary low tariff is acceptable as an alternative and addition to industrial loading. There is no comparison between the steady input of, say, a flour mill or large engineering works connected direct to the high tension main for from eight to ten hours per day, and a sparsely populated suburb using electric cooking, necessitating heavy distribution expenditure to numbers of small consumers probably operating spasmodically on and off the peak.

Allowing then for the domestic load being accepted as the next best thing, the writer of the paper must be congratulated on the manner in which he surmounted the difficulties attached to the acquisition of this desirable load, and it is pleasing to note that the writer's work and energetic campaign were supported by a sympathetic City Council. I can fully appreciate the competition of the gas undertaking. In Johannesburg both the Electricity and gas undertakings are owned and operated by the City Council under separate management.

There are not many points of criticism in the paper. All that can be said is mainly of a congratulatory nature. To apply some of the methods adopted in Cape Town in the operation of the purchase scheme in certain Transvaal towns would be extremely difficult, not only from the financial but from the administrative point of view. To go through briefly the main contentious points, I notice that, when the hire purchase facilities were proposed in 1930, the traders, through the Chamber of Commerce, immediately protested against the City Council commencing the scheme, in spite of the fact that there was no intention of direct trading. The writer and his Council are to be admired for the firm stand they máde and for the way they arranged to have the Provincial Ordinance amended to give them greater powers than hitherto. There can be no question but that the position of a municipal electrical undertaking should be one of service; the consumer should be the first consideration.

When the hire purchase scheme was launched, I notice that the number of appliances was limited to a fixed amount each year. Only twelve makes of stove, for instance, were on the City Council's approved list, and every agent or representative to keep his place on the list must sell at least 36 stoves per year. This was undoubtedly, a step in the right direction as the indiscriminate inclusion of all makes of appliances on the approved list tends to lower the standard of approval, and the idea of making a condition that a certain number must be sold each year certainly keeps the manufacture up to a reasonable standard.

Dealing with the question of service, this during the period of the hire purchase agreement is given by the City Council at Cape Town. At Johannesburg, through the Council's deferred payment scheme, the traders agree to service the appliance for the first twelve months free of charge. The servicing of electrical appliances, unless a simple hire scheme where the appliance is not the property of the consumer, is a costly business The writer of the paper has gone very thoroughly into the question, and his first consideration has, undoubtedly, been the consumer. There I agree with him. If service has to be given, it should be thorough. I was pleased to notice that the service cards were marked "urgent." Another pleasing point I noticed is that the consumer is not just left at the end of the hire purchase period, but the appliance is thoroughly overhauled and handed over in good condition. This must be very satisfactory for the consumer, and must lead to harmony and good feeling between the public and the department.

The advertising and publicity methods adopted in Cape Town appear to follow the general lines of electricity advertising advertised by the British Electrical Development Association, and the writer seems to favour showrooms as a medium for bringing electricity to the notice of the ratepayer. Cape Town has, undoubtedly taken the lead in this matter as far as the Union of South Africa is concerned, and has established showrooms in the city and the suburbs. I notice that the showrooms are used as depots for collecting municipal revenue. This is a common practice with municipal undertakings overseas. I believe the scheme was borrowed originally from the gas companies, the idea being that when consumers come to pay accounts they would see appliances displayed and would probably acquire them, thereby making greater use of the service. This scheme is successful where the electricity department has control of its finances and collects its own accounts at a number of depots. In Johannesburg the complete control of the City Council's finances is vested in the City Treasurer, with a central collecting depot at the City Hall. There is also a combined meter-reading scheme, the same officials reading electricity, water and gas meters. It is, therefore, practically impossible for the Electricity Department, as things are at present constituted, to utilise showrooms as collecting depots.

It can be seen then that the methods adopted in Cape Town to advance the domestic load, whilst working harmoniously there, could not easily be applied in other centres. The showrooms are, however, a great boon to the consumer and ratepayer, and I am of the opinion that every town of reasonable size should have at least one electrical showroom where the consumers can see appliances and obtain advice without, as the writer states, having to buy or be worried by salesmen. Another matter on which the Capetown Electricity Department is to be congratulated is the erection of their new offices, showrooms and demonstration rooms in Strand Street.

The theme of the paper is "Service," and a study of the service rendered shows it to be of an exceptionally high order to the benefit of the consumers and public as a whole. The paper constitutes a textbook and practical treatise of successful development, and it will be of great assistance to those whose duty it is to develop the domestic load. Our thanks are due to Mr. Swingler for his valuable contribution to our Association proceedings. (Applause).

Councillor D. Nelson (Paarl): I am not an engineer, and I am not so much interested in this discussion from an engineer's point of view. But Mr. Eastman has stated that they charge 2s. per £ to the consumer who buys their appliances. For that 2s. they instal the appliances and also put in the wiring. I put it to him for the sake of argument that if you sell a stove costing say, £25, the consumer then pays 2s. in the £ monthly for 12 months. This brings you in a total amount of £30 —a profit of £5. Now as you have to wire up the premises for the consumer which is included in the 2s. per £, what does the wiring cost the Municipality? If you can do this wiring for the £5 then the deal squares itself. But I find that the wiring of a house for a stove cannot be done for £5, but cost about £12, hence there is a loss of £7, plus other expenses like the cost of the showroom, etc. So if you sell 100 stoves you are making a loss of £700. My question is merely to find out whether our cost of wiring for £12 is in excess, and whether it can be done cheaper. I should also like to know what is the cost of the upkeep of these showrooms, and what is payable in interest, redemption, travellers, demonstrators and such people. What does that cost, and what is the loss or the profit? I want to be clear on these matters.

Mr. J. H. Gyles (Durban): I want to congratulate Mr. Swingler on his very valuable paper, the Cape Town Scheme differes in many respects from the Durban one, but our scheme has also been very successful as the following figures will show. The scheme was started about 1925 and since that date 8,770 Stoves, waterheaters and refrigerators have been purchased through the Town Council, and in Durban at present there are installed 12,050 stoves, 6,662 water heaters and 4,614 refrigerators.

The total amount advanced by the Town Council to purchase appliances has been £272,734 and bad debts have been less than half of one per cent., and this has been accomplished without the aid of Municipal show rooms. I would be glad if Mr. Eastman could let me have the cost of running the show rooms in Cape Town.

Mr. G. G. Ewer (Pietermaritzburg): Whilst appreciating the mass of information contained in the paper which Mr. Eastman has read to us, there are one or two points which I should like to have cleared up, because it seems to me that this scheme although a good one for Cape Town, is not suitable for many towns in the Union or Rhodesia. In the first place there is the four-wire house service, and I would like to know the reason for this, as it seems to me an unnecessary expenditure. On the other hand they tell us that the average demand of the consumer is only from one to two kilowatts. If that is so, why provide a four-wire service? I agree that it is necessary to have four-wire distribution in the streets, but I do not see any reason why each ordinary domestic consumer should not be put on single phase. If you put in a three phase four-wire it means extra expense for the meters also. If you put in single phase service there is only one meter necessary for each consumer. I would like to know the reason why Cape Town advocates the four-wire service. It occurs to me that this arrangement is unsuitable for the majority of towns in the Union. I would also like to know if there are any arrangements under their Hire Purchase schemes for the wiring of houses for electric lighting. In Pietermaritzburg we have had such a scheme for six or seven years and a large number of installations have been put in. We include the wiring for lighting and for any other purpose. The consumer can go to any registered Electrical contractor in the town, select the apparatus required, (a stove or other appliances) which must be of approved type, and the contractor puts in a tender to the department. If approved by the department we send the consumer an agreement to sign. We add $2\frac{1}{2}$ per cent. to the contractor's figure for supervision and spread the payment over one, two or three years. Six per cent. is charged on the instalments. That is the scheme in Pietermaritzburg and it works very successfully.

Councillor Adcock (Port Elizabeth): From a layman's point of view I may be of assistance to those who may be contemplating this particular scheme. I am in the position of having worked two years with our Engineer in getting people interested (with the assistance of Mr. Swingler and Mr. Eastman who supplied us with the information). We tried our best to work with those concerned who I am sorry to say suffered from the fear complex, our idea being that you had to have a combination of the lot in order to make it successful. We got over our difficulties and we worked it successfully for four months and were doing very well indeed, but my committee wanted profits in four months. If you contemplate a scheme and you give your Engineer and Treasurer confidence they will get over the difficulties, but there is a man in the street who comes along and tells you all his difficulties, and I say don't bring such matters up in open Council, give the engineer your confidence and tell him the difficulties, and he will have the answers for you, otherwise you make his position intolerable. My friend, Mr. Nelson, from Paarl is afraid of the loss, I would like to ask, how much does he spend in advertising his electricity undertaking in the Paarl?

Councillor Fleming Johnston (Durban): I am another layman and am in this position too. I did not have the document before me to read before I came here and have had to listen to the speaker

(Mr. Eastman) so I am at a very great disadvantage in not having read the paper. I want to say this: I hope the various municipalities represented here, if they have not taken up the hire purchase scheme, and if they contemplate it at all, will not go away obsessed with the idea that they must have showrooms. I do not think it is necessary for municipalities to duplicate the work which is already done by the retailer who has his own showroom. We in Durban do not have our own showroom and we are doing well. If I remember rightly Mr. Eastman said that, in certain circumstances, they took 15 per cent. of the retail price and ten per cent. in other circumstances. We are satisfied with six per cent. You have heard what Mr. Gyles has said. It costs £150 a year to get the business we have got. We get portion from the trams and from the Public Health, and I am satisfied that if the municipalities make a proper agreement with the retailers of stoves, refrigerators, etc., they do not require to have any showrooms.

Mr. G. E. H. Jones (Mafeking): It may be of interest from the point of view of tho smaller towns if I mention Mafeking with a population of 2,300 where at present we have 60 cookers installed. Approximately 50 per cent. of these have been obtained under the Council's hire purchase arrangement. Briefly the arrangement is that approved consumers might buy approved appliances from whom they wish. The Council pay the whole of the cost immediately to the firm, and the consumer pays down 20 per cent, ten per cent is added to the balance, which is payable in eleven equal monthly instalments. We do not have longer than 12 months. The hire purchase scheme is applicable to all domestic appliances from a range to a kettle, with the exception of refrigerators. Service is free, and it has been a great success. It has been in force for about two years and we have had no financial loss whatsoever.

Mr. A. Q. Harvey (Springs): I would like to offer my congratulations to Mr. Swingler on his excellent paper. There are, however, three points on which I should like some information. He states that a 6 K.W. stove gives an average load of 2 K.W. which is a diversity factor of 0.33 of the installed load. On page 93 of the paper reference is made to blocks of flats, where a diversity factor of 0.75 is allowed in calculating the size of the connection required. It also appears as though the higher the rating of 1,000 amps per sq. in. is taken for the conductors of the connections, which appears to be a very high and generously rated connection.

Instead of holding back portion of the money due to a supplyer of a hire purchase article, they are required to deposit £100 security for being allowed to sell under the hire purchase scheme, this would represent a lot of money to firms on the Reef if this policy was adapted, and they would require a very large capital.

Lastly we have the "off-Peak" water heater operating on out of balance currents, the idea is good, but supposing for the sake of argument someone is sick in the house, during the winter months and a radiator is kept on continuously, the water heater will not come on at all and so no hot water will be available.

Councillor A. Rankin (Johannesburg): The paper read by Mr. Eastman is very interesting indeed especially to us in Johannesburg where we are negotiating with regard to showrooms. Our trouble, of course has been the merchants, although the business has not come to a finality yet. They, of course, are jealous of the Municipality, thinking possibly that the Municipality might sell appliances direct. I have told them that we would not do so. Now it was difficult to get permission from the Council to establish a showroom, and it was only carried by three votes. But I think the possibilities may be that we can come to some arrangement similar to that obtaining at Cape Town. I hope that Mr. Rodwell has a copy of this paper, for it will be a great help no doubt to us in coming to some settlement in Johannesburg.

Mr. S. V. R. Lewis (Gwelo): We have had this subject discussed at many of our Municipal Conferences. but at last it has been brought forward in a concrete form. It is actually a paper to which we can refer in future on the matter of hire purchase agreements and the methods of getting new loans. After all we have to be prepared to supply what our consumers want and when they want it. If that contractor which Mr. Eastman referred to had not had such an enormous number of appliances available in Cape Town and others on the water available for his big supply he could not have supplied requirements. I wonder if we are not in the same position. I do not understand Mr. Ewer's objection to the three phase four-wire scheme. Personally I do not see any difficulty at all in it. With the single phase you will have to put in heavier wire. There is also the point you mentioned to me, Mr. President, whereby you had an idea of being able to switch off water heaters by dropping or rising. You have all the load controlable from the power station irrespective of the peak from any one house. I wonder if Cape Town has investigated that proposition, as I understand that there are firms that are prepared to supply the apparatus.

The President: I intended discussing the apparatus for the control of water heating as suggested in the paper.

The object in view is to limit the maximum demand of individual consumers by cutting out water heating during peak periods. With this apparatus the periods of operation of water heating would be governed by the out of balance by means of the current in the neutral wire. It would therefore be possible for one consumer to obtain a 24 hour water heating service without any restriction to his peak. providing he maintained a reasonable balance. On the other hand there would be consumers who would obtain a much shorter period for water heating with a comparatively small demand due to, say, one or two radiators operating on the same phase.

Mr. Horrell (Pretoria): Mr. Eastman mentioned in regard to the contractors that they were perfectly satisfied. I believe they are, but I would like him to give us that assurance again because the electrical contractors in Johannesburg and in Pretoria have spread a report about that the electrical contractors in Cape Town are not satisfied.

Councillor J. D. Low (Cape Town): I am in no way responsible for the paper. I only read it in the train coming up. I had very little idea that I would attend the Conference at one stage, and only did so at the last moment. I was, however, for some years Chairman of the Cape Town Electricity Committee and therefore I am acquainted with the general development of the hire purchase scheme.

From the paper it might appear that everything had been plain sailing and that we never had any difficulty in the Council whatsoever. That is not exactly so. A great deal of preliminary work had to be done and considerable capital expenditure was involved in the extension of the mains and the erection of transmission and distribution lines.

I have a recollection of a member of the committee leaving our committee and making judicious enquiries as to the reason, he said, that we spent too much money and he was overwhelmed with the amount of capital expenditure involved in the initial stages. It was recognised, however, that unless that was done troubles with the consumers would follow and continuity of supply would be endangered. Even when it was completed, as mentioned by Mr. Eastman, we were placed in a difficult position owing to the fact that we had very limited trading rights owing to the then existing Ordinance in the Cape. This opposition, of course, came from the interested parties.

Pressure was soon put upon us by the Chamber of Commerce and it looked as if we would have difficulty in getting the scheme through the Council providing an amendment of the Ordinance. We however proceeded, and we were asking for full powers to trade. We never really intended to enforce it. Our intention all along was to carry out a scheme such as has been put forward in the paper. But we were not going to be hung up or held up by the traders as a whole and we were determined that if they were not prepared to come into line we would go to the Provincial authorities and ask for full powers and these as you know we got. This was the determining influence and, helped at a later stage, in coming to an agreement with these dealers. Not only that, but from the fact that so many were involved it was difficult to deal with them all singly and that forced them into an association of their own, and so we were able to deal with them as a body.

Whatever view Mr. Horrell may have here, so far as I know there is no difficulty in dealing with either the dealers themselves or the contractors.

So far as I am aware, and you will see from the amounts disbursed by the Council and the payments made to these people, that far from being discontented, they have begun to realise the benefit of the scheme to both themselves and to their employees.

Having obtained the requisite powers we put our scheme into proper working order. It was never our intention to go in for trading because of the previous experience we had had in hire purchase dealing when the Council stocked the apparatus themselves. You realise the many changes that were coming about, and before long we found ourselves with a good deal of junk on hand.

Developments were taking place and Messrs. So and So were supplying an apparatus of a later type and, of course, the parties who had been supplied with the old type immediately came to us for exchanges and so on, and all along we, as a committee, realised the difficulty to ourselves if we stocked our own apparatus. Therefore, that led to these arrangements with the dealers. Minor difficulties and complaints were, of course, experienced, but the gentle art of negotiation overcame these, and resulted in the formation of the dealers' association. This has proved greatly to the advantage of both parties and likewise to the consumer and the work has been carried out at a minimum cost.

You will also have gathered that the Municipality in their show rooms are merely exhibiting approved appliances and are therefore carrying no stocks of their own. The prospective purchaser has the entire selection. Once it has been made the Municipality effect the sale and carry through the completion of the necessary hire purchase scheme on the scale approved by the Council. So far as we are concerned we do not do that from loan moneys, because for a number of years we have accumulated a surplus. We do not make any losses Mr. Nelson. We have contributed part of the surplus to a betterment fund and out of the betterment fund we finance these hire purchase agreements. I may tell you that in 1930 when the scheme was started, I think it was towards the end of the year, we financed up to £16,674, and in 1931 to £53,857. Up to the end of 1931 out of the £69,000 advanced we had been repaid nearly £40,000. There you can see for yourselves. After all said and done from the very time the sale takes place, the very next month there is a return of a portion of the money. The financial obligations involved are not so much as might be anticipated.

Much opposition was put up to the erection of the first showroom. In fact the first one contemplated has never yet been erected. Plans were got out for an elaborate showroom on the corner of Darling Street and Lower Plein Street on an open space on the parade. So far as the Council were concerned we got them to accept the scheme. Unfortunately, the Chairman of the General Purposes Committee put forward an enlarged scheme for an administrative block as well as showroom. That unfortunately was our downfall. While we anticipated the spending of £40,000 or £50,000, by the time we got to the administrative block we had run into something like £250,000, and the ratepayers being incensed at the amount of the contemplated expenditure, and also taking strong exception to the site we were defeated, and at that stage the Council, with the exception of nine resigned.

Although we were nearly all re-elected, in our first fight it did not all go with the plain sailing one might imagine from the paper. Seapoint was the first showroom to be erected. As a matter of fact it only camouflaged what would have been an unsightly sub-station, and that really only represented a good show window. It has been a remarkable success.

At a later stage they opened up domestic supplies in given residential areas. There is a very good site at Wynberg. At a later stage a building belonging to the Municipality became vacant on the main road at Woodstock and was handed over to the Electricity Committee and it was fixed up as a small display room. That has been useful and it gave a large number of people, most of whom had little or no domestic apparatus in their houses, the opportunity of enquiring and of having demonstrated to them what electricity can do for them in their homes. It gave the Department the opportunity to come into direct touch with the consumers, and to overcome fear and prejudice as well as indicating the saving in cost by scrapping old methods of heating and cooking. There is a great development of the subject in that direction.

A large supply is going to houses of four, five and six rooms. It is to this type of people that labour saving devices appeal more than to people in larger houses where they have a large amount of help and where perhaps the saving of a few shillings a month does not so much matter.

Notwithstanding the first opposition to the showrooms we have since opened up a further one in Mowbray and we have had a further request from the ratepayers for another at Claremont. You have also seen the large number of people who visit these showrooms.

Cape Town is a large and straggling area on the seacoast extending from Camps Bay right down to Kalk Bay, and we have to open up some of the suburban places for the convenience of the ratepayers and for the payment of dues to the Municipality.

There is really not very much opposition from the individual to-day. We have an attractive showroom in a good position right on the Main Road which is lit up every night. We have not a great deal of expense at Mowbray. We have only a small corner display window which the committee overcame by sacrificing an advertisement, and the cost is not nearly as much as one might imagine. In Seapoint and Wynberg we have our own buildings. They have nice fronts as you will see from the photographs given in the annexures to the report. The discount allowed by the dealers we regard as an offset towards the cost of installation. My friend from Durban was wondering how we finance them. Naturally that does not pay the entire cost. Not for one minute would I like you to believe that, but at the same time we have gone definitely out to purchase load with successful results.

The number of units used for domestic purposes in 1933 is now forty-six per cent. of the total sales. Far from proving disadvantageous to the Department or to the Council, we had a profit, after contributing £50,000 to the relief of rates last year, of £32,700. We paid all the wages in connection with the running of the showrooms and so on and we still have that surplus which, as usual, was carried to our betterment fund. So you will see that the increase in revenue has helped to swell the betterment fund, and the betterment fund itself has been used as I indicated in the first instance to finance the hire purchase appliances. I may say this that the reason why the betterment fund is added to in that fashion is due to the fact that the total surplus is not sufficient to warrant a general reduction of tariff. By putting it to a betterment fund we use it for capital expenditure in connection with the development of the undertaking itself.

In this connection, up to 1931 we had expended something like £16,000 in the like of buildings and a further sum of £28,000 in machinery and we extended our mains to the extent of £10,000 or £11,000 out of that fund. We have also purchased out of the fund a site for the erection of our main showroom. It is known as Electricity House, and it will be situated at the corner of Strand Street and St. George's Street. The building has not been erected yet, but the plans are in the hands of the architect at the moment, and the proposal is, as we have it designed, for a nine or ten storey building, but we propose in the meantime to erect one of four storeys making the ground floor a showroom. (Applause.)

The Convention adjourned at 5 o'clock p.m.

VISIT.

A visit was then made to the Prince's Kinema where a film exhibition was given by the British Insulated Cables (S.A.) Ltd., which showed the various works and processes in the manufacture of cables.

FRIDAY, SEPTEMBER 14, 1934.

The Convention resumed at 10 a.m. with the President in the chair.

"The Development of Domestic Load in Cape Town."

The discussion on Mr. G. H. Swingler's paper, "The Development of Domestic Load in Cape Town" was then continued.

Councillor Low (Cape Town): Mr. President. I cannot say that I can recollect at the moment the exact stage at which I left off yesterday. I have not had time to recollect the points raised by the various speakers beforehand. However, should we miss any of them I have no hesitation in saying that either Mr. Eastman or myself will endeavour to make you acquainted with the manner in which we have worked in Cape Town. Someone raised the point as to how we allocated the costs of the domestic supplies. I assume he meant in regard to the general propaganda of the showrooms.

Cape Town is exempt at present under the provisions of the existing Ordinance from rendering accounts on the prescribed forms. You know, of course, that this Association is desirous that these accounts should be rendered in a uniform way, but for some reason or other our Treasury Department do not seem anxious to change from the existing system and so far we have not been able to come into line. We hope, however, to overcome that in time. As the present Chairman of the Finance Committee I may be able to influence them later in that direction.

The present position is that we continue to prepare our accounts in the ordinary form in which they have been rendered for years past. Therefore, instead of showing our costs separately on the main account, they are all included in the general administration and installation cost. You will see that our present scheme is an entirely assisted-purchase one. Therefore it does not entail us carrying any stocks whatever.

Overseas experience appears to have been the same, as the individual company is liable to be left with out of date appliances owing to rapid development and change in the types of apparatus. Our policy of neither stocking nor direct trading has proved to be the best. Although the traders in the first instance fought us over it they now realise that the co-operative system initiated has been to the advantage of all, and must obviously have saved the dealers sinking a very much larger amount of capital in their respective businesses by the Municipality paying out the cash amount of the purchase price for the apparatus.

The success of the scheme has been undoubted. Cape Town Electricity tariffs have been reduced five times during the past twelve years, twice since August 1930, and in July of this year we made a further reduction which will be equal to about eight per cent.

We sacrifice in revenue for the second half of this year £20,000. That will be £40,000 for next year. So you see that by our policy we have been able to show the consumer the advantages of this increased load, and if any of you are interested, I have a graph here—I do not know whether it is included in the report—which will indicate to you the drop in tariffs from 1914 up to the end of 1932. This line is the line of our tariffs. You see the tendency for a short period is to increase during the war period, but continuously since then there has been a drop until, as I say, for this year we are making further sacrifices of something like eight per cent. of our revenue. I do not think that there is very much further for me to say at the moment. It has been a most extraordinary period, and of course it was impossible for anyone having dealings with the Department to become otherwise than enthusiastic with Mr. Swingler owing to his energy and desire for the development of his undertakings. On the other hand he was fortunate in being able to carry on continuity of policy over long periods, during the time he has been in the service of the Corporation.

I think he said he had three Chairmen. The first Chairman was Mr. W. J. Thorne, the second Mr. Andrew Cunningham, and I followed. I caried on for a period of something like eight years, and the whole tendency was to have continuity of policy and this helped us considerably in Cape Town in the development of our undertaking there.

We have from time to time had discussions in the Council and on many occasions it has been said that it is to the disadvantage of the Council to have one carrying on for a long period. Personally, I do not believe so. I would say that the Council benefits by that man's experience, as it is far better to become perfectly acquainted with the workings of one or two committees and to make yourself conversant with the work, and the general help that you can give in that direction will be to the advantage of the Council and the whole of the town. Then again, sometimes some of our members in Cape Town are apt to think that I personally know a great deal about electricity. Let me say to the Councillor delegates here, that I have never attempted to know anything about the technical side of it. Naturally I have come across and have got to understand some of the technical terms in which you speak, but so far as my part is concerned I have dealt only with the financial side of the problem and with the general facts revealed by the position. Whether it was an advance in our capital expenditure, or of a reduction of tariffs, all I wanted to understand was the general effect. We have to go straight-forwardly to the Council and tell them the whole story and never try to hide anything from them. In that way Mr. Swingler gained the respect of the whole Council. They have confidence in him, and in that way the committee were able to gain their confidence also. That has largely accounted for the material advance we have made in our Cape Town undertakings. (Applause.)

REPLY.

Mr. Eastman (Capetown): In regard to the reference in the paper to the saturation of the industrial load, it should be explained that this has been the state of affairs for many years through the fact that the motive power in every factory has been supplied by electric energy purchased from the Council to the exclusion of any other form of power, so that the quantity of electric energy used in those factories has been determined largely by the state of trade and any considerable increase in sales of electric energy for industrial purposes has been brought about through the establishment of new factories and extensions to existing concerns. That the sale of electric energy for industrial purposes is not stationary is indicated by the fact that it has increased three-fold to 35,000,000 units per annum during the last ten years and is still increasing. Unfortunately, because of the arrangements of interconnection between the Council's and the Electricity Supply Commission's Undertakings in Capetown and the absence of simultaneously recording demand meters in the feeders it is not possible to state accurately what the load factor of the Council's Undertaking is at the present time, though as far as is known it amounts to about 35.8% taken over the year. This figure is less than obtained before the development of the domestic load to its present stage, and although electric ranges continue to be installed at the rate of about 200 per month, it is not anticipated that the load factor will fall much lower having regard particularly to the large increase in sales of electric energy for water heating purposes which may be expected in the near future upon the introduction of the off-peak water heating rate.

Tests made recently on a feeder to which 20 consumers, each with an electric range, were connected—the average connected load of each of which ranges was 6.7 K.W.—show that the increment in maximum load on the feeder due to the ranges amounted to only 2 kW. per consumer and that the increase in load at times of peak demand on the substation brought about by those ranges was of the order of 1kW. per consumer. This indicates the wide diversity which may be anticipated in the loading of electric ranges, though, of course, the actual load demand of any individual consumer might well amount to 10 kW, assuming the use of one or more radiators, kettles and other appliances simultaneously with that of the range, and it is to avoid troubles in voltage regulation that the three-phase, four-wire system of distribution has been standardised in Capetown for supplies to all except the smallest consumers.

The deposit of £100 required from approved electrical wiring contractors is not as great a hardship as might appear at first sight. The deposit may be made in the form of Municipal stock on which the Council pays interest, or in some other gilt-edged security on which the contractor is entitled to receive dividends, and it serves the useful purpose of ensuring as far as possible that only those persons who are well establihed in business and who may, therefore, be expected to carry out their obligations fully engage in contracting work of this nature for the Council. A speaker mentioned that electrical contractors had expressed dissatisfaction with the Hire Purchase Scheme, in reply to which I would point out that there is always a large waiting list of contractors desirous of participating in it. The Electrical Dealers Association has also officially intimated that it considers the Council's Hira Purchase Scheme an entirely satisfactory one from its point of view.

It was mentioned in the discussion that difficulty might arise in using the type of off-peak water heating control switch described in the paper where there is sickness and therefore where electrical heating equipment may be in use intermittently day and night. This is realised, and it is anticipated that it will be possible to overcome any such dfficulty by suitably raising the minimum load at which the control switch operates. It is a matter for experiment, however, and our experience in this connection will be communicated to the Association should any difficulty of this nature arise. One hundred sets of control apparatus of this kind will be installed shortly. It should be mentioned that consideration has been given to alternative methods of controlling water heating supplies on off-peak periods by superimposing upon the system short-period high frequency currents of from 4,000 to 1,000 cycles per second to operate the control apparatus, and synhronous motor-driven time switches of various makes have also been examined as to their suitability for the purpose. After a full investigation of the apparatus available, however, it was thought that the type of switch described in the paper was likely to meet the requirements better than any other alternative schemes which have been examined to date.

The paper shows clearly the amount of difference between what is paid to the electrical dealer in the appliance and the electrical wiring contractor and that which is received from the consumer. The difference over the whole period of working to date works out at 7s. 4d. per kW. installed, but during the last twelve months it was 4s. 10d. per kW. and is gradually falling. This figure, described by some speakers as a loss, is looked upon by the Council as sales development expenses. Only recently an editorial article appeared in "Electrical World" advocating the purchase of load in America for the development of domestic supplies of electricity, and I have no doubt but that in this country when the point of view that the purchase of load is essentially a development expense is more fully appreciated the majority of South African Undertakings will be doing it in one way or another.

The President: Thank you very much Mr. Eastman for your interesting reply. The discussion on Mr. Tubb's paper: "Notes on Gaseous Discharge Lamps" will now be resumed.

Discussion—(continued.)

Mr. H. A. Tinson (Johannesburg): I have some figures which may be interesting, and also a few remarks to make, which, with your permission, I will now give. Blue, green and yellow rays constitute most of the light output of the mercury gaseous lamp, with very little red present. In order to correct this defficiency, the addition of cadmium and zinc to the mercury introduces red lines into the spectrum. This red component is obtained at the expense of efficiency. It has quite recently been stated in a London publication that the mercury gaseous lamp, assuming 100 per cent. efficiency, has one per cent. red light. Daylight has, approximately, 15 per cent. red, and by putting sufficient cadmium and zinc into the tube to raise the red to only 4.5 per cent., it lowered the initial efficiency to 60 per cent.

For practical purposes, the colour cannot be changed by filters because to filter out the excess yellow lines characteristic of the sodium lamp, for instance, would reduce the efficiency to almost vanishing point. The sodium yellow line represents 85 per cent. of the radiated energy. As far as the respective qualities of the very marked difference in light characteristics of gaseous discharge lamps are concerned, renowned specialists, who are studying the problem, are not yet able to make predictions.

Reference to articles in the technical press will show that definite conclusions as to the respective merits of the gaseous discharge lamp versus the tungsten filament lamp, have not yet been expressed. Rather do these specialists seem to emphasise the necessity for further scientific study of the many important factors of seeing, particularly in respect to contrast.

The development now taking place in the new forms or types of illuminants are most interesting, but it is necessary to realise that the initial experimental stages are probably not yet completed. Sodium lamps at present being made in America are for a useful guaranteed life of, at least, 1,350 hours, representing three renewals per fitting per annum for all-night lighting.

Quite recently experiments have been made at Rugby in operating the mercury discharge lamp in a horizontal position. This now seems to be quite satisfactory, and is accomplished by placing a magnet over the tube to overcome the convection currents and to maintain the central position of the arc. Previously, there was too great a concentration of heat over a small area of the glass. If lamps can be commercially operated in this position, fittings having much better light distribution characteristics can be designed..

Mr. A. Q. Harvey (Springs): The figures given by the author in his comparison I do not think are altogether correct, as £12 10s. for fitting for filament lamps seems very high to me, even if they are bought at Salisbury. I am quoted £16 16s. for the complete Gas Discharge Lamp, but for the finest filament lamp I think the price was £6 10s.

I have recently lighted a main street in Krugersdorp, 2,000 ft. long and 100 ft. wide. This street, with the author's spacing of 130 ft. for gas discharge lamps, would have cost £470 for fittings, and, with other fittings, £261 10s. a difference of £208 10s. in favour of the ordinary lamps, and the fittings for the filament lamps are the most expensive fittings that were quoted. They are very attractive lanterns, and the illumination is about the best I have seen.

On working out the running costs and replacement costs on the basis of 400 Watt gas and 750 Watt ½ watt lamps, I have taken 750 watt lamps as the lamps are placed only 40 yards apart. Taking current at cost price, say, .3d. per unit, which is slightly higher than we pay, and the author's assumption of 1,500 hours for gas discharge and 1,000 hours for filament lamps, the cost of units and replacements per annum would be : at 3,780 hours per annum would require the life of $2\frac{1}{2}$ gas lamps per annum, which would be equal to about £5 12s. 6d. for replacements, and not £3 8s, 5d. as stated by the author. With the filament lamps we would require a life of $3\frac{3}{4}$ lamps at 10s. 9d., equalling about £2, which is also slightly higher than the author's figures. The running costs for units would be, at .3 pence per unit for gas, £2 0s. per annum; with filament, £3 11s. That makes it £7 12s, 6d. per annum as against £5 11s. 0d., or the gas lamp would be £2 1s. 6d. per lamp more expensive. So if 100 were installed the filament lamp would cost £207 10s. per year less than gas lamps, not £380 in favour of the gas lamp. I have taken 750 watt lamps, as, from my experience, I find them equal to the gas lamp of 400 watts, and anyone who has seen the Krugersdorp job will bear me out.

In the above figures I have done as the author has done, that is to assume, with the running costs, that the condensers and chokes will last for ever, and that the lamps are removed immediately they have run the stated hours, which of course, is very seldom, if ever, done.

The gas lamps have been tried out at Springs, and the best effect is obtained when alternate gas lamps and filament lamps are put up, as this removes most of the objectionable colour effect.

The lamps are too new to criticise the burning hours, etc., the lamps at Springs having given us about 700 hours to date. I do not wish to discourage this gas discharge lighting, but, to be absolutely frank, I have still to be convinced that it is cheaper to instal and operate, and that the lack of red ray is not an objectionable feature. What further development will do is in the hands of the research laboratories.

Mr. R. F. Riley (Johannesburg): Mr. Tinson has dealt with the technics of the gaseous discharge lamp, particularly in connection with colour correction, and Mr. Harvey covered the ground dealing with the economics of this form of lighting and the capital cost of the equipment. I shall, therefore, deal briefly with the subject from the aspect of practical results obtained from the use of gaseous discharge lamps.

I gather from the remarks of speakers that the chief objection is the colour characteristic. I admit that I shared this prejudice myself on first seeing the trial installation in Johannesburg in company with several of the Engineers present at this Conference, but, after a short time during the inspection, when we realised the value of the acute visibility obtained, we agreed that the colour characteristic was quite a minor matter, and that the initial prejudice would rapidly die out.

We must admit that this new form of lamp produces results exactly as required by Street-Lighting specifications—namely, maximum visibility without glare.

It is true that the initial capital cost of the installation is higher than that of equivalent ordinary gasfilled lamp lighting equipment, but time and increased production will very shortly cancel out this factor.

In England, Central Station and Municipal Lighting authorities have so far adopted gaseous discharge lamp lighting for a number of important thoroughfares, and the number is growing rapidly.

The colour characteristic objection is, therefore, quite rightly not permitted to offset the undoubted efficiency of this system of street-lighting, and surely these Municipal authorities cannot all be wrong.

We are ourselves apt to be conservative and opposed to change. The modern stream-lined car and Diesel engine trains represent a step in the development of higher road and rail speeds, and in a very short time, I feel sure that we shall accept these steps in design as the natural result of progress, Therefore, in connection with the colour characteristic objection in the new form of lighting, I say that progress will not be stopped by prejudice.

REPLY.

Mr. Tubb (Salisbury): Mr. President,—Some of the points raised in the discussion have already been very ably answered by several members present, and, as time is pressing, I shall not enlarge upon these points. Taking Mr. Harvey's point I should like to congratulate him on being able to buy "juice" at .3d. I think there must be something wrong with the quality of it. (Laughter). Mr. Harvey conveniently forgets to mention that he pays a maximum k.w. demand charge, next he takes the comparison of 400 watt gaseous lamp with a 750 filament lamp. My figures are a 420 watt gaseous lamp and a 1,000 watt filament lamp. They both have approximately the same output. If Mr. Harvey compares two lamps of totally different types his argument falls to the ground and I am sorry for his figures.

In regard to the next point raised I have a few historical notes, and if I may be permitted to do so, I should like to read them. I shall not detain the Convention for more than a few minutes. In 1701, Hawkesbee produced the first electrical discharge tube. In 1752 Watson obtained a steady column of light, filling a tube 32″ long. In 1802 Sir Humphrey Davey brought the incandescant filament lamp out. In 1838 Michael Faraday studies luminous discharge at low pressures. In 1864 Jules Vernes equipped each of his subterranean travellers with a small discharge tube worked from a battery and coil. (Laughter). The early tubes suffered from the clean-up of the residual gas, and the life of the tube was short. Today the mercury lamp gives 1,500 hours, and the sodium lamp gives 3,000 hours. That, I think, covers the points raised.

THERMAL STORAGE

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Mr. J. S. Clinton (Formerly of Cradock, now of Salisbury): Before reading my paper on "Thermal Storage" a few explanatory notes are, perhaps, indicated. The subject is probably well known. It is too vast to confine to a single paper of suitable length, For this reason, only the salient points of storage affecting municipal supply undertakings have been attempted. The paper was written some five or six months ago, since when several interesting contributions have appeared in the South African technical press. I refer particularly to a paper by Dunn and Black. Mr. Black is Ruth's representative on the Rand.

SUMMARY.

The paper presents aspects of thermal storage affecting Municipal Electricity Undertakings. Applications of storage in other directions, perhaps of major importance, are not included.

The bearing of fluctuations of load are discussed with a view to ascertaining the possible benefits of storage in smoothing out steam demands.

Subsequently the heat content of the average plant in relation to its hourly evaporation is considered. This is followed by an outline of the various forms of storage as evolved in the so-called variable and constant pressure systems.

The concluding section deals with the suitability of the forms described, to existing and projected plants.

INTRODUCTION : Fluctuating Loads.

Fluctuating loads, the present dearth of means for obviating this undesirable nature of demand

and the lack of an economic method for storing adequate supplies of electricity, create the necessity for a reserve of heat.

Were it possible to meet fluctuations of demand without loss in efficiency or additional cost, there would be no cause to debate the question. These factors are, however, materially affected.

The variations in demand are momentary, hourly, daily and seasonal. There exists, nevertheless, a similarity between general utility electricity undertakings. The larger the plant, the greater is the extent to which momentary and hourly variations are damped. The diversity in the individual demands enables the generation of steam to be followed with restricted effect upon its conditions.

Figures 1 to 3 illustrate the daily load curves of average electricity undertakings in South Africa. On the Eastern seaboard Figure 2 gives indication of a predominating maximum load occurring in the early Winter evenings. The load curve in Figure 1 applies to most inland towns. Figure 3 shows that of a station catering for a base traction load.

In the single unit plant (plus stand-by), a small station up to 300 kws. capacity these variations are countered by adjustments in the fuel supply.

The plant consisting of a battery of boilers, besides fuel variations, achieves this object by adding or subtracting steaming units.

Whilst, as in the case of Figure 3, the fluctuations are seemingly too irregular to be anticipated, in practice, stokers are able to recognise recurring characteristics of hourly and daily variations. This in turn permits a degree of anticipation in adjusting firing conditions which partially diminishes the undesirable features attendant upon fluctuating loads.

Nevertheless, in both small and large plants, there is a constant endeavour to meet steam demands with a minimum of variation in its condition. In spite of intelligent anticipation the operation is, in the main, subsequent to the demand.

This demand can be determined only by detecting variations in pressure. Moreover, on noting a change adjustments to the fuel supply must be suspended until it can be ascertained whether the change will be momentary or sustained.

Where the number of units steaming has to be altered an adequate safety margin must be maintained. This, therefore, makes the task of keeping straight line conditions an onerous and expensive one.

The variations in steam conditions and the efforts to restrict them within reasonable limits, affect the power plant in several ways. The effect will be considered under three heads, viz :—

(a) The effect on steam generating plant ;

(b) The effect on prime movers ;

(c) The effect on supervision maintenance and operating costs.

(a) Steam Generating Plant.

Dependent upon its capacity and physical characteristics the boiler plant efficiency is affected in two main ways.

Firstly : The "no load" losses of the boiler room naturally increase as the load factor of the demand decreases. Moreover, the smaller the plant capacity, the greater the relative influence of this loss.

By "no load" loss is meant all such unavoidable factors as radiation, banking, auxiliaries, lighting, soot-blowing, decreased superheat, increasing flue radiation and enforced stoppages of units.

The effect of low load factor of demand upon this loss does not require elaboration.

Secondly: Even with economically perfect conditions of firing, the boiler efficiency varies with the load. The overall thermal efficiency is lowered for all demands other than the normal evaporative duty. Figure 4, in giving the efficiency, curves for various boiler ratings, illustrates this point. Maximum efficiency is the normal duty of the boiler. The reasons for the variations in the curve are well-known.

To obtain, however, such theoretical efficiencies at a particular load, the demand must remain sufficiently steady in order that the economically perfect fuel setting can be made. Sudden variations cannot be immediately met owing to the time lag in the cycle of operation. If the fluctuations are numerous and of short periods, there is a continual hunting after satisfactory steam conditions. This is generally at the expense of the theoretical values of CO^2 content. More so does this hold in the case of stoker fired units.

In order to illustrate to what degree uneconomic percentage of CO^2 affect boiler efficiencies Figure 5 is included. The graph indicates for two boiler ratings, the variation in boiler efficiency with different values of CO^2.

It does not serve a useful purpose to discuss here the effect percentages of excess air have on boiler efficiencies. Likewise the differences played by the personal element, balanced or purely induced draft methods of firing, stoker or pulverised fuel units, and the various areas of grate covered by live fuel at various ratings, are all factors for a more specialised study of combustion.

Sufficient has been included to indicate that the efficiency of the unit and of the battery decreases where the load factor is low; also when the fluctuations are numerous and sustained for only short intervals, that is to say simply for maximum efficiency, the plant must operate at a steady load for lengthy periods and as near to normal evaporative duty as possible.

In order to indicate the extent to which fuel consumptions are affected by variations in the average boiler efficiency Figures 6a and 6b are added.

It will be noted from these curves that for a small drop in average efficiency of the unit amounting to 3 per cent. from 85 per cent., the excess coal consumed is 5 per cent. For a drop from 85 to 65 per cent. it is 32 per cent. The extra coal consumed when the average is lowered from 85 to 60 per cent. is 42 per cent. When it is borne in mind that the average load factor is low the bearing of these figures can be appreciated.

It may, however, be advaned that the boiler efficiencies do not drop to such low figures. Referring to Figure 4 this argument seems tenable. The test efficiencies are considerably in excess, except for hand fired boilers, of 75 per cent. at all loads from ¼ upwards. Were these figures obtainable as annual averages, the scope of any attempted saving by storage would be greatlv restricted.

In order to illustrate, however, the wide gap between test efficiencies and average results, figures 7a and 7b have been added. These give an approximate idea of what obtains in practice. On the right, in Figure 7b, are steam evaporations for several common fuel and steam conditions plotted against percentage boiler efficiency.

On the left in Figure 7a are plotted curves of varying steam consumptions against fuel consumption per kilowatt hour. By assuming an average turbine steam consumption, reading up from the average fuel consumption, across to

Figure 7b and down from the curves for the corresponding conditions, will indicate very approximately the average boiler efficiency. It will be seen that a plant operating at 1.5 lbs. coal, 13,500 B.T.U.S. Cal. value, steam 215 lbs. per sq. in. abs. 550F. total temperature and 12 lbs. steam per kilowatt hour averages 69 per cent. boiler efficiency. Other conditions will bear out the difference which usually obtains between test and actual average results.

If by storage these low average efficiencies can be improved, the corresponding percentage saving can be read from the curve in Figure 6b. Moreover, the no load loss decreases in a like proportion.

The effect therefore, on the steam generating plant is such as to encourage steps to improve the steam demand load factor.

(b) Prime Movers.

The disabilities in this connection following in the wake of fluctuating loads arise from several causes. They are, moreover, dependent upon individual plant characteristics.

Firstly, the steam conditions of the fluid are varied from normal.

Secondly, due to the need for adequate plant to cope with peaks, it is often necessary to continue to run more machines than warranted by the immediate load.

Thirdly, the losses due to the starting and shutting down of units.

The last two disadvantages remain whether storage is adopted or not. They all, however, result in a decreased thermal efficiency. The benefits accruing with constant steam conditions are what immediately concerns the question of storage.

In the case of reciprocating engines for quite moderate variations in pressure, the loss in efficiency is very marked. These variations are common even in the relatively steady conditions obtaining in electrcity undertakings. The indicator diagram of a compound engine in Figure 8 illustrates the effect of a 20 lbs. per sq. in. drop in steam pressure. The decreased power available for a fixed cut off in this case is 14 per cent.

Likewise in turbine plants the efficiency is adversely affected by lowered steam conditions. The pressure and superheat correction curves are given in Figures 9a and 9b.

From these it will be seen that, for both the reciprocating and turbine plant, quite moderate drops in steam conditions result in an appreciable loss in efficiency.

(c) The Effect upon Operating Costs, etc.

In the case of a single unit plant the operating costs remain unchanged by the vagaries of fluctuating loads. There is, however, added cost in maintenance and shorter steaming periods due to the effects of alternative forcing and idling in efforts to equate the load.

These factors in practice affect the issue materially. In large plants with a battery of boilers the item of increased maintenance is of even greater import. By means of storage it is usually possible to reduce the number of steaming units. The effect of this and consequent saving can be appreciated.

Moreover, where the stokers are natives or of poor standard, the amount of supervision is likewise increased. This is especially the case where fluctuations are sudden and severe.

Having briefly surveyed the undesirable results of fluctuating demands, it is patent that some addition or method of levelling steam generation, or both, is required. This must be achieved in the face of an inconstant prime mover demand.

Storage of heat, in either large or small amounts, serves therefore, to achieve the following summarised ends :—

1. The multiple unit station can be operated with a minimum of plant, at maximum possible unit and station efficiency. In addition the labour maintenance and supervision charges are reduced to a minimum.

   The small station is similarly affected.

2. In contemplated undertakings, if separate storage is incorporated, a lower capital outlay is possible. This is accounted for by the fact that boiler heating surface is more costly than the equivalent storage capacity.

3. The losses due to inconstant steam conditions are decreased.

4. A steady firing rate is possible with attendant fuel saving.

The extent to which these improvements can be attained depends naturally upon the amount of storage and the degree with which it damps out irregularities in the prime mover demand.

The manner in which storage can be achieved will be considered.

The possibility of storing the heat of combustion against its need is ruled out of practical politics. It is too early a stage in the cycle of steam generation to accumulate a reserve of thermal energy.

The most suitable solution is to store steam, after formation, ready for use. The second, but indirect method, is to store the energy in water or other bodies, which will readily give up its store when required.

In a power station plant storage takes place in the following ways :—

1. In the water and steam content of the boiler;
2. In the water content of the feed system;

3. In the economiser;
4. In special storage systems for steam, water, or both.

The extent and value of these various reserves of energy will be examined in more detail.

1. Boiler Water and Steam Content.

The accumulation of heat in the boiler is obviously the simplest method of obtaining the ideal of storage. Unfortunately the modern water tube boiler is not adapted to this purpose.

The amount of steam available in relation to the hourly evaporation from the energy momentarily stored, is small. Moreover as the size and pressure of the unit increase so does the proportionate storage capacity decrease.

The water content is likewise small. It does, however, provide against the contingencies of minor variations in load. This is familiar to boiler operatives, who, by anticipation are able to raise or lower water levels within the prescribed limits of safety, supply cold or warm feed and generally adapt the unit so as to obtain the best results from its potential storage capacity.

At this stage it may be useful to illustrate the difference between the water content of the main classes of steam raising units.

Class.	Ratio $\frac{\text{Water Content Lbs.}}{\text{Hourly Evaporation Loss}}$
High Pressure Generator	0.40
Water Tube Boiler	1.0 to 3.0
Lancashire Boiler	4.5 to 5.0
Locomotive Boiler	1.38
Return Tube Boiler	3·75

The above ratios in boiler selection are of more importance than is usually conceeded. In its process of evolution the construction of the water tube boiler necessitated the sacrifice of water content. They are, however, of numerous designs incorporating different ratios of water content to hourly evaporation.

This means that a boiler with twice the water content of another type can for equal drops in pressure, at peak periods evaporate twice the amounnt of steam from the termal storage in its water content.

Figure 10 gives a curve of the steam and water content of various ratings of B. & W. boilers. Figure 11 gives graphically the weight of steam evaporated at the lower pressure for various drops in steam pressure. From this, assuming that a maximum drop in pressure of 20% is permissible, a further curve is added to Figure 10 illustrating the value of the water content as a standby for peak periods of demand. It will be noted that the increase in evaporation is small and further diminished in value owing to the proportionately greater prime mover demand at the lower pressure.

Failing storage of energy outside the boiler steam and water content, the latter if limited, is nevertheless of valuable assistance in times of emergency as in normal operation.

2. **Heat Stored in Feed Water.**

The storage of energy in the feed system is in a different category from the foregoing. Whereas the boiler water content is at saturation temperature that in the feed system is usually confined to a much lower value.

Its virtue as a storage medium is not negligible. Any heat added serves to increase boiler evaporation.

To the incoming, or reserves of feed water, or both, waste heat is added. Alternatively, or together, additional storage is incorporated by regenerative feed heating systems.

In the former case is included steam drain recoveries, reciprocating auxiliary exhausts, steam ejector discharges and direct contact heaters. These are limited to the general features of the plant.

Regenerative systems are as a rule confined to turbine plants. Theoretically the system can be applied, with limited effect, to reciprocating engines. In practice, however, bleeding the low pressure receiver, in order to recover a portion of the heat normally given out to the circulating water, has failed. This is due to the abnormal condensation which accompanied such attempts. As a result, the consequent increased steam consumption nullifies the thermal gain.

It is, however rare to find a turbine installation operating without extraction for feed heating purposes. The economic advantages as the result of higher thermal efficiencies are best illustrated by reference to Figure 12a. The lower limit is naturally the Rankine, whilst the upper approaches the Carnot cycle efficiency.

Figure 12b shows the limitations of bled steam heating. A set of curves for single to three stage heating indicates the maximum efficiencies attainable and the resulting feed temperature. This elaboration of feed heating is mentioned in order that the combination of regenerative systems and storage of heat produced by the boiler, should be fully appreciated. This is dealt with in the concluding section.

In all considerations of feed water storage of heat the hotwell in the open type system restricts the final temperature. For storage above this limit the closed feed system must be adopted.

Figure 13 shows the relation between the water content in the feed system and the hourly evaporation of the plant at peak periods. It will be seen that the ratio is relatively small. This need not be the case however. Hypothetical instances can be conceived, where it would be economical to increase the feed system reserve. This could be heated by means of direct heat exchanges utilising live steam. Alternatively the object can be achieved by circulating the reserve through bled steam heaters at low load periods.

It can be seen from this short digression into the realms of feed water heating that the principle of conserving energy in various stages in the cycle of generation and utilisation is inseparable from any method of increased storage direct from the boiler.

3. Economiser Water Content.

The gradual elimination of water content from the water tube boiler, especially for high pressures, makes the economiser of greater importance as a reservoir of heat. It is, moreover, usually regarded as the means for providing the sensible heat in the water prior to its transfer to steam in the boiler.

Its virtues, in this respect, arise from several sources, namely :—

(a) Economiser heating surface is usually cheaper than the corresponding boiler surface.

(b) The heating surface can be better suited to the transfer of heat than the last pass of the boiler.

(c) Rapid circulation of water at saturation temperature in the boiler is the most efficient method of generating steam.

(d) For considerations of heat transfer the higher the steam pressure and corresponding saturation temperature, the higher must be the boiler exit gas temperature. This naturally means a greater amount of heat in the waste gases to the economiser which it is arranged to recover.

In order to illustrate the bearing of the economiser as pressure increase Figure 14 is included. This gives in graphical form the total heat in water and steam for varying pressures. The rapid rise in the amount of sensible heat to be added as pressures rise is patent therefrom.

In addition Figure 15 gives the minimum boiler exit gas temperature for economic conditions at various steam pressures. This elaborates the statement in (c) above relative to the increasing importance of the economiser in the high pressure region of practice.

Figure 16 indicates the relation between economiser water content and the boiler hourly evaporation.

Although the average outlet temperature of the economiser water content is usually below the saturation temperature its value as a heat reservoir is not lessened at peak periods. This reserve is drawn upon at a higher rate. The boiler evaporation is therefore additionally assisted. In order to allow the economiser water content temperature to approach more nearly the boiler saturation temperature it is necessary to instal the steaming type of economiser.

Throughout the foregoing examination of the storage content in the average undertaking, it will be appreciated that intelligently operated there are potential reserves of heat. Such storage is however, both limited in extent and unsuited to the levelling of prolonged peaks. At its best the storage facilities are of use for fluctuations of only short duration and to provide a safety margin in operation.

4. Safety Storage Systems.

Before investigating the modern outcome of a demand for storage, it may be usful to review early historical efforts.

In 1899 Druitt Halpin proposed his scheme of heat storage. Figures 17 and 18 show two of these developments. In effect the idea is merely an extension of the water content of the boiler. The storage vessel was similar in construction to the boiler steam and water drum above which it was suspended.

At periods of low loads an excess of feed was pumped into the boiler from which it passed to the storage drum. This increase in the water content was heated by the steam or the boiler gases in the case of Figure 18. The resulting increase in water content at saturation temperature was drawn upon at peak periods. A full description is uncalled for. The diagrammatic illustrations are self explanatory.

The system fell into disfavour for several reasons easily explained and remedied in the light of modern research upon this subject.

In 1901 Rateau proposed a somewhat different form. It was the forerunner of the variable pressure system of to-day just as Halpin's relates to the constant pressure type.

Figures 19 and 20 show the first two proposals in order of invention. Figure 21 illustrates a later development by Rateau and Morrison.

In all these the principle was to store steam, the exhaust from reciprocating engines in particular, for subsequent use in an exhaust turbine. The steam exhausted through suitable diffusers, was drowned in water in the storage drum. The water content served to store the heat. By subsequent controlled drop in pressure steam was obtained by evaporation and put to service in a low pressure turbine.

The effect upon the boiler firing rate was not the basic reason for this scheme of Rateau and Morrison. It had merely the improvement in thermal efficiency as its object by using non-condensing engine exhausts. It will be noted therefore, that the pressure range was low.

Before passing from these historical features it will be of service to examine certain limitations in storage.

Steam stored as such is naturally the most suitable method of accumulating a reserve. Maturer thoughts will, however, dispel this idea. At 200 lbs. per square inch absolute and 250° F. of superheat the volume of steam per lb. is 3.25 cubic feet. The extent of storage necessary to maintain a peak for two hours of 1,000 K.W. Hrs. at a turbine consumption of 11 lbs. of steam per K.W. Hr. is readily deduced from this figure.

Besides if it is desired to store the steam for use at the working pressure, it must be done on the gasometer principle. The weight and insulation necessary make this an uneconomic proposal. The alternative is to utilise the steam at a lower pressure in a consuming device such as an exhaust or mixed pressure turbine.

In the second method heat can be stored in masses of water or other materials from which the heat is abstracted as and when required. Water, having distinct advantages, is most commonly used. The absorption of heat by water is given in Figure 22. This storage is naturally limited to the saturation temperature.

The stored heat can be utilised in one or both, of two ways. It can be released by evaporating steam through a drop in pressure. The amount of steam released at the lower pressure can be read, per cubic foot of water, stored, from Figure 11.

Alternatively the heated water can be fed to the boilers in the usual way, at peak periods; thus increasing their evaporative capacity. The heating of the water is effected at low load periods or whenever the pressure tends to rise owing to fluctuating loads. The firing rate is therefore unchanged over considerable lengths of time.

The fact that the evaporative capacity of the steaming unit is materially increased by supplying feed water at saturation temperature, is easily verified. The theoretical gain in the rate of steam generation is shown in Figure 23. The lower limiting factor, initial feed temperature to the accumulator, has naturally a big bearing on the question of the relative advantages of the storage system and such normal adjuncts as an economiser and regenerative feed heating. Moreover, the duration of the peaks has to be considered in designing the extent of storage. The increased evaporation can be maintained only as long as there is feed water at saturation temperature. This, however, is merely a matter for economics and designed capacity.

Besides the theoretical gain in the rate of evaporation derived from purely thermo-dynamical considerations, there is another factor to be taken into account.

As early as 1899 Halpin noticed that the feeding of water at saturation temperature, by means of his storage system, increased the rate of evaporation beyond the limits anticipated from acknowledged theory. This has since been confirmed by other investigators. No fully accepted theory has as yet been advanced for the increased evaporative efficiency. Halpin puts the gain due to this at 20%.

Whether this holds equally with the improved circulation of the modern water tube boiler is a point upon which authoritative information is lacking.

In one case quoted by Halpin, a boiler of 12 000 lbs. evaporative duty anticipated to give 15,000 lbs.

per hour under certain storage conditions actually evaporated 25,000 lbs. per hour, a percentage gain of 108% in all.

Unwin has also commented upon results of a personal storage investigation which were inexplicable in the face of recognised theory.

It seems that feed water at saturation temperature improves the circulation, hence the transmission of heat through the walls of the tubes with a consequent greater release of steam.

In all works upon this subject, as a rule, no credit is taken for this factor. The basis of design being the thermo-dynamic gain.

The various forms of modern storage systems will be briefly described.

(a) Variable Pressure Type.

The successor of Rateau and Morrison in this field is Dr. Jōhannes Ruths of Sweden. His System is in principle that of these pioneers. The essential difference lies in the fact that Ruths perfected a design to absorb steam in any quantity at all pressures and for any superheat.

Figures 24 and 25 illustrates a typical Ruths' accumulator and a diagram of the steam and feed system incorporating such storage.

The accumulator consists of two main parts, the accumulator drum and the automatic valves for distributing and governing the storage and release of steam.

The construction of the drum is cylindrical with hemispherical ends containing 90% to 95% of water. The container is suitably insulated with about 3 to 4 inches of cork or magnesia. As a rule the drum is placed in the open, immediately outside of the boiler house.

A non-return valve E admits charging steam to an internal header F. From this the steam passes to charging nozzles G equipped with circulating pipes H in order to minimise noise and facilitate the heating of water.

The steam discharge from the drum takes place through the non-return valve I. A de Lavel nozzle K restricts the maximum discharge rate of steam from the accumulator. This serves as a protection in the remote case of a burst steam main.

The usual complement of gauges and indicators common to a boiler are included.

The size of the accumulator is naturally governed by the nature, period and rate of fluctuations in the steam demand. The capacity is, moreover, affected by the lower discharge pressure. The design of adequate volume is a matter for simple thermo-dynamical calculation. Figure 11 gives a curve for interpolating the weight of steam available per cubic foot of water capacity for various pressure limits.

Since the use of steam on the secondary side is confined to a lower pressure the utility of this form of storage is confined to definite applications. These are dealt with in a concluding section.

(b) Kiesselbach Constant Pressure System.

In the constant pressure field this is perhaps the best known system. The feed water circuit is diagrammatical illustrated in Figure 26.

The construction of the accumulator is very similar to that of Ruths' storage drum; being a cylindrical vessel with hemispherical ends. The system of operation can be followed from the diagram.

The boilers are fed by means of two pumps discharging to different headers. The one pump operates for limited periods, at a constant rate.

Its suction is from the bottom of the accumulator, its discharge to a common main feeding the line of boilers. This rate of feed corresponds to the maximum steam demand.

The second pump operates at a variable speed and duty. controlled in this, by the varying pressure in the main steam range. Its suction is taken from the nominially cold feed tank. The discharge is through the economiser to a header for normal feeding.

At low load periods the feed pump operates at full rating, thus tending to increase the water level in the boiler drums. The surplus water, however, drains to the accumulator through overflow pipes shown. The storage drum is therefore, charged at saturation temperature and boiler pressure.

On peak loads, the falling pressure in the steam main stops the feed pump. The steam demand is then met entirely by the evaporation of water provided from the accumulator by the circulating pump. The drop in water level in the storage drum as the result of sustained demands is made good by the feed pump, during the low load periods of demand.

A balancing pipe from the steam main to the accumulator serves to equalise both the pressure and saturation temperature therein. An economiser, customary in most existing power stations, is shown in the feed circuit.

(c) Ruths' Constant Pressure System.

This system though constructed upon similar lines to the foregoing operates in a different manner.

Referring to Figure 27 it will be seen that the steam in excess of the momentary demand is bypassed through valve A, where it enters a direct heat enchanger, to the accumulator. The cold water entering this heater, serving therein to condense the steam passing, is delivered by the feed pump from the feed tank shown.

Only sufficient water is admitted through valve B to condense the steam entering in order to maintain sensibly constant pressure and temperature in the storage drum. Valve B is operated by the accumulator pressure, whilst Valve A is controlled by variations in steam main pressure.

The usual arrangement of boiler feed pump and control equipment draws the water from the bottom of the accumulator and discharges to the feed headers.

At light loads the steam main pressure tends to rise, thereby opening valve A to allow steam to enter the accumulator via the heat exchanger. This in turn causes a rise in the accumulator pressure which serves to operate valve B. The latter allows cold water to condense the incoming steam in order to restore equilibrium by raising the water level in the drum.

During peak periods the steam by-passed to the accumulator ceases. The feed from the latter at saturation temperature is therefore fed to the boilers. The restoration of water level in the storage vessel is effected as above when opposite conditions obtain.

(d) The Marguerre Feed Water System.

What appears to be the most suitable storage system in the constant pressure field is that developed by Dr. Marguerre of Mannheim. This statement is qualified by the restrictions applying to electricity undertakings.

Figure 28 illustrates a diagrammatic arrangement of the system incorporating such features as economisers, preheaters, and regenerative feed heating. Not all of these might be found together. They are however, shown to indicate the relative positions in such systems.

A feed pump discharges from the hotwell, through an economiser, to the storage drum. Valve B in this circuit is operated by a float and so maintains constant level in the storage drum. A circulating pump draws water from the bottom of the accumulator and, at certain periods, together with the feed water from the economiser discharges through valve R to a heat exchanger at the top of the storage drum. The latter is erected vertically, being operated on the displacement principle, hot water uppermost, cold water below.

A boiler feed pump draws its supply from the top of the accumulator, discharging into the usual boiler feed headers. An alternative feed circuit from the economisers, by-passing the storage vessel, is arranged through valve L. Steam to heat the storage medium enters through the top of the drum through pipe K. Valve R is operated by variations in the steam pressure of the main header. Regenerative heaters or preheaters can be arranged as shown.

At periods of low demand, due to constant firing conditions, an excess of steam is generated. This goes to heat the water stored. The condensation of this steam is effected by the circulating pump extracting nominally cold water from the economiser and the bottom of the tank. This is passed together with the incoming steam through the top of the storage drum.

The hot feed required by the boilers is extracted from the top layer of water in the accumulator as required. At periods of peak demand no steam is condensed. The supply of water to the accumulator to equalise the drain from the top to the boilers, is made good by incoming supplies from the economiser circuit. When fully charged the whole of the storage vessel is at saturation temperature. When discharged the contents have come direct from the economiser.

Comparisons and Applications.

It remains to consider the relation to the average electricity undertaking of the various forms described in the preceding section.

The variable pressure accumulator would appear to have a limited field of application. Exceptions exist where there is a demand for process steam heating. This is usually required at low pressure and saturation temperature. Again the secondary steam can be used to generate energy by means of mixed or low pressure turbines. This, however, is as a rule undesirable as it entails extra generating plant. This is not altogether a drawback since it need operate only at peak periods.

The system is sometimes claimed as the future development in conjunction with a high pressure steam generator. This is doubtful since with interstage superheating the exhaust from the high pressure turbine is more likely to be utilised in the intermediate or low pressure cylinder of the turbine unit. If any storage is done it is more likely to be in connection with an extension to the boiler water content.

For process work demands most power stations are not ideally situated. The sites adjacent are often quite unsuited for the layout of such factories.

The greatest drawback of the variable pressure type is the lack of superheat in the secondary steam. This leads to wetness and consequent higher consumptions in energy consuming units. Attempts, by passing the steam over heated plates, have been made to overcome this defect. They have not, however, met with universal approbation.

It can, moreover, be easily deduced that for the storage of equal amounts of energy, the capacity required is many times that of the constant pressure type with a consequent reflection in the capital outlay.

The greatest virtue is its ability to store unlimited amounts of energy. The storage contents can be discharged moreover, at rates limited only by the capacity and needs of the consuming units.

The various forms of constant pressure storage have certain features in common.

One objection usually advanced is that at peak evaporative periods, the increased rate of steam passing through the superheater is in excess of its designed capacity. The result anticipated is lowered final steam temperature. This disadvantage is more apparent than real.

In the first place the boilers subsequent to a storage installation, are usually operated at normal evaporative duty. From Figure 4 it will be noted that this is the top of the efficiency curve, well below the maximum rating. The Flow of steam is therefore within the capacity of the superheater.

Moreover, with the increased flow through the superheater improved transmission of heat obtains. Due to the higher velocity, according to well-known laws, portion of the loss in temperature is offset by an improved heat transmission factor.

In any case there are variations in superheat in normal operation of plant without an accumulator. Most authorities agree that these are not exceeded in an accumulator cum boiler installation.

The second objection is that the previous installation of an economiser restricts the scope of storage. So does the regenerative feed heating. Both admittedly limit the advantages.

This is shown by the way in which increased rates of evaporation when feeding at saturation temperature, are lowered in Figure 23 as the inlet feed temperature rises.

These statements must however, be qualified.

At peak rates of evaporation an adequate storage to carry the boiler plant over several hours is often necessary. The economiser is not suitable for the rapid transfer of heat under these conditions nor has it the water content necessary.

During this period also pass-out steam is usually restricted in order to decrease turbine steam consumption. It is therefore seen that all heated feed must be drawn from an outside supply. This, moreover, is obtained by storage during valleys in the demand.

It is illogical to exclude the saving offered by an economiser in order to grasp at an equivalent gain from the total improvement obtained under storage conditions. There is, however, ample scope for both.

In the Kiesselbach and Ruths' form of storage, precautions have to be taken to protect the economiser.

This is specially the case for economisers of cast iron construction. In the former the flow through the economiser ceases at peak periods. This necessitates mechanical warning or safety devises to prevent dangerous conditions arising. This need not be considered an insurmountable drawback. There are many similar warning signals in operation for the protection of power station plant. A small but adequate flow can likewise be maintained through the economiser. Its low rate of heat transmission and water content serve still further to protect it.

The Ruth's System is somewhat differently affected since the economiser is in the direct path of the feed water from the storage drum to the boiler. The temperature in the former must therefore, be maintained at such level that the water therefrom is heated after passing through the economiser, to not more than the equivalent of 30°F. below boiler saturation temperature.

This disadvantage of an economiser installation does not affect the Marguerre system of storage.

The third disadvantage common is that the inlet feed and saturation temperatures limit the peak rates of boiler evaporation achieved by storage at the latter temperature. Although this is the case and illustrated in the graph in Figure 23, nevertheless constant firing conditions can be obtained over fairly wide ranges and for prolonged periods. This, without bringing the boiler steam production to a 100% load factor basis, is sufficient as a rule to justify the installation.

The duration of the peak rates of discharge obtained under storage conditions is Limited only by economic considerations. The rates of discharge by the temperature factors, boiler grate area and combustion volume.

In order to illustrate the value of a constant pressure system in providing constant firing conditions over considerable periods Figure 29 is included. This gives particulars for a Marguerre system applied to a Municipal undertaking incorporating regenerative feed heating.

The constant firing periods have been levelled off on the load curve of steam demand. The reduced boiler plant necessary to meet the peak demands can be interpolated. It will be noted that the use of two boilers was dispensed with subsequent to the installation of storage equipment. The consequent reduction in "no load" losses and plant maintenance is apparent. Besides these are the savings due to constant high efficiency, firing conditions discussed in an early section. Even a 10% improvement in efficiency, so easily possible, with constant firing conditions entails a substantial saving as shown in Figure 6b. That this is a gain not difficult to obtain with stable conditions is one patent to power plant superintendents.

Economic considerations dominate the selection of plant. Engineering is basically the science of investing money wisely. There are occasions when it is difficult to translate a service into monetary values. The installation of a storage system is not in this category.

In order, however, to give figures of costs specific conditions must be known. Only by applying local, individual conditions and commonsense is it possible to determine the value of or justify the installation of storage to a particular plant.

As a general rule it can be assumed that storage capacity is of lower capital outlay than the equivalent boiler rating. For the contemplated plant, therefore, bearing in mind the limitations of storage, such installation is a wise investment however small the gain.

In the older plants, which it is not proposed to extended further, the installation must justify itself on a different basis. Usually with the older types of boiler plant the gain is greater. It is here necessary for the fuel saving to show a favourable balance against the annual loan and operating charges. This is, as remarked, often possible owing to the resultant fuel saving being high.

Moreover, in view of the almost universal popularity of the two part tariff in its various forms, every saving in fuel cost makes a further reduction possible in the energy charge of electricity. This, in turn, is an inducement which results in an improved load factor and increasing sales.

Since the limiting saleable value of a unit can be considered as the fuel cost any reduction thereof is bound to reap good. A fuel saving of 10% when the cost is in the vicinity of 0.25 penny may appear of small value. Even so, 0.25 penny passed on to the consumer will give resuts.

Apart from this aspect, if the direct annual saving is not passed on to the consumer, the undertaking has a nest-egg in the shape of increased profits.

Considerable thought is often given to the section of types of transformer or generating plant where the saving might amount to such small amounts as fractions of 1%. It seems therefore that there is need for developing a better acquaintance with the greater benefits possible from storage.

Figures available for the savings effected in practice generally agree. These indicate that from eight to twelve per cent. is a safe estimate for the savings possible in moderate capacity plants. In large undertakings from four to six per cent is the average saving on the fuel bill. Eighteen to twenty per cent have been obtained.

Much depends upon individual cases and the supervision of firing methods in vogue. In many instances when the variations have been cut down due to storage to a few over prolonged periods and where the class of boiler attendant is poor, occasional testing and setting of fuel conditions is easily arranged.

Certain undertakings in South Africa are in a position to verify the savings possible and peculiar to their conditions. The Cape Town Municipal Undertaking in parallel with that at Salt River of the Electricity Supply Commission, could so imitate the constant firing conditions achieved by a storage system as to enable the management to determine the reduction obtained in fuel and maintenance costs.

Other such similarly situated plants come to mind such as those on the Reef. It would be interesting if such figures could be obtained and published for the benefit of South African Engineers.

In conclusion the various Engineering firms who so kindly assited in the compilation of this record of storage by furnishing data and the relevant

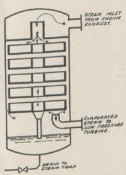


FIGURE 19.

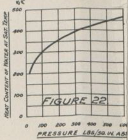


FIGURE 22

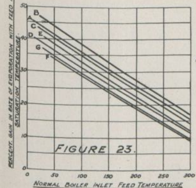


FIGURE 23.

REFERENCES FIGURE 23.

A	Steam pressure	365 lbs/□" Abs.	Total temp.			700°F.
B	"	"	"	"	"	600°F
C	"	315	"	"	"	600°F
D	"	265	"	"	"	700°F
E	"	265	"	"	"	600°F
F	"	215	"	"	"	700°F
G	"	215	"	"	"	650°F

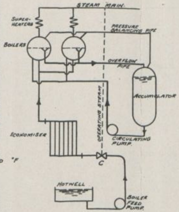


FIGURE 26

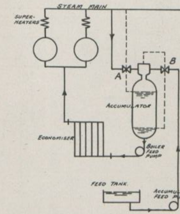


FIGURE 27

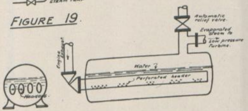


FIGURE 20

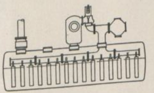


FIGURE 21

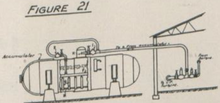


FIGURE 24.

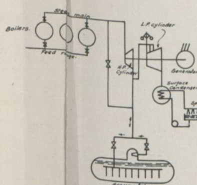


FIGURE 25.

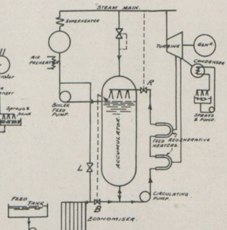


FIGURE 28.

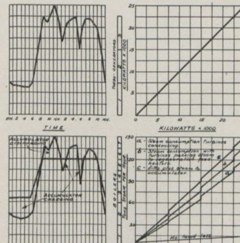


FIGURE 29

FIGURES 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, & 29.

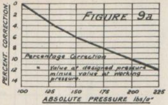


FIGURE 9a

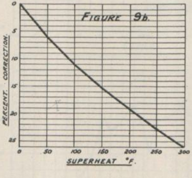


FIGURE 9b.

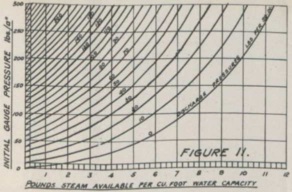


FIGURE 11.

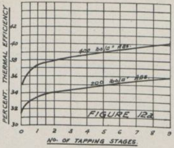


FIGURE 12a.

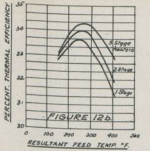


FIGURE 12b.

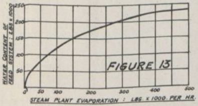


FIGURE 13

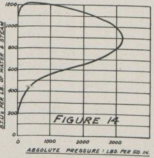


FIGURE 14

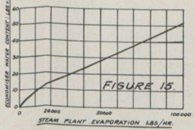


FIGURE 15.

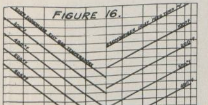


FIGURE 16.

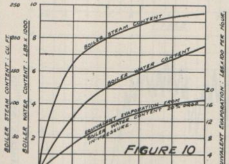


FIGURE 10

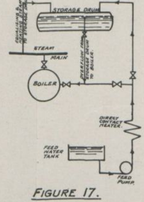


FIGURE 17.

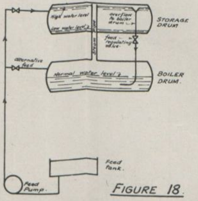
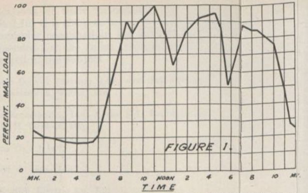
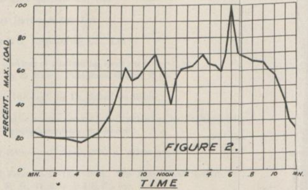


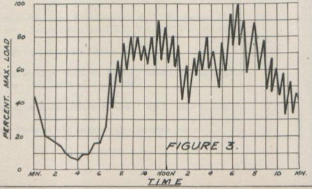
FIGURE 18.

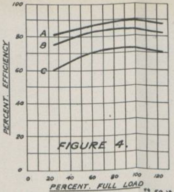
FIGURES. 9, 10, 11, 12, 13, 14, 15, 16, 17 & 18.

FIGURES 1, 2, 3, 4, 5, 6, 7 & 8



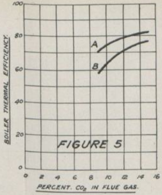


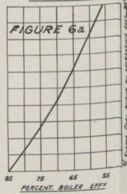


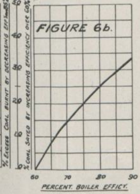


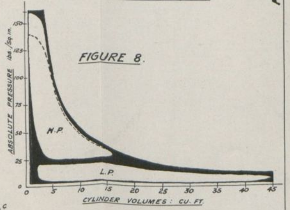
REFERENCES FIGURE 4.			
	Evaporation lbs. per hr.	Mode of Firing.	Accessories.
A	150.000 100,000 50.000	C.G. Stoker	Economiser & Air Heater
B	20 000 10 000 6 000	C.G. Stoker	Economiser
C	4000 2000	Hand fired.	—

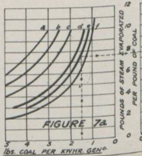
REFERENCES FIGURE 5	
A	Boiler rating lbs. steam/□' H.S. 2·5
B	" " " " 5·0

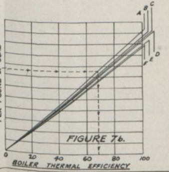












REFERENCES FIGURES 7a & 7b.

SYMBOL	CONDITIONS			
	COAL CALORIC VALUE	STEAM PRESSURE	TOTAL STEAM TEMP °F	ECON. WATER INLET °F
A	13500	215# ABS.	550	100
B	13500	215# ABS.	650	110
C	13500	350# ABS.	750	140
D	12500	215# ABS.	550	100
E	12500	215# ABS.	650	110
F	12500	350# ABS.	750	140
a	AVERAGE GEN. PLANT STEAM CONSUMPTION 30 lbs steam / KWHr.			
b	" " " " 25 " "			
c	" " " " 20 " "			
d	" " " " 14 " "			
e	" " " " 12 " "			
f	" " " " 10 " "			

publications of their principals and others are thanked for this co-operation. A list of firms and bibliography consulted in the preparation hereof is appended for the fuller information of anyone interested in the subject.

Reynolds Sons & Partners, Ltd., and their Principals
Babcock & Wilcox, Ltd.

Greens Economisers, Ltd. & the S.A. Representative
S. H. Garnett, Esq.

Siemens (S.A.) Ltd.

Reunert & Lenz. Ltd.

The English Electric Co. Ltd.

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"Thermal Storage" by E. G. Ritchie, D.Sc. in Steam Engineer. Oct. 1931 to Jan. 1933.

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"Steam Turbines" by Goudie and numerous others.

DISCUSSION.

The President : I have studied Mr. Clinton's paper with great interest, and should like to congratulate him on his effort. The maximum benefits are obtained from thermal storage with the boiler plant operating at 100 per cent. load factor. To adopt the Marquerre feed water system to existing municipal power stations, the accumulator would be required to store large quantities of water at saturation temperature for a long period during the 24 hours in order to obtain a straight line demand on the boiler house for maximum efficiency. No data is available on the "no load losses" of the accumulator. Assuming a boiler house load factor of 50%, the accumulator may have to be of such a capacity to supply the average evaporative demand for 12 hours to give a straight line for the load curves in figs. 1, 2 and 3, which would mean that the accumulators would assume the large dimension of three times the water content of the boiler plant in operation. The capital charges and the no load losses of the extra plant would have to be compared with the gain due to higher efficiency from thermal storage.

Mr. Rodwell (Johannesburg): The paper has been compiled with a great measure of care and thought. It is a subject that has not been to the fore to any large extent in South Africa, but that there is scope for the usage of thermal storage must be apparent to all. It is one that requires considerable thought when investigating the merits of the different classes of thermal storage, more particularly as applied to generating stations.

The cost of meeting the short-lived evening peak loads on our power stations, is one that has a distinct bearing on the total cost of production with its consequent influence, however small, on the cost to the consumer. This part of the cost of production of electrical energy to-day, in reasonably modern installations, is, of course, a very small part of the selling price of the unit, and it is not inconceivable that any slight further reduction in generating costs would be too small to enable the benefits to be passed on to the consumer. By this it is not inferred that any reduction of generating costs, no matter how small, is not worth striving for. The question of how it can be attained is one that has to be considered on the merits of each individual undertaking, and, taking South African power stations, I submit we can find as great variety of local conditions as anywhere in the world.

We have power stations operating on a coal cost of 2s. 4d. per ton, and others over 25s. per ton. Obviously, the amount of capital that may justifiably be expended in increasing the thermal efficiency of the station burning coal at 25s. a ton must be far greater than that justified for the station where coal costs 2s. 4d. per ton. The question of what to provide for meeting peaks on any particular system must, therefore, be directly influenced by local conditions which would vary as the following :—

(1) Cost of coal. (2) Nature of peak or peaks. (3) Incindence of peaks in relation to time of the year and climatic conditions. (4) Duration of peaks. (5) The relationship between maximum peaks and maximum steady loading. (6) Space available. Various other factors would also have to be taken into account in existing power stations, i.e., the type of turbine plant and boiler plant already installed, for this factor would, to a large extent, determine the type of thermal storage plant most suitable.

Items 1 and 2 would be a definite local condition and it should be a simple matter to determine their bearing on the question. Item 3 would also be a local condition, but has a very distinct bearing on plant capacity necessary to meet varying conditions of summer and winter loading and essential stand-by plant.

Where conditions are such that the demands in winter are considerably greater than those in the summer, the usual practice is to overhaul the plant during the period of lowest demand, so that as little plant as possible is out of service during the period of greatest demand.

In certain instances in South Africa, the steady demand for the greater part of the daylight hours during the winter is almost equal to the maximum peak demands of short duration during the summer period. Consequently, the minimum of plant capacity with essential stand-by must be, at least, that necessary for meeting the steady winter day demands.

The addition of thermal storage plant in this case would be principally for assisting the peak periods of the winter in lieu of additional generating plant for that purpose. It is, of course, realised that the operating of the thermal storage system, if installed, would be of advantage throughout the year with beneficial results on the overall thermal efficiency of the station, but its value as such in determining what reduction in actual generating plant was permissable would need to be a matter of careful consideration in the instance above referred to.

Item 4 : The duration of the peaks to be met would decide the capacity of the thermal storage plant to be installed and the cost of same compared with additional boiler plant. Item 5: This is to a large extent bound up with Item 3. Item 6 : This is an important factor where power stations are already in existence in congested areas, but should not be an obstacle in designing and laying a new station. There appears to be a great future for thermal storage system in schemes necessitating new stations, where the design of mixed pressure turbine plant should operate to great advantage. The author is to be congratulated on the results of his labours which must have necessitated a considerable amount of time spent in collecting the data and co-ordinating the whole into what must be considered a paper of outstanding merit, more especially as it deals with a subject on which we have little practical experience in Southern Africa.

Mr. A. E. Val Davies (Johannesburg): Mr. Clinton has done the only thing possible if it is desired to get to the bottom of this somewhat thorny subject. That is to say, he has taken his coat off and settled down to extricate the facts that practically decide the pros and cons. In the simple case, such as steam-winding engines exhausting to atmosphere, the value of thermal storage goes without saying, and I have been personally connected with a case where, under these conditions with a simple Rateau receiver and a low pressure turbine, the owners were able to obtain power from a 1,000 k.w. turbine almost constantly at no expense whatsoever.

In relatively small municipal plants, however, a difficulty arises because of the series of steps in which development occurs, resulting often in a form of geometrical progression in the size of the prime movers installed. This does not simplify the problem for the man responsible for the expenditure of municipal funds. Moreover, it is sometimes difficult to convince a Council that additional expenditure, such as would be involved, woud be a profitable investment. To my mind the value of storage can best be shewn in the cases of power stations built for a definite output, with no intention of adding additional units in the future. (Applause).

Mr. H. L. Shermer : I should like to contribute a few remarks to this very able paper. I should also like to echo some of the remarks made by previous speakers with regard to the amount of research Mr. Clinton must have put into the preparation of his paper. I think he is to be congratulated upon it. (hear hear).

As Mr. Clinton has pointed out, the steam accumulator seeks to eliminate load variations leaving the boiler to operate under steady load for which combustion can be set to maintain efficient conditions. The steam accumulator is, therefore, available to respond immediately to sudden demands for steam with a consequent beneficial effect on the boiler pressures, which, in turn, reflects favourably on the efficiency that can be maintained on the steam power plant as a whole, since the boiler is thereby enabled to operate at base loads. While this appears to be quite simple it is, however, the case that a generalisation of this kind is far from representing the conditions that may obtain in practice, and,, as Mr. Clinton has wisely pointed out, "much depends upon individual cases and the supervision of the firing methods in vogue." I would go even further and say that complete technical study of any specific case would not be complete unless careful and expert consideration was also given to the very latest practice in boiler design and operation, including the use of bled steam for closed feed water heating during the off peak loads in order to form any reliable conclusions both as regards thermal efficiency and relative capital cost of systems with and without accumulator plant. In this connection, Mr. Clinton does not refer in his paper to the effect automatic combustion control has on this problem.

Although the more complete control systems which are now available allow fluctuations in the rate of evaporation to occur, they take steps to prevent either the steam pressure or the combustion efficiency from being adversely affected by load variations. Admittedly, such systems cannot effectively respond to violent changes as well as would be the case if steam accumulators were installed, but the author's paper is mainly concerned with power station practice where the load variations are likely to be less abrupt than is the case in certain types of industrial plant, and particularly those using process steam, and consequently automatic combustion control, as at present devised is well able to follow the load curve.

In regard to capital cost, there is a good deal to be said for the installation of automatic control in preference to steam accumulators in those cases where prevailing conditions are available from the point of view of load variation, as the initial cost is very considerably lower, and although the number of boilers has a direct bearing on the total cost, the price for automatic control per boiler decreases more or less in proportion to the number of boilers controlled. There is also the point that as the apparatus is much the same, whether it is used for large or small units, it is not much more costly to use it for large boilers than for small ones. Equipment of this type is designed to deal with large or small load ranges so that it becomes more worth while as the load range to be met increases. In the case of a steam accumulator the initial cost is not so much affected by the number of boilers as by the steam quantities involved in load fluctuations, and its size and capital cost, therefore, tend to increase with the size of the boiler plant. The wider the load range and the longer the duration of the peak, the larger and more expensive must be the accumulator. It therefore, follows that the more desirable the accumulator on technical grounds, the greater must be its capital cost.

It may be argued that this will be offset by a considerable saving in capital cost of boiler plant, and, indeed, Mr. Clinton has mentioned this point. Except, however, in those conditions which are particularly favourable to the use of steam accumulators, and which are of the type not usually encountered in power station practice, it is extremely difficult to show that this argument holds good. While, therefore, conditions involving violent fluctuations of load would appear, on technical grounds, to favour the accumulator, it definitely does not provide for a gradual varying load occurring over a wide range for prolonged periods, which latter conditions represent those more likely to be encountered in power station work.

The author has presented a paper which sets out very fully the case for and against thermal storage—a subject which has been discussed at length at every World Power Conference since conferences were incepted. He has, in common with other investigators, doubtless encountered the difficulty which exists in presenting concrete arguments for thermal storage on the basis of general assumptions.

There is no doubt that the argument for or against thermal storage can only be brought to finality where it is applied to detailed conditions existing in certain specific plans, and under such circumstances it becomes difficult to find ideal conditions for a steam storage installation so far as power utility practise is concerned. Without doubt, a satisfactory case for thermal storage can be made in certain plants where steam is required for power generation and process purposes, but a survey of power utility practice throughout the world at the present day show that only in one or two isolated instances has thermal storage been applied to power station practice, and in those cases where it has been applied the overall efficiency of the station considered on a year's working, has not been in any way outstanding as compared with normal methods. The best instance of this is, perhaps, the case of the Charlottenburg station in Germany. When this station was in the process of design and erection, optimistic statements were made in regard to the efficiency which might be expected to arise from the incorporation of the thermal storage plant there, but although the plant has been in commercial service for a number of years, nothing outstanding in the way of efficiency has been realised.

One might, therefore, be led to the conclusion that although thermal storage has engaged the attention of power engineers for a considerable number of years past, the concensus of opinion has been generally against the wide adoption of such storage systems. (Applause).

Mr. A. M. Jacobs (Electricity Supply Commission): I suffer from a disability in addressing you on this paper, in that I have not had the opportunity of studying it before I heard Mr. Clinton read it. I will, however, at once say that my outstanding impression is that it is a very fine survey of the theory and practice of thermal storage and should prove very useful to any member of this Association who wishes to study the subject.

If I may speak personally for a moment, I would say that I was first of all interested in the subject of thermal storage towards the end of 1926 when it looked as though my Commission would take over the running of the Colenso power station from the South African Railways, and when we were getting ready to supply electricity from the Salt River Power Station.

I visited two plants in Germany connected with thermal storage. One was the Blankanese-Ohlsdorf railway, Hamburg, a line with suburban electrification characteristics. The other railway system I studied was in Lower Silesia, a line of railway running through mountainous districts and comparable to the system operating in the Union in Natal.

I happened to have a fair knowledge of German, so I was not forced to rely solely on statements made to me by the people at the top or by our friends on the merchants' side who had supplied the plant. I was able to question other men right down to the stokers in the boiler house, and I attach a great deal of importance to the statements I got from these men. They told me that they had been practically relieved of all worry in connection with load peaks on both railways. Some men, higher up, gave me valuable information in regard to saving in maintenance cost on the boilers if you cut out the fluctuations in temperature to which the whole of the boiler structure is subjected when it is alternately shut down, or banked, and raised to full steaming capacity again. I was also given figures showing how many more millions of units the power stations had turned out due to thermal storage than if they had not put in those accumulators.

Both systems I have mentioned are equipped with Ruths' steam storage. The reason is that while steam storage can provide almost unlimited peak covering hot water storage is limited to a figure which you may take roughly at 20 per cent. of the steaming capacity of the boiler. In railway practice you are apt to find a lot of fluctuations, and the hot water storage system would not go very far towards meeting those peaks.

The question, of course, would inevitably come up in the minds of those listening to me at the moment: if the Commission is convinced of the value of steam storage, why has it not applied such storage to the power stations at Colenso and Salt River? It would carry me too far to explain exactly the reasons, but I can say that there are good reasons for our not having put in thermal storage at either of these power stations. I can also say that the question has not been lost sight of. I would mention that I had the opportunity in designing a power station for the South African Iron and Steel Industrial Corporation where I put in a couple of Ruths' steam accumulators and they are working very successfully indeed. The terms provided for 4,000 k.w. to be supplied with peaks up to 10,000 k.w. The terms were rather vague and perhaps nobody is to be blamed for not making them more definite. I could not find out anything about the duration of the peaks of 10,000 k.w. I steered a middle course between high capital expenditure on one side without thermal storage, and smaller capital expenditure with restricted thermal storage on the other. I said a prayer, and seem to have struck it right. The engineers at the Steel Corporation told me that they are highly satisfied with the operation of the Ruths' steam storage system. I mention this as a matter of practical interest. You cannot simply put these storage shells outside without any protection whatsoever. In the Northern hemisphere the shells must be better insulated than in our climate. It would be inadvisable to leave such shells outside without insulation exposed to the weather. It is necessary to provide weather protection and if you should be considering the installation of storage that is a point that you must take care of in your estimates of expenditure. It is rather expensive to cover these shells with metal.

Coming to the practical effects of thermal storage as applied to municipal power stations, I would mention that I know the Chief Engineer of the Berlin electricity works. I wrote to him a year ago and asked whether he was entirely satisfied with the results obtained from the installation of 16 Ruths' steam accumulators at the power station at Charlottenburg. This was an old station in my student years, reconstructed later. The reply I got indicated that he was entirely satisfied and very enthusiastic about the installation. Further stations have been built in Berlin since that time. One is really a peak-load power station so situated and designed that it can deal with peaks very economically; and that is the real reason I think why there has been no further increase in the thermal storage installations in the City of Berlin. There are a good many other large towns on the Continent, including Mannheim, mentioned by Mr. Clinton, which has an extensive thermal storage, and if I had a little time to look up my references I think I could easily give you a further six or ten references to very large towns on the Continent which have found it to their benefit to instal thermal storage. I may say that my Commission at present has under consideration the question of equipping one of their power stations with a hot water storage system which is a cross between Ruths' and the Marguerre, and if as and when the plant is completed, I shall be glad indeed to take an early opportunity, if I should be invited by your Association again, to submit whatever results, be they good or bad, obtained from that installation.

Mr. Clinton has thrown out the suggestion that the Commission might easily run the Salt River Power Station in such a way as to find out what the savings would be if a thermal storage were installed there. The Commission has not lost sight of the possibility of putting in thermal storage at Salt River which supplies the traction load in addition to assisting another power station to cover the city demands. The fact is that during the last three or four years we have been busy with construction, and there has been little time to carry out any tests, and I have refrained from making the suggestion to the operating people at the Cape well knowing how busy they are. I think the suggestion is an excellant one, and I shall not lose sight of it.

The President of the Institute of Electrical Engineers has asked me to call the attention of members to the fact that the Institute will pay a visit to the Steel Works at Pretoria, may be in October this year, and opportunity will be given to members of seeing the Ruths' steam storage system in operation. It is hoped that as many members as possible will take the opportunity of visiting this plant, which I think is the first in the southern hemisphere to instal thermal storage. I would say further, in case I give you the impression that I am advocating the wholesale application of thermal storage, that I am in full agreement with Mr. Shermer's remarks that it is a question to be examined very carefully and with expert knowledge before coming to a decision on the subject. But gentlemen, I think, in view of the fact that most of our power stations operate with such a pronounced evening peak, the question is one that is worthy of examination practically in every power station in the Union, and probably too in Rhodesia. (Applause.)

Mr. Dawson (Durban) contributed the following to the discussion, which was read by the Convention Secretary :—

I have found this paper to be of considerable interest, and regret that I am unable to be present at the Convention. I am unable to reconcile the difference between test and operating boiler efficiencies. An operating efficiency of 69% with a test figure of over 80% for the load curves Nos. 1 and 2 is a poor reflection on the station engineer, and, fortunately, not borne out by the figures given in the paper. A little calculation will show that a turbine operating under the conditions stated in the paper, i.e., 215 lbs. absolute 550°F temperature and assuming $\frac{3}{4}$ lb. absolute exhaust, and a unit about 10,000 k.w., would have a guaranteed consumption at economical load of not less than $11\frac{3}{4}$ lbs. per k.w.h., and even with 100% electrically driven auxiliaries the estimated monthly consumption of 12 lbs. (i.e. + 2%) would be insufficient to cover radiation and drain losses and increased turbine consumption at low loading etc. With any smaller unit 12 lbs. would be about the guaranteed consumption. The operating consumption is, therefore, certain to be between 13 and 14 lbs. k.w.h., and according to charts 7a and "b" the efficiency of the boilers would be raised about 78% which is about the figure to be expected from an efficiently operated plant with a test efficiency as given in the paper. The scope, therefore, of a saving from thermal storage is considerably curtailed.

The application of storage to the load curve in figure 29 is interesting, and I should like to ask the author the size of vessels required for this duty, supposing, for example, the maximum load were 30,000 k.w. For about $4\frac{1}{2}$ hours in the morning the accumulator would be discharging, and then would be boosted for $1\frac{1}{2}$ hours, followed by a discharge of $2\frac{3}{4}$ hours, and a boost of another $1\frac{1}{2}$ hours, and finally a discharge of some three hours. The net output of units during this period would be about 200,000, and the steam required by the turbines at say 12 lbs.=2,400,000 lbs. I am not sure whether, during the whole of this period, the boilers would produce steam at the peak rate, while the firing would be at the average rate, the difference being due to the hot feed and the surplus steam being absorbed by the cold feed; but, if this is the case, the amount of feed water required would be considerably more than 2,400,000 lbs. Using, however, the lower figure the length of drum of 12 ft. diameter to hold the water only, at high temperature, would be some 400 feet. This would appear to partly account for the absence of accumulators in the power generation field, and when the regular variations of loading on a municipal system are taken into account, any intelligent operator can anticipate the load very accurately, and the savings due to an accumulator cannot approach those given by the author. It will be noted that, even with the accumulator, boilers must be banked for about ten hours per day so that some of these losses are still present.

The President. I should like to ask Mr. Gyles to convey our thanks to Mr. Dawson for his contribution.

The next business is an item from the Council, which I will ask the Secretary to read.

APPOINTMENT OF PERMANENT SECRETARY.

The Convention Secretary read the following resolution :—

> That this Council recommends to the Association that a Permanent Secretary and Treasurer be appointed at a salary of £5 per month for which all secretarial service shall be provided, plus 30s. per day subsistence allowance in respect of absence on the Association's business and travelling expenses.

Mr. Rodwell (Johannesburg): Members of the Council know the difficulties experienced in co-ordinating the secretarial work during the last few years, due to circumstances over which we have no real control. It is essential to the aims of the Association that we should have a permanent secretary. We gave the matter a good deal of thought before we came to any conclusion, and I want to support the resolution most heartily, and I hope you will do so too and carry it unanimously.

We definitely want you to do that because it is the only way we can adequately carry on the work of the Association.

On the motion of Mr. Ewer (Pietermaritzburg), seconded by Mr. Rodwell (Johannesburg) the resolution was unanimously agreed to.

ELECTRICITY SUPPLY REGULATIONS.

The Convention Secretary: The following resolution was passed by the Council yesterday on the subject of electricity supply regulations :—

> That this Council recommends to the Association that Messrs. Rodwell and Wright, the delegates originally appointed to serve on the committee elected to deal with the electricity supply regulations, be re-appointed for the same purpose with power to act on behalf of this Association.

Mr. Rodwell (Johannesburg): In the absence of Mr. Horrell this task devolves upon me. Most of the members of the Association will remember that this question of standard regulations has been before us for a large number of years. A tremendous amount of work has been put in by various Councils and sub-committees, and, finally, a set of model regulations was prepared in Cape Town by Mr. Swingler and his assistants, and they were put forward at the Port Elizabeth Convention last year. Finally, this matter was discussed with the Electricity Supply Commission, who, I understand, are prepared to adopt these model regulations. The Commission took a very broad view of the matter; they felt that it was desirable to get all the various associations and people interested to agree, if possible, to a standard set of regulations which might ultimately be promulgated for use throughout the Union of South Africa.

At that time there was a Safety First Committee sitting in Johannesburg, and they have representatives on it from the South African Institute of Electrical Engineers, your own Association, the Association of South African Certificated Electrical and Mechanical Engineers, and, in addition, they had acepted members from the Master Builders Federation of South Africa. They dealt with a number of subjects, and it was felt that this committee should join up with the Commission and to discuss these regulations.

Under the able chairmanship of Mr. E. T. Price, of the Commission, these matters have been dealt with from time to time. A large number of meetings have been held and a number of small amendments suggested so far as they can be made applicable to local authorities and other people interested.

Now it is desired to reach some finality on the subject. It should be made quite clear to each local authority that there may be an addendum to these regulations which may be incorporated, and each local authority will make amending regulations or add to the regulations to suit the varying conditions which are known to exist in the several local areas. We are taking a broad view and our thanks are due to the Commission for the work already accomplished and primarily to Mr. Swingler who drew up these model regulations. I ask you to pass this resolution.

Mr. H. A. Eastman (Cape Town): It is most important that finality be come to immediately in connection with the revision of the standard Electricity Supply Regulations recommended by our Association, and I sincerely hope that there will be no further delay in concluding this matter.

The President : Our idea in suggesting the names of Mr. Rodwell and Mr. Wright who are at present members of that committee, is to obviate delay.

On the motion of Mr. Ewer, seconded by Mr. Gyles, the motion was unanimously agreed to.

Mr. W. H. Milton (Electricity Supply Commission, Johannesburg): In connection with the members you propose to nominate now will they have power to come to final arrangements in regard to the regulations, and will they bind your whole body of members? The Commission is most anxious that this particular matter should be finally settled. There has already been considerable delay. The regulations put forward by Mr. Swingler were circulated before the last Convention. At the last Convention it was mentioned that any criticism of any nature should be submitted as soon as possible and I understand that no criticism at all has been levelled against these regulations and no comments offered. I have the feeling that if your Association were to adopt them in their present form there would be a storm. The Commission feels that it has now waited for a matter of eighteen months, and it can wait no longer. Certain undertakings are operating at present by local regulations and that position cannot be continued.

The President : The resolution is to the effect that the two delegates have power to act. My interpretation is that this Association is bound by the views of the two delegates representing us on the committee.

Mr. Rodwell (Johannesburg) : There have been a large number of meetings and numbers of suggested amendments, which do not materially alter the conditions of the model regulations set up for Cape Town, but they make slight amendments which may be considered more applicable and helpful to the smaller local authorities.

DATE OF NEXT CONVENTION.

The President : I have to announce that the next Convention will be held at Pietermaritzburg, during September, 1935.

The Convention adjourned at 1 o'clock p.m.

AFTERNOON SESSION.

The Convention resumed at 2.15 o'clock p.m.

NEW MEMBERS.

The President: I have to announce that the following new members have been elected :—

D. P. Stewart, Electrical Engineer, Gatooma.

J. C. Delport, Electrical Engineer, Barkley East, Cape Province.

A. Rossler, Cradock, C.P.

J. S. Clinton, Electrical Engineer, Salisbury, S.R.

F. Stevens, Electrical Engineer, Alice, C.P.

F. A. P. Perrow, Electricity Department, Port Elizabeth.

H. Purves, Electrical Engineer, Graaff Reinet.

G. J. Muller, Electrical Engineer, Krugersdorp, Transvaal.

J. W. Phillips, Asst. Elect. Eng., Bulawayo, S.R.

RESIGNATIONS.

Messrs. Bower and Vowles.

HOUSE SERVICE LINES REGULATIONS.

Several questions were asked of Mr. Clutterbuck the Chief Inspector of Factories, in regard to House Service Wires, but he replied that the Regulations were very definite and there was little to add, except to ask for the co-operation of all Municipalities whose great care is for the safety of any person coming into contact with the wires.

A SHORT DESCRIPTION OF THE
SALISBURY BEAM WIRELESS STATION.

By J R. BRUCE.

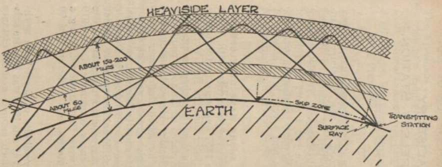
As you are aware it is proposed that you pay a visit this afternoon to the Salisbury Beam Wireless Station, owned by Cable and Wireless Limited, and, prior to doing so, Mr. Metelerkamp has asked me to give you a short description of the Station. The Wireless Station is one employing short waves and a very brief history of short wave wireless development may perhaps be of interest to you.

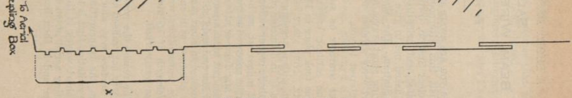
BRIEF HISTORY OF SHORT WAVE DEVELOPMENT.

The earliest known experiments with short waves took place in 1887 and were performed by Hertz. Nine years later Marconi first worked a beam with a wavelength of 10 inches, using brass balls 4" in diameter placed at the focal point of a parabolic copper reflector. He worked a distance of 2 miles but, as he found that longer wavelengths appeared to give greater range, he did not pay any further attention to the shorter waves. It was not until a period of 20 years had elapsed that Marconi and C. S. Franklin once more became interested in short waves and a range of 6 miles was obtained with spark transmitters. In 1919 valve transmitters were first employed, using a wavelength of 15 metres, and a distance of 70 miles was worked.

The reason the possibility of short wave working was not realised at this time was because only the surface ray, which extends a short distance from the transmitting aerial, was encountered. The radiation that is the means of communication on short waves is that which leaves the transmitting aerial at an angle, enters the Heaviside layer and is then bent back towards the earth.

Fig. 1.





UNIFORM AERIAL Fig. V.

This may be clarified if reference be made to Fig. 1. It will be seen that there is an area, between the zone of surface radiation and the point of return to earth of the first bent ray, where reception is most unsatisfactory. This area is known as the "skip zone" and during the day on 15 meters the skip distance may be about 1,000 miles. In 1919 nobody thought of investigating signal strength 1,000 miles from the transmitter.

In 1923 the Marconi Company commenced experimental transmission from Poldhu in Cornwall, using a parabolic reflector system and a half wave aerial, and utilising a wavelength of 97 metres. Reception was carried out on Marconi's yacht, the Elettra, and useful information was obtained with regard to wavelengths, power and conditions.

About this time the British Government was considering the erection of a chain of costly long wave stations for Imperial communications, and in consequence—the Marconi Company advised the Government of the results of the Poldhu-Elettra experiments.

Further experiments were carried out in the spring of 1924, and in July of that year the British Government and the Dominions entered into a contract with the Marconi Company for a number of shortwave beam stations to be employed on Imperial communications. The conditions of this contract were severe, high speeds having to be worked for long periods with a system of which the knowledge was not too extensive. The earlier parabolic reflector was replaced by a flat projector fed through concentric tube feeders, being very similar to the system in use at the Salisbury Beam Station. The transmitter employed had an input of 20 k.w. and the receiver was of the double heterodyne type.

In 1926 the Canadian Beam Service commenced, and in the following year the Australian, South

African and Indian circuits were opened. It may be of interest to you to know that a speed of 350 words per minute was worked during the preliminary tests of the Australian service.

It must not be thought that all the credit for the discovery and development of short wave working should go the the professional wireless engineer, as the amateur has played his part. Immediately after the war it was decided that, in order that commercial or Service working might not be prejudiced, the amateurs might use the wavelengths below 200 metres, as at that time these wavelengths were considered to have a small range. The amateurs did not like this decision but in 1921 they arranged a 200 metre test between Great Britain and the United States of America, successful communication resulting on several occasions. Two years later two-way communication was established by amateurs between the United States of America and France on 100 metres, and in October, 1924, Mr. Goyder of Mill Hill School, London, worked with New Zealand and Australia. It will thus be seen from the few instances mentioned above that short-wave development owes a certain amount to the amateur.

Following the success of the British Beam Stations, Germany, France and the U.S.A. turned their attention to the development of beam aerial systems, and from this time onwards communication by means of short waves has been developed to a great extent—a large number of telegraph and telephone circuits having been opened during the last 5 years. At the present moment it is possible for a large percentage of the worlds telephone subscribers to talk to each other owing to the use of shortwave wireless link.

When the Beam Wireless System was first designed, the transmitter and complementary receiver at one end of the Wireless link were situated some miles apart, for example Bodmin in Cornwall and Bridgwater in Somerset, the English end of the South African Beam. Later design now places the transmitter and receiver in the same building, and the Salisbury Beam Wireless Station was one of the first of this type.

STATION POWER DISTRIBUTION.

The power supply at this station is obtained from the Salisbury Municipality, the supply at the main transformer being 2,200 volts, 50 cycles, 3-phase. This 50 KVA transformer (1, Fig. II) was manufactured by Metropolitan-Vickers and is oil immersed and self-cooled—the normal no-load voltage being 2,200/380. The secondary of the transformer is connected to the switchboard (3, Fig. II) and by means of switches and automatic voltage regulator (2, Fig. II) of the induction type is introduced. The rating of this regulator, which is manufactured by the English Electric Company, is 5 KVA, and it is the oil immersed self-cooled type. It maintains about plus or minus 1½% voltage provided supply variations are not rapid and deep. In the latter case the control would lag owing to the fact that the complete time of travel from maximum negative to maximum positive boost is approximately 1½ minutes.

From the switchboard 380 volts A.C. is supplied to various apparatus perhaps to be transformed to some other value and, in some cases to be rectified.

With the exception of the transmitter Master Oscillators and Master Oscillator Amplifiers (10 and 11, Fig. II), the transmitting valve filament supply is obtained by transforming the 380 volts down to between 17 and 21 volts by means of 2.1 KVA single phase transformers (situated on panels 6, 7, 8 and 9, Fig II), the actual values to the valve filaments being regulated by various resistances. The filament supply for the Master Oscillator and M.O. Amplifier is obtained from a 6 volt battery of accumulators having a capacity of 120 ampere-hours.

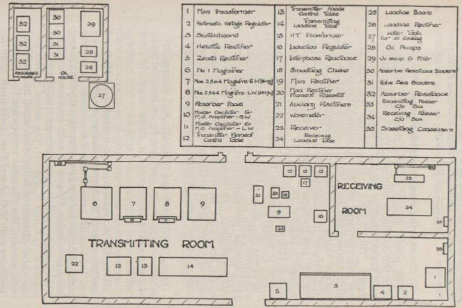

1 Main Transformer
2 Automatic Voltage Regulator
3 Switchboard
4 Metallic Rectifier
5 Zenith Rectifier
6 No. 1 Magnifier
7 Nos. 2,3 & 4 Magnifiers S.W.
8 Nos. 2,3 & 4 Magnifiers L.W.
9 Absorber Panel
10 Master Oscillator & M.O. Amplifier – S.W.
11 Master Oscillator & M.O. Amplifier – L.W.
12 Transmitter Filament Control Table
13 Transmitter Anode Control Table
14 Transmitting Landline Table
15 H.T. Transformer
16 Induction Regulator
17 Interphase Reactance
18 Smoothing Choke
19 Main Rectifier
20 Main Rectifier Filament Rheostat
21 Auxiliary Rectifiers
22 Wavemeter
23 Receiver
24 Receiving Landline Table
25 Landline Board
26 Landline Rectifier
27 Water Tank for oil cooling
28 Oil Pumps
29 Oil sump & Filter
30 Absorber Resistance Blowers
31 Valve Seal Blowers
32 Absorber Resistance
33 Transmitting Feeder C/O Box
34 Receiving Feeder C/O Box
35 Smoothing Condensers
ABSORBER HOUSE
OIL HOUSE
TRANSMITTING ROOM
RECEIVING ROOM

Fig. II

The grid bias supply for the transmitter, the high tension supply for the Master Oscillator and M.O. Amplifier, and the supplies for some of the checking circuits are obtained from the Auxiliary Rectifier (21, Fig. II) to which unit 380 volts is supplied, transformed to various values and rectified by valve rectifiers and, in one case, by a Westinghouse metal rectifier.

The H.T. supply for the transmitter is derived from three 9 KVA single phase transformers (15, Fig. II) supplied with 380 volts modified by the introduction of a three-phase 6.75 KVA oil immersed self-cooled induction power regulator (16, Fig. II) which is, in turn, energised by the 380 volt supply. The transformed voltage is rectified by means of 6 rectifying valves in the Main Rectifier (19, Fig. II) and smoothed by means of a choke (18, Fig. II) and 5 microfarad condensers (35, Fig. II). The value of DC., H. T. voltage supplied to the transmitter (to be broken down by resistances in some instances) is controlled by a push button on the Anode Control Table (13, Fig. II), the button controlling the induction regulator. The normal H.T. voltage to the transmitter is 8,000 volts.

Oil cooling is required for certain transmitting valves, and the oil is circulated by means of a pump (28, Fig. II) driven by a one H.P. induction motor, which is energised by 380 volts, 3-phase supply. The possibility of valve damage due to failure of the oil circulation is avoided by the use of a "Monitor" Flow indicator and a D.C. trip circuit interconnecting contacts on this Flow Indicator with a solenoid which is incorporated in the transmitter main H.T. switch. If the oil fails the Monitor Flow Indicator breaks two contacts in the trip circuit, thus breaking the H.T. switch and also closes 2 contacts which cause a bell to be rung and a red lamp to be illuminated. The circuit of this trip coil includes several devices for breaking the H.T. circuit rapidly, one of them being two contacts which are broken by the failure of the supply to the Auxiliary Rectifier.

Air Cooling for the seals of one of the transmitting valves is obtained from a blower (31, Fig II) operated by a $\frac{3}{4}$-H.P. induction motor supplied at 380 volts, three-phase.

An air blower (30, Fig. II) is also required to cool the resistances in the Absorber House, and the blower is driven by a $2\frac{1}{4}$-H.P. induction motor supplied with three-phase AC. at 380 volts.

The receiver supply consists of batteries of accumulators.

The receiver filament voltage is obtained from an 8 volt battery having a capacity of 180 A.H. and the actual supply to the valve filaments is broken down through the use of resistance in the receiver.

The grid bias supply to the receiver is derived from a 20 A.H. 24 volt battery of accumulators, the required varying values of grid bias being obtained by means of break-down resistances in the Grid Bias Unit of the receiver.

The H.T. of 204 volts for the receiver is obtained from part of the Station Battery, which consists of 120 cells and has a capacity of 76 A.H. This battery also provides station lighting, in the event of a failure of the Town Supply. The battery is tapped at intervals and these tapping points are brought out to Charge and Discharge Switches on the main switchboard.

The various batteries in the Station are charged by means of rectifiers supplied with A.C. at 380 volts. The Station Battery is charged by a mercury vapour rectifier (4, Fig. II) manufactured by the Hewittic Electric Company. This rectifier has a D.C. output of 12 amperes at a pressure of 340 volts.

The receiver, filament, receiver grid bias and Master Oscillator filament batteries are charged through the medium of valve rectifiers (5, Fig. II) manufactured by the Zenith Electric Company.

The signalling current from the rectifier relay to the landline, and thus to the telegraph office, is derived from the Landline Rectifier (26, Fig. II). The transformer of this unit is supplied with 380 volts from the switchboard, is stepped down to about 130 volts and rectified by means of a Westinghouse metal rectifier. The D.C. output at normal load is plus or minus 50 volts.

THE TRANSMITTER.

The transmitter is capable of radiating on two wave lengths, namely, 16,051 metres (a frequency of 18,690 kilocycles) and 33.17 metres (a frequency of 9,045 kilocycles), the former being for use during the day and the latter being utilised when working on the shorter wavelengths proves unsatisfactory—this being the case in the evenings at certain periods of the year.

The four panels of the transmitter consists of—

(a) No. 1 Magnifier (6, Fig. II).

(b) Nos. 2, 3 and 4 Magnifiers (7, Fig. II) the Master Oscillator and M.O. Ampliefier (10, Fig. II) on the Shorter Wavelength.

(c) Nos. 2, 3 and 4 Magnifiers (8, Fig. II), the M.O. and M.O. amplifier (11, Fig. II), on the longer wavelength, and;

(d) the Main and Sub-absorber circuits (9, Fig. II) which divert the H.T. supply through resistances during the spacing period, this tending to keep a constant load on the Main Rectifier.

It being an essential with modern commercial telegraphy to have a transmission of constant frequency, this is obtained by means of the Master Oscillator and extremely careful attention to transmitter construction. The M.O. is the Marconi-Franklin Constant Frequency Drive, which is an oscillator self compensating for temperature variations. A Frequency is generated at approximately 3,000 kilocycles and, by means of the M.O.

Amplifier, amplified and trebled (in the case of 33.17 metres) or multiplied by six (in the case of the shorter wavelength).

Reference should now be made to Fig. III which is a schematic diagram of the transmitter.

The M.O. Amplifier being carefully screened from other circuits, is then coupled to No. 4 Magnifier, this stage acting partly as an amplifier and partly as a buffer stage between the C.F. Drive and further magnifiers and thus tending to keep a constant frequency when keying. This stage is, in turn, coupled to No. 3 Magnifier; No. 3 Magnifier being coupled to a No. 2 Magnifier, and finally No. 2 Magnifier to No. 1 Magnifier. This last magnifier is the main power stage, employs an oil-cooled valve, and has an input of 8 KW.

Keying of the transmitter is obtained primarily by means of a Creed Relay, which is actuated by double current signals received from the company's telegraph office, Salisbury, via landlines. Should the spacing current be received from the telegraph office the relay tongue will move to the space contact, causing the Main absorber oil-cooled valve—through the intermediary Sub-absorber—to pass current. It will be seen from Fig. III that in consequence there will be a voltage drop along the absorber resistances, and the H.T., Supply to Nos. 2 and 3 Magnifiers will be so reduced as to make them inoperative. As a result no radiation will take place from the aerial. On the other hand if it is desired to transmit a mark, the relay will cause the Main Absorber valve not to pass current, and the full normal H.T. will be supplied to Nos. 2 and 3 Magnifiers. Consequently all magnifiers will be operative and energy will be transferred to the feeder and aerial system.

When it is desired to change the wave-length from, say, the shorter to the longer optional wave-length, panel 7 (Fig. II) and unit 10 (Fig. II) are cut out, panel 8 (Fig. II) and the longer wave-length M.O. and M.O. Amplifier (11 Fig. II) introduced, and the panel 6 (Fig. II) re-adjusted.

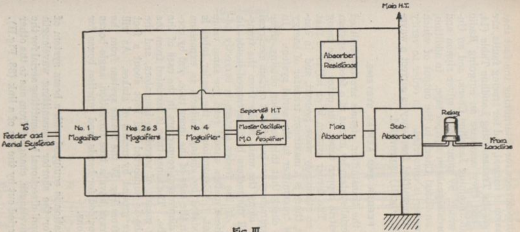


FIG. III

SCHEMATIC DIAGRAM OF TRANSMITTER.

Checking devices for determining the fact that transmission is normal, and for tracing faults, are situated on the Transmitting Landline Table (14, Fig. II) and they comprise an outgoing Radio Check, an Incoming Landline Check, and an Undulator which, by means of a silver siphon and ink, records signals on a paper tape. In addition, there is an Aural Check to the output of which a loudspeaker is connected. In order to verify that the transmitted frequency is correct a wavemeter (22, Fig. II) is provided.

FEEDER AND AERIAL SYSTEMS.

From the transmitter, signals are transmitted to the aerial system by means of a feeder system of concentric copper tubes, the outer tube being earthed. The feeder system is so adjusted that there is no stationary wave present, and in consequence, there is a maximum transfer of energy from the transmitter to the aerial system. In order to check that this condition obtains, three thermo-ammeters are inserted at certain electrical distances along the main feeder from the transmitter, all the meters being arranged inside the building. If the feeder system is correctly adjusted these meters should read the same value of current. Expansion of the feeder tubes is accommodated by sliding contacts in expansion boxes—in the case of the inner tube, and by corrugated diaphragm connectors in the case of the outer tube. The inner tube is insulated from the outer by means of porcelain insulators, and the outer tube is supported and kept about a foot above the ground by means of stakes. As will be seen from Fig. IV the feeder system from the beam arrays have a tree formation, angle boxes being provided for bends, and junction boxes for bifurcations.

The station is equipped with a beam system of aerials for the shorter transmitting wavelength and an omni-directional transmitting aerial for the longer wavelength, changing from one to the other being carried out by the use of a link (33, Fig.II).

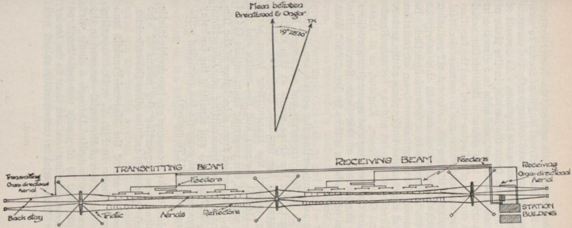

Mean between
Brentwood & Ongar
T.N
19°28'30"
TRANSMITTING BEAM
RECEIVING BEAM
Transmitting
Omni-directional
Aerial
Feeders
Feeders
Receiving
Omni-directional
Aerial
Back stay
Triatic
Aerials
Reflectors
STATION
BUILDING

FIG. IV

With the beam aerials system, the feeder system is such that the electrical length of feeder to each aerial is the same, and consequently the currents in all the aerial wires are in phase. As a result of energy radiated from the aerials, in the plane of the aerials, cancels out, and adds in a direction at right angles to this plane. Behind the aerial hangs a curtain of reflector wires, and the function of the reflectors which are a certain electrical distance from the aerials, is to cut off radiation in a backward direction and add this energy to that from the aerials in a forward direction. In consequence, a strong narrow beam of radiation results at right angles to the plane of the aerials, oeing directed at a point midway between Brentword and Ongar in Essex, England, as at these places are the receiving and transmitting stations of the English end of this Beam Service. The direction of the beam is thus 19 deg. 28′30″ West of true North.

The masts, supporting the aerials, are 250 feet high with 90 feet crossarms and are spaced 650 feet apart. Of the three masts at this station, the centre and the furthest from the Station building support the transmitting beam aerial system (16.051 metres) and the centre and the nearest support the receiving beam aerials (14.64 metres). Suspended from a backstay of the furthest mast is the transmitting omni-directional aerial (33.17 metres) and similarly the backstay of the nearest mast supports the receiving omni-directional aerial (31.76 metres).

Attached to the crossarms are two double triatic suspensions, one supporting (by means of wire triangles) the aerials and the other the reflectors.

The aerials are of the Marconi-Franklin uniform type—shown in Fig. V, with supporting wires. The bottom of the aerial—as used in the beam array—is connected through a single wire feeder (X. Fig. V) of nearly non-radiating type to the aerial coupling box and thus to the feeder proper. The aerial is consequently raised well above the earth and as a result, efficient low angle radiation is obtained. This type of aerial gets its name from the fact that the current formation on the aerial is approximately uniform, and this means that greater radiation per unit length results than when employing an aerial with which this condition does not obtain.

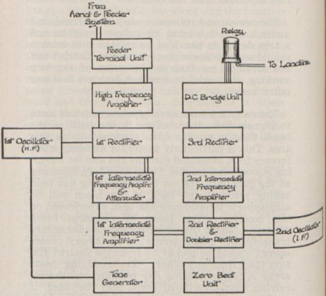
The aerials and reflectors are kept vertical, and under a certain tension by balance weights, and a trip device is provided to release this tension should wind pressure prove excessive. Catch wires are arranged so that in the event of the trip working, the aerial in question does not foul any other aerial.

The receiving beam aerial system responds more to signals from the stations in the path of the beam than to signals from stations outside this area. This is particularly useful for avoiding interference from unwanted stations and also for lessening atmospheric trouble. There have been instances at the Salisbury Station when lightning has been taking place at the back of the beam and no atmospheric interference has been experienced on the receiver. The beam of reception being directed towards Ongar, where the complementary transmitting beam points to Salisbury, more energy should be picked up from the desired station than from any other. The receiving beam array is for use during day working and the receiving omni-directional aerial may be used if working on the longer wavelength be desired.

THE RECEIVER (23, Fig. II).

The signals picked up by the aerials are transferred via the feeder system to the Feeder Terminal Unit (See Fig. VI). From this unit the signals—which are usually received at a frequency of approximately 20,000 kilocycles (a wavelength of 15 metres)—pass to the High Frequency Amplifier which amplifies the signals at this frequency. The output of this unit together with oscillations from the first Oscillator then pass to the First

Rectifier, where the frequency is changed to approximately 144 kilocycles (a wavelength of about 2,080 metres). The signals are then transferred to the First Intermediate Frequency Amplifier which is of the band filter type, having a band width of approximately 5.5 kilocycles. A consideration of the original frequency will show



SCHEMATIC DIAGRAM OF RECEIVER.

FIG. VI

that this amplifier greatly assists the selectivity of the receiver. There are 6 stages in this amplifier and the gain per stage is about 12 decibles. This unit is provided with an attenuator control for regulating amplification manually, should this be necessary. The output from this amplifier and the oscillations from the Second Oscillator are fed into the Second Rectifier, signals at a resulting approximate frequency of 52 kc (an approximate wavelength of 5,770 metres) passing from this unit into the Second Intermediate Frequency Amplifier, which is of the Band Filter type having a band width of approximately 5 kilocycles.

From this amplifier the signals pass to the third and final rectifier, where the wireless frequency disappears and this output from this rectifier is keyed D.C. This output then passes to the Bridge Unit Limiter stage—where the fading of signals, encountered with shortwave working, is mitigated—and finally to the relay valves which cause a Creed Relay to be actuated. This relay sends D.C. signals to the telegraph office via landlines.

With a receiver of this type employing 2 band filter amplifiers, having narrow band widths it is essential for good working that the oscillator frequencies are such that the resultant frequencies through the amplifiers coincide with the mid frequencies of the amplifier bands. The frequency of the second oscillator is fixed, consequently the variable is that of the first oscillator and through the agency of the Zero Beat Unit, and the Double Rectifier the first oscillator frequency may be adjusted to the middle of the band widths during traffic without introducing interference.

The receiver has a control panel which is fitted with meters, etc., and by means of various jack points on the receiver it is possible to diagnose quickly faults which may arise.

A Tone Generator producing oscillations at a frequency of 1,000 cycles, is provided to modulate the first oscillator, should this be necessary for listening purposes.

An undulator, which employs a silver siphon and ink to record signals on paper tape, is used for checking the signals sent to the telegraph office, and may be plugged across the relay output for checking purposes by means of the Landline Board (25, Fig. II). The incoming landlines are joined to jacks on this board and the station relays, etc., are connected to the plugs.

In conclusion, I trust that this short description has not been too brief and will be of some assistance when you visit the Station this afternoon.

I am indebted to Mr. A W. Ladner Superintendent of the Instruction of the Marconi Company, for information in connection with shortwave development.

The President: On behalf of the Association I wish to thank the members of the Wireless and Cables Ltd., for permission to visit the Beam Station. Whatever Mr. Bruce or his staff may think of our knowledge of high frequency by our questions at the Beam Station, I can assure him that his paper will be helpful in enabling members to obtain some idea of the transmission and reception by Beam. I must again thank Mr. Bruce for the trouble he has gone to in the preparation of his paper.

REPLY
to discussion on
"THERMAL STORAGE."

Mr. Clinton (Salisbury): I am not quite prepared to reply to the contributors to this discussion, but, firstly, let me thank you for the reception you have given the paper. In drawing up the paper I attempted to cover the essentials in the hope that I could reply to further points raised in discussion. The President raised the question of capital cost. That is the bugbear of all expenditure—the cost of equipment. Unfortunately, I was not able to get figures of cost and I endeavoured to avoid quoting any specific case.

I think it will be agreed that in any item of expenditure one must take into consideration local conditions, and, as several speakers emphasised, expert opinion must be obtained, and there is a good deal of study necessary before embarking upon any such revolutionary scheme as thermal storage. I will, however, give certain figures of cost taken from a paper on Thermal Storage read by Dr. Ritchie. It appeared in the "Steam Engineer" in December, 1932.

Case (A) a steam accumulator, capacity in k.w. hours, 7,500. The maximum load carried by the accumulator, steam, in k.w. was 8,650. Time duration of peak load carried by the accumulator, 1 hour 44 minutes. The capital cost of the accumulator was £21,300. The cost per k.w. hour was £2.46. Case (B): Capacity, 15,000; maximum load 12,260; duration of peak load, 2 hours 27 minutes; capital cost, £38,400; cost per k.w. hour £3.13. Case (C): A steam accumulator of 30,000 k.w. hours; maximum load carried, 17,330; time duration of peak, 3 hours, 28 minutes. Cost, £69,500; cost per k.w. hour, £4.01. These are specific cases and cannot be generally composed with undertakings in South Africa.

Then with regard to the 100 per cent. firing line mentioned by the President, I think that is an idea which should not be tolerated. I hope that I did not give the impression that, as a general rule, 100 per cent. boiler output was possible. Personally, I consider that even if you can control your boiler output so as to obtain a fairly constant output over a long period of two or three hours duration you will obtain a considerable benefit in thermal storage or boiler efficiency.

As regards losses, unfortunately I must have mislaid my notes, but I think the loss works out at in the vicinity of from .16 to .23. From data which I have obtained the cooling losses rather show about 0.5 to 0.1% of the output of the boilers, so they are really without any great significance. In a pamphlet by Ruths' Accumulators I note they give the loss as 0.16 to 0.23 BTUS per square ft. per hour per °F. This is somewhat dependent upon the size. Naturally you will be able, if you have a specific case in view, to work out the particular losses of your installation.

Mr. Rodwell mentioned local conditions and plant characteristics. I think I stressed that point in the paper. Of course it must be taken into consideration, but where Mr. Rodwell is lucky to obtain coal at 10s. per ton, we in Salisbury are not so fortunate. Cape Town is on a par with Salisbury.

Mr. Val Davies mentioned the case of the base load station. In a chat with him on the subject I understood his intention was to refer to a station where there would be no ultimate extension, but yet where there were variations from the load. I think that, perhaps, that will clarify the position because the reference he made might give the impression that he was referring to a station like Witbank where the load is fairly constant.

Mr. Shermer brings up the question of automatic combustion. Automatic combustion, of course, is an acknowledged fact, but, at the same time, I think the point is overlooked that even if you control your combustion and improve efficiency, there are other losses which will take place and which can be compensated for by steam accumulation. He also mentions the fact that the load increase is not very abrupt. I have had some small experience of running boiler plants at Cape Town and my experience was that the load increase was fairly abrupt. Where you have a battery of seven or eight boilers you have considerable trouble in the evening peak periods of controlling your plant, and yet, at the same time, having them available when that abrupt peak takes place. It takes some running round to keep your steam up.

I think Mr. Jacobs covered the case of Charlottenburg to the satisfaction of the members, but Mr. Shermer is rather dubious about the results.

Then the only other point brought up by Mr. Jacobs is the 20 per cent.—I won't call it a bogey. But even if you can eliminate 20 per cent. of your peak load you will be on the way to obtaining beneficial results on your boiler efficiency. Mr. Jacobs' personal reminiscences of stations in Germany were particularly interesting. I unfortunately have not had personal experience of steam accumulative plants, but the subject has been of absorbing interest to me. I trust the Electricity Supply Commission in the future will make available to the engineering fraternity in South Africa and in Rhodesia whatever results may be obtained from the installations at the Steel Works, and, I hope, also at Congella.

In reply to Mr. Colin Dawson, I should like to emphasise the fact that it has been my endeavour in the paper to eliminate direct comparisons with particular cases. Each case must be treated upon its merits. Certainly where the average annual boiler efficiency is 78% the scope of storage is limited. But I disagree with the analysis which serves to indicate that this is commonly attained. Firstly, I consider the figure of 11¾ lbs. per k.w. hour high under the conditions given. But even so, the number of stations operating at 1.5 lbs. coal per k.w. hour generated according to the Municipal Year Book amounts to one. My figures of 1.5 lbs. per k.w. hr. and 12 lbs. steam consumption per k.w. hr. can, therefore, be safely assumed as being those commonly found together.

The second objection raised by Mr. Dawson relates to the size of the accumulators. One does not, as a rule, when 2,000,000 lbs. of steam are required, build a single boiler to raise this amount. Why then limit the accumulator to a single drum 400 ft. long? The special case of banking boilers for 10 hours per day seems to make the argument for a larger accumulator more patent. I think that covers all the points.

The Convention adjourned at 3.30 o'clock p.m.

VISITS. Visits were later made to the Beam Wireless Station and also the Salisbury Municipal Power Station where tea was served. In the evening the members of the Convention were the guests of the Municipal Council of Salisbury at a Bioscope performance at the Palace Theatre.

SATURDAY, SEPTEMBER, 15, 1934.

The Convention resumed at 9-30 a.m. with the President in the Chair.

The President : **Mr.** Nicholas unfortunately is not present, but Mr. Lewis has kindly consented to read his paper.

UMTATA
HYDRO ELECTRICAL SCHEME
REMOTE CONTROL

"Electrical Development in a small town due to low tariffs, yet remote from coal fields and industries."

By I. J. NICHOLAS.

DESCRIPTION OF WORKING SCHEME.

The development of Umtata's Automatic Hydro Electric Scheme has proved interesting as it goes to show how much can be done by means of cheap water power especially with regard to low tariffs and Umtata can say it is a real electrical service to its consumers.

Since the installation of a 100 k.w. Hydro Electric Plant in 1928, at the No. 1 Falls, the increase in the loads and output has been so rapid, that in 1931 an additional Hydro Plant of 400 k.w. was installed at the No. 2 Falls, some 8 miles further down stream, so that the same water which feeds the No 1 plant could be used again to feed the No. 2 plant and so **in dry season without any storage or pondage** the No. 1 plant could develope at least 100 k.w. and the No. 2 plant 200 k.w.

The dry season low water flow takes place during the end of August and not during the Winter peak load months of May, June and July, thus the dry season period does not clash with our yearly heavy loads.

For ten months of the year we have available **a minimum water power of nearly double this amount** but we have only 500 k.w. of hydro plant installed.

Although we can generate only 300 k.w. of hydro power in dry months it does not follow that we cannot take 500 k.w. peak load at 60% load factor when storage is provided to meet our daily demands. Therefore by erecting the necessary weirs and holding back all the spare water during light loads we would accumulate enough additional water to meet the above 500 k.w peak loads at 60% daily load factor in dry season, or a total output of 7,200 units generated per day had we the weirs to hold back the spare water for daily pondage. In this way it can be seen that the water stored can be liberated to feed the turbine as required and no water per day, in dry season will run to waste.

This acute position lasts at the most for six weeks—each very dry season, which occurs about every fourth year—but this is the **very lowest river flow recorded since 1904.** When these low water flows occur, our peak loads are considerably down and so we are not embarrassed due to lack of water as might be expected, and Umtata, therefore, under the above circumstances is very fortunate.

Thus it can be readily seen that in Umtata although our loads may be high during the winter months, at this period we have plenty of water and it is only when our peak loads begin to drop to about 2/3rds of our winter peak that the low water question comes into the picture, as late as August or September and sometimes as late as November.

So in a very few words we can develope or rather supply, a peak winter load of double that which can be generated during low water flow, as the peak-loads and low-water flow do not clash. Thus the water power supply in Umtata is unique which has made it possible to offer the public such low tariffs for all uses, and still manage to bear the heavy capital annual charges on the Hydro Plants as well as the Diesel scheme which latter scheme is a burden of £800 per annum on the undertaking as it is an inadequate standbye at a very high capital cost The working cost remaining practically constant at a moderate figure with the **intrinsic value of the unit NIL.**

Thus our tariffs are very low and compare favourably with other towns much larger than ourselves and in addition as the value of our unit generated is so low it permits us to encourage an "OFF PEAK" Load at a very low figure as this in no way increases our peak loads but helps to improve our yearly load factor.

DEVELOPMENT IN UMTATA DUE TO LOW TARIFFS.

In continuing with this paper I will now deal with our tariffs, capital charges, working expenses feature of our development in Umtata, especially and off-peak loads. The latter forming a special the off-peak loads which we must foster if we are to continue to be so successful and improve our yearly load factor and at the same time keep down our peak loads and capital expenditure, which latter fact is now our deciding factor, and has to be watched very closely and delayed as long as possible.

As the intrinsic value of the units generated for fuel and engine room stores is NIL this has made it possible to have low tariffs, and it is the low tariffs which account for our abnormal development, particularly since we are remote from coal fields (fuel in Umtata is the locally grown wattle tree) and industries; In Umtata we have no large consumer but our loads and revenue are made up from a number of small consumers, tha largest being Hotels and Hospital each consuming about £200 per annum, and the largest motor using about 1,000 units per month at a load of 27 B.H.P.

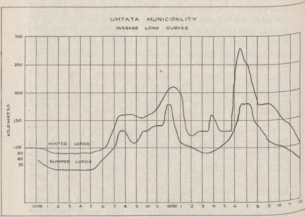
It is on account of this fact that the "OFF PEAK" Load has been seriously persued, as it has been felt that as no industry exists here in Umtata we have had to try other means of improving our load factor, and yet keep down our loads and naturally, capital expenditure, and so far, we have sold about 70,000 units during 1933 for off-peak load without any increase in the peak loads or working expenditure and as the intrinsic value of the unit is NIL this revenue has all been profit and money from home. This system will be pursued still further as my concluding remarks show.

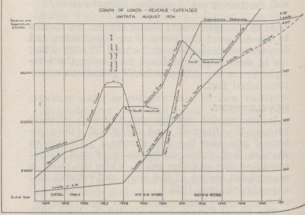
At this stage I would like to express my thanks to the different Chairmen of my Committee, and Mayors and Councillors of the past for supporting me in these suggestions and for having the foresight to see the different tariff reductions an accomplished fact.

DEVELOPMENT.

In tracing the development you are asked to refer to the financial and statistical tables attached and also the two graphs. One is an average load curve during summer and winter excluding any extreme peaks, while the other is a graphical record of the loads and revenue and expenditure since 1924.

The Diesel Scheme was started in April 1921 with two sets each 60 k.w. D.C (Total 120 k.w.)


UMTATA MUNICIPALITY
AVERAGE LOAD CURVES
KILOWATTS
WINTER LOADS
SUMMER LOADS
12 MN
12 MD


GRAPH OF LOADS - REVENUE - EXPENSES
UMTATA AUGUST 1934
Revenue and Expenditure
K.W. Loads
Expenditure
Revenue
Loads
Tariff reduction
DIESEL ONLY
100 K.W. HYDRO
400 K.W. HYDRO
End of Year

but when the plant was purchased the prices were at their very highest and consequently capital annual charges were also of a high order which fact has burdened this undertaking ever since; but not only this, the fuel and engine room stores and repairs were too heavy and tariffs were naturally high and development impossible. Particular reference should be made here to the high price of the machinery and consequent capital charges which fact has handicapped the undertaking ever since, and to-day the two hydro plants on account of their very low generating costs carry the excess capital charges on the old Diesel Scheme amounting to about £800 annually. As we had this Diesel plant and as we could get no price if it were sold, it has become a standby plant, but to-day it is so small it is just about obsolete, due to its size and heavy running costs, but as the loan was on a 30 year basis we still have a large number of years to run before this position can be relieved, and loans mature.

By the end of 1927, due to the above position, the electricity scheme had to be helped from rates amounting to £763, and by 1928 had accumulated a deficit of just £3,000 at the time the No. 1 Hydro plant was installed

Under the Diesel Scheme, as can be seen from the graph, the expenditure in 1927 rose abnormally as an attempt was made to develop, and at the same time the revenue grew, but both revenue and expenditure grew equally without giving the public any real reduction in the price of the unit. At the same time the loads were growing slowly but were very near the capacity which made it necessary to begin to think seriously of the question of extending to meet the future demands but without any hope of bettering the financial position, but to make it decidedly worse and so there was no way out for improvement if we continued with the Diesel plant as prime movers for generation.

In 1928 the 100 k.w. **Automatic** Hydro Plant (I believe the first of its kind to be installed in this country) was installed as the only means of turning our deficits into a profit and at the same time carrying the annual capital charges on the Diesel scheme. Thus the primary reason for the first Hydro Plant was a financial reason but which proved also to be the means of cheap electricity in Umtata.

CHANGE IN WORKING COSTS.

From July, 1928, the date of start of No. 1 Hydro Plant a very decided change in working costs came about as can be seen from the graph; for the first half of the year the expenses rose, but for the other half they dropped abnormally, thus remaining constant as a total expenditure over the whole of 1928. But in 1929 the Hydro Plant did the whole of the generation, and the working expenses dropped so low that including working expenses and capital charges there was a tremendous drop in the annual total expenses. This resulted in a large surplus and in addition the best part of £1,000 was spent on improvements on the distribution system, and continued to be spent over a number of years while abnormal development was going on (all out of revenue).

Revenue in 1929 stood still owing to tariff reductions, but as the total expenditure dropped so low there was still a large surplus.

Development was so rapid that my Council considered it advisable, contrary to my advice, to curtail as much as possible any definite attempt at development by means of advertising and canvassing, but in spite of this, development continued at the same rate, the low tariff proving sufficient advertisement in itself; and by the end of 1931 the No. 2 Hydro Plant was installed in order to meet the rapidly growing demand.

A 400 k.w. Hydro plant was installed instead of a 200 k w. plant as was first thought desirable, at No. 2 Falls, for it was felt that the interests of the town were better served this way by making more provision for the future; and by increasing the capital outlay from about £15,000 to £20,000 we doubled the capacity of the plant but in doing so the Council were fully aware that we would run the Department at an annual diminishing deficit over a period of three years and thus at the end of the three years we have an accumulated deficit of £1,500 which will be reduced to nil over the next two years. In the meantime Umtata's public are enjoying cheap electricity which is the real point. Also all Municipal Departments are deriving benefits from this Department, which otherwise could not have been possible, and we are now supplying power to the Municipal pumping Departments at a ½d. per unit for 18 hours per day. Without this cheap power these pumping schemes would have been prohibitive and so we are even NOW contributing indirectly towards other funds, although they have the privilege of paying us this small price per unit. It is only a nominal charge and they are getting real service by means of cheap power as low as ½d. per unit

Of course some of my Councillors would like to see a £ s. d. surplus on my department and so see a £ s. d. assistance to other departments but that can only be done if the other departments contribute their fair share towards our revenue and so in Umtata instead of showing a large surplus and large grant to other departments from this department we give service at the lowest possible figure and so indirectly save the running cost of other departments, actually to our loss as a department, but as a gain to the Municipality as a whole.

In a few words this cheap electricity is an asset to the Municipality by means of which cheap pumping can be carried out for sewerage, and domestic water supply at OFF PEAK load periods by simply making the necessary storage to suit the hours of supply.

INCREASING CAPACITY OF FEEDERS AND MAINS.

I would like to mention that during the years 1928 to 1931 the H T. Feeders and low tension feeders were increased from a capacity of 200 K.W. to well over 1,000 k.w. and so made provision for taking increasing loads in the future. All this was done out of revenue as it was realised that it was no use having the finest generating plant if we did not have the means to transmit this cheap power to the consumers premises. To-day we are in the fortunate position to have mains capable of development by simply adding transformers as pole type substations at any point where loads may develop. The H.T. Feeders now form three sides of an overhead system ring with several inner cable underground feeders.

Also as our transmission loses on light loads cost us nil, we are able to have numerous sub-stations, all of 50 k.v.a. standard size as no £. s. d losses occur but as our peak loads are not for the 24 hours per day it is cheaper to loose units at no cost to generate than to pay additional capital charges, for the units lost on peak loads are few compared with the cost of paying additional capital charges for years and years. In fact it is cheaper to run our expensive Diesel engines for the odd hour or so on peak load than pay extra capital charges for the whole year round (Kelvins law). Our main generator feeders from the Hydro Plant are arranged for a 10% loss on full load.

SECOND BIG PHASE IN OUR DEVELOPMENT, 1932.

At the beginning of 1932 the position of the department was as follows :—

A. The Council had promised to reduce the tariff for light to the business and private house holders from 1/- to 9d.

B. Our feeders were established to meet any sudden demand in any area within reason.

TABLE "A."

FINANCIAL YEAR'S ENDING 30 th JUNE.

ITEM.	Old Station.		1,000 K.W. Set.			2,000 K.W. Set.		4,000 K.W. Set.		
	1925.	1926	1927	1928	1929	1930	1931	1932	1933	1934
1. Units generated	1,335,410.	1,666,340.	2,260,370.	5,331,000.	6,915,400.	9,382,172.	13,002,370.	13,620,000.	13,516,280.	15,804,710.
2. Units sent out	1,151,810.	1,476,924.	2,003,387	4,991,201.	6,480,500	8,755,572.	12,219,670.	12,562,500.	12,320,774.	14,485,694.
3. Units used on Works	183,600	189,416.	256,983.	359,779.	434,900.	626,600.	782,700.	1,057,500.	1,195,506.	1,319,016.
4. Percentage used on Works	13.8	11.4	11.4	6.8	6.3	6.7	6.02	7.7	8.8	8.3
5. Maximum Load K.W.	375.	400.	760.	1,050	1,400.	2,350.	2,950.	3,150.	3,125.	3,775.
6. Load Factor	40.5	47.4	34.0	57.9	56.8	45.6	50.3	49.2	49.4	47.8
7. Coal lbs./unit sent out	6.4	5.7	4.4	2.5	2.21	2.05	1.75	1.93	2.02	2.01
8. Units Sold	931,439.	1,190,446.	1,635,568.	4,336,904.	5,774,687.	7,672,809.	10,515,700.	10,693,812.	10,320,202.	12,199,121.
9. Losses, Units	220,371	286,478	367,819.	634,297	705,813.	1,082,763.	1,703,970.	1,868,688.	2,000,572.	2,286,573.
10. Losses per cent.	16.6	17.2	16.3	11.9	10.2	11.6	13.1	13.7	14.8	14.4
11. Revenue	£30,858.	£34,210	£38,138.	£45,364.	£48,593	£59,786.	£76,198.	£71,444.	£69,208.	£72,940.
12. Average Price received per unit	7.95d.	6.89d.	5.595d.	2.51d.	2.02d.	1.87d.	1.74d.	1.603d.	1.61d.	1.43d.

TABLE "B."

ANALYSIS OF UNITS SOLD.

	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934
Industrial Power Units Sold	533,620.	781,662.	995,721.	3,357,140.	4,028,537.	4,815,519.	6,162,563.	5,454,191.	4,377,463.	5,475,549.
Lighting & Domestic Units Sold	272,513.	304,660.	380,326.	504,227.	1,010,185.	1,977,594.	3,003,784.	3,755,637.	4,178,923.	4,608,198.
Municipal Units Sold (Including Street Lighting)	125,306.	104,124.	259,521.	475,487.	735,965.	879,696.	1,349,353.	1,483,984.	1,763,856.	2,115,374.
Total Units Sold	931,439.	1,190,446.	1,635,568.	4,336,904.	5,774,687.	7,672,809.	10,515,700.	10,693,812.	10,320,242.	12,199,121.

C. Reduction in basic rate from 1d. to ¾d. was suggested.

D Reduction in off-peak load tariff from ¾d. to ½d. was suggested.

E. Prepared to meet a deficit for three years taking the long view on financial matters.

F. Definitely opposed to advertising, for fear of too fast a development and the necessity for extending our plant.

Well to cut a long story short, in July 1932, all the above was an accomplished fact and by referring to the graph the results can be seen at a glance. Revenue dropped and expenditure was high due to additional capital annual charges giving us the first deficit for many years, but only a temporary deficit, while we were giving good service and paying the bank interest on the deficit. This was at the end of 1932.

By the end of 1933 the position was improving but it must be remembered that in July, 1932, we reduced our tariff and in all created an immediate loss of £1,000 per annum. This tariff reduction was still felt during 1933, but as development was taking place 1933 suffered from loss of revenue for the whole of the year by the same amount as the year 1932 suffered for only half the year.

By the end of 1934 it is estimated to recover fully from the tariff reductions of 1932 thus taking 1½ years to see any actual increase in revenue. All this time the loads were increasing as well as the output and as we had installed the larger plant (400 k.w.) we were able to face development without the necessity to increase our generating plant or mains from a capital loan point of view.

Naturally some of my councillors are not satisfied with this policy and as one councillor said he could see that we would not reach the millenium this year, 1933. By referring to the graph it will be seen that he was obviously referring to the time when there was a £ s. d. balance, this will be seen at point between 1934 and 1935 where expenditure and revenue cross. But, of course, £. s.d. is not all that counts where real service is being given in the form of cheap power to the rate-payers, and other departments.

LONG SIGHTED POLICY.

It must be remembered that Umtata's Electricity Department is only 13 years old; and by this I mean that none of its loans have matured and capital loans are being added at intervals and the total capital loans are increasing as well as the corresponding annual capital charge but with all this no anxiety exists due to the fact that we are Hydro Electric and naturally cannot become obsolete as regards generating plant in the same way as most other prime movers, for I cannot see myself calling my generating Plant obsolete for the sake of 5% gain in efficiency. In addition the actual life of the hydro plant is many times that of the other types of prime movers, and so when our loans do mature, there is every likelihood that no fresh loans on the present plant will be raised as with moderate maintenance and repair the hydro plant will still be a valuable asset.

Until such times as our first loans mature say 16 years hence, capital will be gradually added and added, but after that date large sums will mature on which the annual capital charges of interest and sinking funds will not have to be met. When this time arrives the department will be run well on the right financial side to which credit side can be added the above capital charges which will not have to be met with the result that at least a further £4,000 per annum credit balance will be added to any then existing balance. The position in the future is decidedly interesting and secure. In the meantime we must secure all the water power available to continue the present and future unique position in Umtata, and with this in mind I come to our special "OFF PEAK" Load tariffs, these may be the cause of some interesting debates.

OFF PEAK LOADS Loads and Low Tarriffs—18 hours per day supply.

On peak-load periods being 10.30 a.m. to 1.00 p.m. and again from 5.30 p.m. to 11.00 p.m. but as time goes on this can be reduced to the following:— 11 a.m. to 1 p.m. and again from 5.30 p.m. to 9.30 p.m.

At present the rate is ½d. per unit, controlled by means of a time switch and is available especially for electrically heated Hot Water and Municipal pumping loads, but is available also for radiators for heating class rooms, etc., at the restricted hours; otherwise it is of no use for domestic use. It is the evenings which are cold and off-peak load rates are not available then.

One disadvantage of this off-peak load is that unless you have adequate water storage there will not be enough hot water for an early evening bath, as most of the water will be used for the evening kitchen washing up. But as we must foster this type of load it is my intention to ask my Council to introduce further reductions in the unit rate and encourage stored heating for electric ranges as well and for hot water heating; the stored heat consumption to be unmetered and be charged at a rate per installed kilowatt.

I intend to suggest the following rate:

HOT WATER HEATING OFF PEAK LOAD ONLY
18 hours Unmetered.

Per kilowatt installed on a yearly basis £0. 11s. 3d. per month.

STORED HEAT ELECTRIC RANGES ON PEAK LOADS
24 hours Supply Unmetered.

Per kilowatt installed on a yearly basis £1 10s. 0d. per month.

It can be clearly seen that in this way peak loads will be created with this cheap rate and the actual time of peak loads will change and as time goes on each set of loads will create its own peaks while others will be off to keep down peak loads, and so in the end we may have four sets of off-peak loads going with a peak of about three-quarters the total added off-peak load.

TARIFFS :

To make this matter clearer I will quote here the details of units sold for first half of 1933:

Primary Charges.

37,423 units at 9d.	£1,436	
27,449 units at 3d.	344	
2/6 per B.H.P. installed	90	
Meter rents	170	
		£1,940 half year.

Secondary Charges or Basic Rates.

34,435 units at 2d. two-rate	£286	
24,000 „ „ 1d. motor	100	
9,427 „ „ 1d. lights	39	
141,575 „ „ ¾d. domestic	445	
		£870 half year

Off-Peak Loads.

34,802 units at ½d.	£75	£75 half year.

From the above it can be clearly seen that it is my ambition to establish a three part tariff and have three sets of charges instead of the usual two primary and secondary. The primary and secondary are fully understood and need no more explanation, but as I have Hydro power, and the intrinsic value of our unit is Nil; we have available a large number of units, about 2,000,000 for sale per annum, which would cost us nothing to generate, and so if only a quarter of a penny is received per unit for them, it is all profit, and at such a low figure should prove very useful to my consumers. If only 750,000 units out of the two million were sold in this off-peak load way, it would bring in an annual revenue of about £800 all of which would be profit, which profit would be the means of paying for any further capital annual charges which are bound to take place as the load and **primary and secondary** charges increase. It is quite obvious that as we have no industry it will take a very long time before the undertaking will be overloaded with off-peak loads so much so that a new peak load may be created by this cheap tariff as it will not suit all conditions it is natural we must continue to increase the primary and secondary revenue loads, but not at quite the same rate as the off-peak load.

FUTURE POLICY.

In future a bold bid must be made to bring in the special **off-peak load tariff at the very low est rate possible** whereby the peak loads can be kept down and naturally the plant capacity thus delaying extensions for as long as possible. At the same time touching quite a new field for revenue from hot water and stored cooking; and so receiving revenue from a field which otherwise could not be touched instead of allowing all the spare water in the Umtata river just to run to waste with no useful purpose to the consumers and at a loss to the department when it could be used to increase the revenue without effecting the peak-loads.

As an example I made the following assumption that we have 200 small stored heat cookers with say 500 watt loading on the 100% load factor basis and also 200 consumers with each 1,000 watt stored hot water heaters. Naturally the loads will be increased by 100 k.w. due to the cookers but the hot water will not clash but will fill up the off-peak loads gaps and so the revenue will be as stated below with only an increase in peak load of 100 k.w. although 300 k.w. load has been added Whereas with the unlimited load basis the peak loads with 200 cookers would be in the vicinity of

600 k.w. at rate of 3 k.w. per cooker and using the same number of units as 500 watt stored heat cookers.

Thus :—

200 stored heat cookers at 500 watts on peak load —100 k.w. @ 30/- £150

200 stored heat water heaters of 1,00 watts each off peak loads at rate of 11/3 per k.w. £110

Monthly Increase of load on peak 100 k.w. ——— revenue £260

Annual increase of loads on peak will be 100 k.w. while the total annual revenue with the above example will be in the vicinity of .... £3,120.

This is all revenue which under ordinary circumstances would be lost to the Department and especially since the fuel cost per unit is Nil this £3,120 per annum will be all profit.

The above loads may not be reached for some time but any proportion of them is equally profitable as it is all profit, no additional expenditure is needed to generate the extra units.

DESCRIPTION OF PLANT.

I would like to mention that the two hydro plants are remote controlled i.e. they can be started and stopped or speeded up and down from the station in Umtata. The No. 1 plant is three miles from town, transmitting at 3,300 volts and with a 5% transmission loss at full load while the No. 2 plant is fourteen miles from town transmitting at 11,000 volts with a 10% loss at full load (copper losses).

The town distribution feeders are all 3,300 volt three phase, three wire, while the low tension feeders are arranged for a 220/380 volt, three phase, 4 wire.

Under normal conditions the No. 1 plant is visited twice a week to give the necessary oiling and attention, at a cost of about £6 per annum for engine room stores. This plant is protected against overload, overspeed, excess alternator winding temperature and excess transformer temperature as well as the usual ball bearing protection against excess temperature. The generator being 400 volts stepped up to 3,300 for transmission to town. On all faults the plant is electrically interlocked and it is necessary to make a visit to the plant before it can be put into commission after a fault has occurred.

Under normal conditions the No. 2 plant is visited once a week. Additional arrangements were embodied in this plant (gained from experience with No. 1 plant) and but for the bearing cooling system clogging this plant could be left unattended under normal conditions for a period of two weeks or more with safety. The plant is protected against overload, overspeed, excess alternator winding temperature, transformer temperature, bearing temperature relays, differential protection and excess voltage. This plant is interlocked on all faults except line fault and excess votage and can be restarted from remote control in the latter two cases. Current is generated at 3,000 volts and stepped up to 11,000 for transmission to town.

Both Hydro plants have their voltage controlled by means of "Tirrill" automatic voltage regulators with line drop compensation of 5% and 10% respectively on No. 1 plant and No. 2 plant.

There is also an adjustment of the regulator for adjusting the amount of compensation and so the delivered voltage at the Umtata Township switchboard rises slightly as the load rises to compensate for feeder losses and also transformer losses and so we are able to maintain a well regulated voltage at the consumers terminals.

There are four H.T. Feeders equally loaded leaving the switchboard feeding 9 standard size 50 k.v.a. pole type substation all as equally loaded as possible and so in this way the compensator on the Tirrill automatic voltage regulator takes charge of far more than would be possible with unequally loaded feeders.

During the daylight hours we are troubled slightly with lower power factor and this for the time being is adjusted by means of a timeswitch which raises and lowers the main voltage of the Tirrill at predetermined times by an amount which is estimated to be necessary for any particular time of the year ; at present in winter we do not use it, but in summer we adjust the main voltage up by 25 volts on the 3,000 generation side at the Hydro plant during day time.

Also the amount by which the voltage is compensated depends on the time of the year. In winter on account of heavy loads we compensate less and maintain a higher main voltage while in summer we maintain a higher degree of compenstion with a lower main voltage as loads do not vary so much in summer and from experience it has been found to suit Umtata's conditions.

With this time switch I do not want you to think that I am correcting the bad power factor, all that I am doing is to try and deliver the correct voltage which is much lower during the daylight with a certain load than it is at night with the same load.

As I add more hot water off-peak loads this slight inconvenience will become less and less as we have no industry and very few motors to pull down our power factor.

Eventually as development takes place and a dry season becomes a worry to us it is proposed to build a weir in conjunction with the town amenities (for boating and pleasure, etc.) in the Umtata River. This weir will hold back about 300,000,000 gallons of water and will be used to maintain the flow of the Umtata River so that we will be able to depend upon an output of about 10,000 units per day as a minimum. This is of course about 2½ times the maximum daily output. Anything which may develop after this amount can be left in safety to itself for by that time Umtata will be so well established that it will be able to afford to generate a few units from other prime movers at a very much higher cost than at present, as there will be such a large number of units generated at the low nominal cost it will not make very much difference to the cost per unit sold.

I hope in writing I have not overstressed any point but as you will see our problems are entirely our own, the main feature is low tariffs due to low working costs. Many more interesting points have cropped up in my mind but I feel I have said enough.

I would also like to mention that although Umtata is one of the small towns it is the centre of the government administration for the territories. A large number of natives leave here every year to work on the mines and so although remote from other towns is has a very large spending power.

The annual spending power of the Municipality is in the vicinity of £30,000 expenditure and £30,000 revenue including all departments. I have just mentioned this to give an idea of the activities here so as not to mislead any of the smaller towns as Umtata cannot be compared with them, as such comparisons will only be misleading and perhaps disasterous.

During the paper I have not quoted too many figures as all such data can be had from the tables. A list and type of consumers contributing to our success is detailed herewith.

I hope to be present at the Convention when I shall be glad to answer any questions.

Lighting consumers only	371
Lighting and cooking only	53
Lighting, cooking and hot water	29
Lighting and hot water only	11
Motor consumers only	26

Motor consumers.

Consumers total	26
Number of motors total	38
B.H.P. installed totals	189
Annual revenue from units	£400
Electric Range as above	92
Hot water installations	40

The President : Our thanks are due to Mr. Nicholas for his interesting paper and to Mr. Lewis for reading it. As Mr. Nicholas states, Umtata's problems are their own. He mentions the possibilities of thermal storage cookers. We here have tried thermal storage cookers. That is a cooker with 700 watt loading and a chunk of cast iron weighing approximately 60 lbs. We have proved that they are not a practical success, and they are not popular with the consumers.

APPOINTMENT OF SECRETARY AND TREASURER.

I have to report that the Council have unanimously passed the following resolution :—

"That Mr. E. Poole be appointed Secretary and Treasurer to the Association on the terms agreed upon by the Association on September 14, 1934."

In reporting this to you I should also like to express this Association's thanks and appreciation to Mr. Perrow, who has been the honourary secretary and treasurer during the past year. Unfortunately Mr. Perrow could not attend this Convention and we have had one or two difficulties in consequence. (Applause).

FINANCIAL AND STATISTICAL TABLE.

	DIESEL POWER							plus 100 K.W. HYDRO				plus 400 K.W. HYDRO		
	April 1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	Est. 1934
Generating Plant Capacity	120	137	137	137	137	137	137	220	220	220	620	620	620	620
Engineer	IJN	IJN	IJN	IJN	IJN	IJN	IJN	IJN	IJN	IJN	IJN	IJN	IJN	IJN
Prime Movers: D. Diesel; W. Water Power	D	D	D	D	D	D	D	D & W	D & W	D & W	D & W	D & W	D & W	D & W
Total Cap. Expenditure	22,379	22,982	23,338	23,856	24,033	24,271	24,396	36,100	35,859	37,157	—	57,986	58,783	58,783
Cost per K.W. Installed	—	—	—	—	175	177	178	165	165	165	165	96	96	96
Total Revenue	1,505	2,780	3,330	4,060	4,393	4,473	4,739	5,349	5,341	5,688	6,666	6,244	6,213	6,780
Working Expenditure Amount Sold	1,313	2,006	1,788	2,118	2,279	2,514	2,934	2,676	1,622	1,795	3,272	3,267	2,784	2,896
Working Expenditure Pence Per Unit	—	—	—	—	5.86	5.98	8.9	4.13	2.09	1.48	1.9	1.46	1.00	—
Cap. Charge: Int. Sink	927	1,835	2,287	2,321	2,277	2,173	2,268	3,077	2,699	2,542	2,910	3,812	3,992	4,194
Total Charges Amount	2,240	3,841	4,075	4,439	4,556	4,687	5,717	5,753	4,321	4,337	6,182	7,079	6,776	7,090
Total Pence Per Unit Sold	15.88	17.16	13.98	10.37	11.7	11.17	14.9	10.53	5.58	3.4	3.7	3.13	2.40	—
Surplus = S. Deficit = D.	D723	D1,061	D716	S64	D81	D5	D435	D404	S442	S1,371	S484	D774	D421	D200
Relief From Rates	—	—	—	400	163	200	—	—	—	—	—	—	—	—
Cost of Oil per ton	—	—	—	—	9.14.9	8.9.6	9.16.0	9.16.0	10.3.0	10.3.6	12.0.0	12.3.9	12.3.9	12.3.9
Fuel, Cost per Unit Sold	—	—	—	—	1.49	1.43	1.43	0.85	.0025	.06	.128	.015	—	—
Population—W.	1,700	1,700	1,700	1,700	1,700	1,700	2,000	2,000	2,000	2,700	2,700	2,700	2,700	2,700
System A.C. or D.C.	8hrs. D.C.	16hrs. D.C.	24hrs. D.C.	D.C.	D.C.	D.C.	D.C.	D.C. & A.C.	A.C.	A.C.	A.C.	A.C.	A.C.	A.C.
Units Sold	31,971	65,950	70,598	94,298	100,461	104,715	120,356	131,315	185,719	306,267	404,084	536,269	664,087	—
Maximum Load KW	—	—	—	60	65	69	73	76	120	177	220	270	310	340
Plant Capacity	120	137	137	137	137	137	137	220	220	220	620	620	620	620
Year Load Factor	—	—	—	—	17	17	19	20	24	21	33	29	32	—
No. of Consumers, L and D.P.	179	227	260	309	335	332	335	340	366	385	424	430	444	454
No. of Consumers, Motors	0	1	4	8	9	9	10	18	17	19	19	19	19	23
Street Lamps	100	100	100	100	100	100	Up to a total of 175							
Gross Profit	191	775	1,542	1,942	2,017	1,958	1,805	2,673	3,719	3,893	3,394	2,979	3,571	3,969
Tariffs:														
Lights, Primary net	1/-	1/-	1/-	1/-	1/-	1/-	1/-	1/-	1/-	1/-	1/-	9d.	9d.	9d.
Lights, Basic Rate	1/-	1/-	6d.	6d. & 3d.	6d. & 3d.	6d. & 3d.	6d. & 3d.	6d. & 3d.	2d. & 1d.	2d. & 1d.	2d. & 1d.	2d. & ¾d.	2d. & ¾d.	2d. & ¾d.
Power Primary	S6d.-3d.	S6d.-3d.	S6d.-3d.	S6d.-3d.	S6d.-3d.	S6d.-3d.	S6d.-3d.	S6d.-3d.	S3d.-2d.	S3d.-2d.	S3d.-2d.	2/6 BHP plus 1d. unit	2/6 BHP plus 1d. unit	2/6 BHP plus 1d. unit
Power Basic	—	—	—	—	—	—	—	—	—	—	—			
Municipality Street Lights	9d.	9d.	9d.	9d.	9d.	9d.	9d.	9d.	2d.	2d.	2d.	2d.	2d.	2d.
Municipality, Light and Power							Same as private consumers							
Municipality, "Off Peak Load," Motor	—	—	—	—	—	—	—	—	—	—	—	½d.	½d.	½d.
Hot Water, "Off Peak Load"	—	—	—	—	—	—	—	—	¾d.	¾d.	¾d.	½d.	½d.	½d.
Meter Rents	1/-	1/-	1/-	1/-	1/-	1/-	1/-	1/-	1/-	1/-	1/-	1/-	1/-	1/-
Time Switch Rent	—	—	—	—	—	—	—	—	1/-	1/-	1/-	1/-	1/-	1/-
Tariffs	1/- 6d. 3d.	1/- 6d. 3d.	1/- 6d. 3d.	1/- 6d. 3d.	1/- 6d. 3d.	1/- 6d. 3d.	1/- 6d. 3d.	1/- 6d. 3d.	1/- 2d 1d ¾d	1/- 2d 1d ¾d	1/- 2d 1d ¾d	9d 2d ¾d ½d	9d 2d ¾d ½d	9d 2d ¾d ½d

A Telegram was later received from Mr. Poole of his acceptance of the office of Secretary and Treasurer.

SPECIFICATION OF A. M. E. WIRE

The President : I have to report another resolution which has been passed by the Council :—

"That this Council recommends to the Association the revised specification of A. M. E. Wire be treated as standard."

A Member : I take it that this revised specification is the one passed on July, 15, 1934?

The President : That is correct.

The President : Mr. Lewis has also kindly consented to read the paper on "The Bulawayo Municipal Electricity Undertaking." Before he does so, I think a few words of explanation are necessary. When these papers were arranged Mr. Horrell suggested that as we in Salisbury had the honour of having this Convention, we should invite the Electrical Engineer of Bulawayo to write a paper. Acting on Mr. Horrel's suggestion I put it to Mr. Phillips, who was then the acting Electrical Engineer at Bulawayo, and he consented to do so. That, I think, explains the position of a paper being read at this Convention from Bulawayo, which I now have the honour to represent.

Mr. S. V. R. Lewis (Gwelo) then read the paper as follows :—

THE BULAWAYO MUNICIPAL ELECTRICITY UNDERTAKING

By J. W. PHILLIPS, A.C.C.I., A.M.I.E.E.;
ASSISTANT TOWN ELECTRICAL ENGINEER.

HISTORICAL.

The original Electricity Scheme in Bulawayo was established under a concession in 1895 to three pioneers, and the scheme was put into commission sometime in 1896 or 1897. The Company was known as the Bulawayo Waterworks Co., Ltd., its other function being to supply Bulawayo with water.

The generating plant consisted of a 75 k.w. single phase alternator, 2,300 volts at 125 cycles, driven by a reciprocating steam engine. The whole of the Plant was tranported by ox-wagon from Mafeking, there being no Railway at that time. The line poles were made in three telescopic lengths, which were cemented together after arrival in Bulawayo. It is a matter of interest that many of these poles were examined 30 years later, when the Council took over the Scheme, and, so far as the bases were concerned there was no trace of corrosion and in fact, many of the poles are in use to-day.

In 1921 the Bulawayo Municipality called upon the Waterworks Company to bring its electricity undertaking into line with modern practice. The matter went to arbitration with the result that the Company changed the System to a three phase, 50 cycle supply, and carried out the necessary modifications to the distribution.

Electricity supply in those days was a luxury, with lighting at a flat rate of 2/– per unit, which by arbitration was reduced to 1/8 per unit about 10 years ago, shortly before the Council took over the Scheme. The design of the original Distribution System was hampered by old fashioned regulations, which actually called for insulated wire on the overhead lines on the Single phase 2,300 volt feeders. With such a costly distribution system and an insufficient plant, it is not to be wondered that the cost per unit was so high.

On the 30th June 1924, the Municipality purchased the Undertaking. The Plant at this date consisted of three Bellis & Morcom Reciprocating Engines, direct coupled to B.T.H. three phase alternators, 625 k.w. total capacity. It is interesting to record, that two of these sets are still in use at the Livingstone Municipal Power Station.

It soon became evident that, in order to meet the growing demand for Power, new and efficient plant was necessary, and after careful consideration, the Council decided to issue instructions for a complete Power Station and Plant, and to call for tenders.

Work was commenced on the New Station in August 1925, and a supply of Electricity to the Town was given from the Plant at the end of November 1926, the official opening taking place on the 18th December, 1926.

The new plant consisted of Two 1,000 k.w. Belliss & Morcom—B.G.E. Turbo-Alternators, 2,300 volts, 50 cycles, 3,000 r.p.m. By 1928, it was found necessary to enlarge the Station, and a 2,000 k.w. B.T.H. Turbo-Alternator was installed also 2,300 volts. Again in 1930, a still further increase was necessary, and a 4,000 k.w. Bellis & Morcom B.G.E. Machine was installed, this time generating 11,000 volts. The need for these increases is very apparent on referring to the maximum load Curve shewn on Graph Sheet 4.

Allowing for normal expansion and the fact that the Rhodesian Railways have now decided to take power from the Undertaking, it was considered in the early part of this year, that a further set was necessary. In consequence, tenders were called for another 4,000 k.w. Machine. The B.T.H. Company however, offered a 5,000 k.w. Set at a very little extra cost, which offer the Council accepted. Work is now proceeding on the erection of this Turbo-Alternator, together with an additional boiler and additional Cooling equipment. As the two early sets are not individually capable of carrying even the minimum load in the Station, it has been decided to offer these for sale as soon as the new machine is working. Thus, neglecting these sets the installed capacity of the Station will be 11,000 k.w. with a maximum nominal output of 6,000 k.w.

With the additions now in progress, the ultimate boiler equipment will consist of 7 boilers having a nominal evaporating capacity of 110,000 lbs. of steam per hour. The Boilers are of the Babcock & Wilcox type, with Mechanical Chain Grate Stokers—the working pressure being 200 lbs. per sq. in. Two Green's Economisers are situated in parallel between the end of the flue and the Smoke Stack, and at the base of the Stack Induced Draught Fans are provided.

The Cooling of the circulating water is carried out by Yarway Sprays in Cooling Ponds which with the additions in progress will cover an area of about 4½ acres.

FINANCIAL DETAILS.

The original price paid by the Council in acquiring the Undertaking in 1924, was £93,333. The Capital expenditure figure to date excluding the New Set in course of erection, stands at £210,333. In giving a true figure of the Capital expenditure however, it is necessary to add to the above amount the sum of approximately £60,000 which represents the amount of money that has been taken out of revenue for capital expenditure during the past five or six years. This amount was spent on the following works :—

(a) Complete change of voltage from 115/200 to 230/400.

(b) Complete re-organisation of the Distribution in the Town and Suburbs, by the installation of 11,000 Volt Ring Mains, Sub-Stations, and new Low Tension Lines.

(c) Contribution of £7,560 to the new 4,000 k.w. set in 1930.

(d) £1,500 for New offices at the Power Station.

The total capital expenditure mav therefore be stated to be approximately £270,000 for an installed capacity of 8,000 kilowatts or £34 per k.w. a figure which is remarkably low.

In addition to the interest charges of about £12,000 per annum on the loan value of £210,333 the following annual charges are borne by the Electricity Department.

(a) Acquisition cost	£2,500
(b) Betterment of Distribution Fund	4,000
(c) Redemption, approximately	2,500
(d) Contribution to Water Dept.	2 500
(e) Depreciation of the 1,000 k.w. Sets	1,500
(f) Line extensions, approximately ...	2,000
(g) Renewals & Obsolescence, approx.	4,000
	£19,000

The total Capital annual charge on the Undertaking is therefore in the neighbourhood of £31,000.

Item (a) needs a little explanation. When the Council purchased the Undertaking, there was a sum of £32,000 included in the price for goodwill, i.e. it is not represented by any tangible asset, and it is the policy of the Council to write off at the rate of £2,500 per annum.

Item (b) is really a reserve account for larger cables, transformers and Sub-stations as the occasion may arise with increased load.

REVENUE.

Item XI. Table "A" shews the comparative figures for the revenue received since the Undertaking was acquired, and it is seen that it has made steady increases every year reaching a maximum in 1931. It will be noticed that the revenue fell off in 1932 and 1933, but the units sold remained at a practically constant figure. This state of affairs was due on the one hand to the depression which prevented the same rate of increase of sales that had been maintained in the previous years, and on the other hand, to the considerable tariff reductions which had taken place. 1934, however, has shewn an improvement to 12,199,121 units sold and a revenue of £72,940.

Further reductions in tariffs have now been made, the revised tariffs being shewn in Table "C".

Item XII. Table "A" shews how the average price per unit has dropped since 1925. For 1934 it is as low as 1.43d.; a figure which I think will compare very favourably with even the larger Undertakings in South Africa. With the still lower tariffs which have now come into force, the figure for 1935 is estimated at 1.32d. Reference to the Curves on Graph Sheet 1, shews very clearly the rapid changes in these figures.

ANALYSIS OF SALES.

The Curves on Graph Sheet 2, shew the total annual units sold, and also the Industrial Power and Domestic units sold. It is seen that although the Industrial power units fell away in 1932 and 1933, due to depression, the domestic units made a steady increase right through and the total units sold remained practically constant. In 1934, the domestic units represent 38% of the total sales. The analysis of these figures for the years under review is shewn in Table "B"

There are 2,423 Domestic Consumers in Bulawayo, and for the past twelve months, the total units sold to this class of consumer, were 4,608,198 or 1,902 units per consumer.

Although the number of the larger domestic appliances installed has not reached any extraordinary figure, it is nevertheless gratifying to see the steady increase year by year. This is shewn in the Curves on Graph Sheet 3. The figures at the 30th June 1934, are 810 Ranges, 522 Waterheaters and 270 Refrigerators.

An interesting point in connection with these figures, is that while the rate of increase of ranges has remained practically constant, the rate of increase of waterheaters is beginning to fall off. This to my mind clearly shews the need for a special tariff for these very useful and convenient appliances, as undoubtedly waterheating at ⅜d. per unit is expensive. This matter is engaging our very serious attention, and it is hoped to devise very shortly, a satisfactory solution to the problem.

The three types of domestic appliances mentioned above, may be purchased through the Council, by the Hire Purchase System which for ranges and waterheaters was inaugurated in 1928. It was only last year that the Council decided to include Refrigerators in the Scheme. The method of payment is as follows :—

RANGES AND WATER HEATERS.

1st Payment : 15% plus 1/24th of the remainder. The balance, plus 6% is divided into 23 equal monthly instalments.

REFRIGERATORS.

25% instead of 15% is required, and the total cost is limited to £60.

All the appliances are guaranteed by the Suppliers for two years, i.e. the full period during which the Consumer is paying off the cost.

The importance of Bulawayo is out of all proportion to the numerical size of its population, and it is not surprising therefore, to understand that the demand for power now existing and contemplated, is equally out of proportion with the population. There is no precedent quite like it, but is is easy to see that it must be so, for the Town is at any rate the commercial centre, the Railway Headquarters, the Railway Nerve Centre, and generally the trading capital of a country of assured future.

The estimated white population of Bulawayo at the 30th June last, is 12,600. With 12,199,121 units sold for the year, the consumption per head of population is therefore 968 units.

It is interesting to summarise the performance of the Undertaking under Municipal ownership during the 10 years under review in the following manner :

(a) The units sold per annum have been multiplied by 13.

(b) The maximum load has increased 10 fold.

(c) The average price per unit sold is reduced to one fifth, and in spite of this;

(d) the revenue per annum has more than doubled.

DISTRIBUTION.

The network for the Town area consists of 11 k.v. Underground Ring mains feeding 15 Sub-Stations, seven of which are underground. The transformers in the sub-stations step down to 400/230 volts for 4 wire distribution along the Sanitary Lanes, and vary in size from 100 to 500 k.v.a. For reasons of economy, when this scheme was installed in 1929, the transformers were protected on the E.H.T. side by Expulsion Type Fusible Links, but they are now being gradually replaced by Oil Immersed Switch Fuses for safer working.

It is fortunate that a break away from the old 2 k.v. distribution system was made in this re-organisation. The increase to 11 k.v. has been fully justified, in that the Main ring consisting of .06 sq. in. 3 core cables, is now almost fully loaded during Peak Hours. 11 k.v. has proved itself to be a very convenient voltage for a Town of this size. It has an advantage over 6 k.v. in that smaller cables may be used, while it is no more dangerous to work with. We have 11 k.v. Kerb Link boxes in addition to the sub-stations which have never given the slightest trouble, and have proved a great convenience. One hesitates however to suggest that a still higher voltage would be justified. The next step is 22 k.v. and I do not think that this would be quite as convenient as 11 k.v. from the point of view of its use in underground sub-stations and Kerb Link boxes. From our experience here in Bulawayo, I have no hesitation in stating that 11 k.v. is undoubtedly the best voltage for a small growing town to adopt when considering a comprehensive distribution scheme.

For distant connections and outlying suburbs, both 11 k.v. and 2 k.v. overhead lines are at present in use, with pole mounting transformers. The extent of the feeders on the system may be gathered from the following figures :—

11 k.v. Underground Cable in use at date	10 Miles.
11 k.v. Overhead Line in use at date	27 Miles.
2 k.v. Overhead Line in use at date	24 Miles.

STREET LIGHTING.

The centre of the Town is served by Central Standards at the intersections of Streets, with two 500 Watt lamps per standard. On the outer edges of the Town and Suburbs, side Lamps of 300 watts each, are placed at the Street Corners diagonally—two at each intersection. The difficulty of lighting streets with a double row of trees on each side has been overcome to some extent by using fittings on the ends of long arms fixed to poles at the edge of the side walk, or by suspended central units.

LOAD FACTOR.

Bulawayo is fortunate in possessing several fairly large power consumers which in good times give a 24 hour load. These are the Premier Portland Cement Company, the Milling Companies and the Rhodesia Co-Op Creamery. These of course have a good effect on the Load Factor, which it will be seen from Item 6, Table "A" went as high as 57.9% in 1928. It has been dropping since then, but still stands at the useful figure of 47.8%. Graph Sheet 5 shews two daily Load Curves, one 18th June last, for a very cold day and the other 7th May last, for a warm day. These days have been chosen as two days with approximately the same industrial load on at the same time, the only difference being the difference in the Domestic Load due to the cold weather. It is seen that there is at times approximately 1,000 k.w. difference in the two curves. The Curves are of course typical for any Power station catering for domestic load, i.e. with the major Peak Load between six and seven in the evening, and a minor Peak at mid-day.

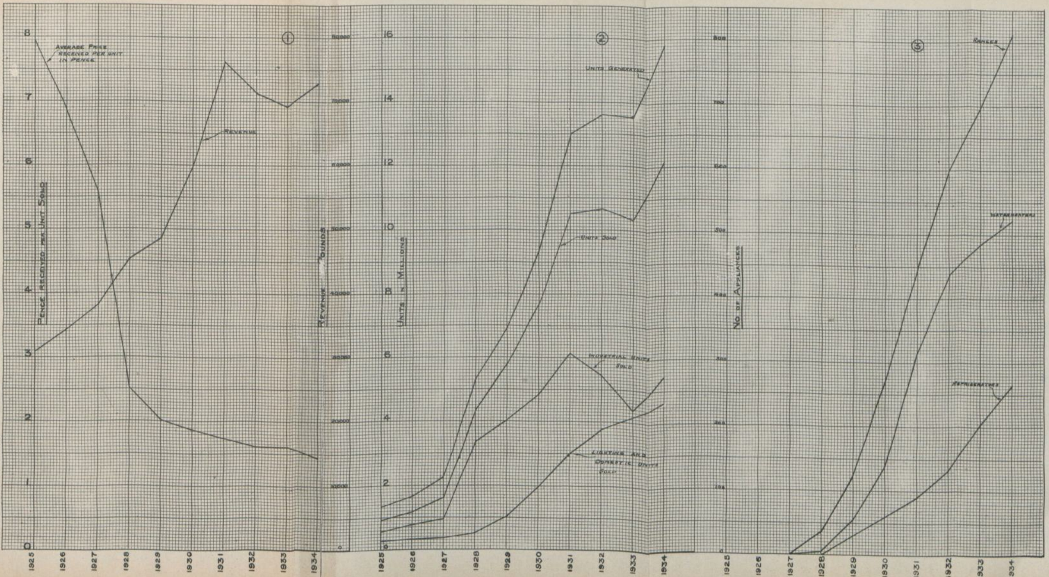
COAL CONSUMPTION.

Item 7, Table "A" gives the Coal Consumed per unit delivered and the corresponding graph is shewn on Graph Sheet 6. It is very clearly seen how this figure has dropped with the installation of Turbine Plant, reaching a very good value of 1.75 lbs. per unit sent out in 1931. The following years shew an increase due to the fact, that the industrial load fell away considerably, resulting in a very poor night load-less than 25% full load for the 4,000 k.w. Machine, which was running practically continuously.

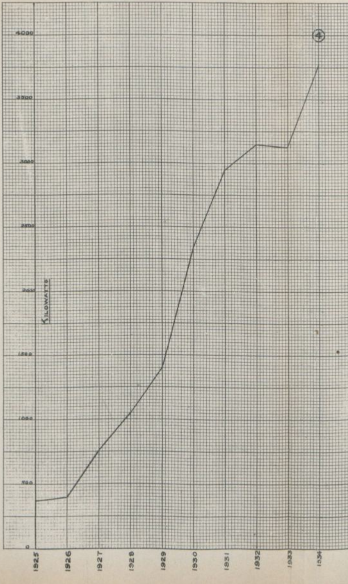
The cost of coal landed at the Power Station siding is 19/- per short ton, which is made up as follows :— 11/6 per ton at the pithead, and 7/6 per ton railage. The calorific value is 13,500 B.Th.U. per lb.

CONCLUSION.

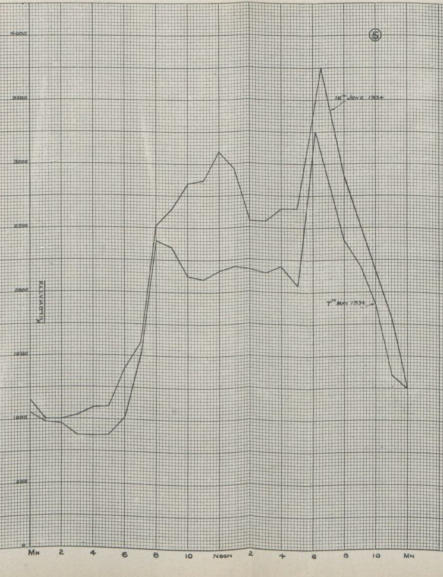
While the object of this paper is not to put forward any extravagant claims for the Bulawayo Electricity Undertaking, nevertheless, it is felt that at all events, so far as electricity is concerned, Bulawayo is definitely on the map. For this, the citizens of Bulawayo have every reason to congratulate themselves in that they had a Council which had the courage and foresight to adopt the



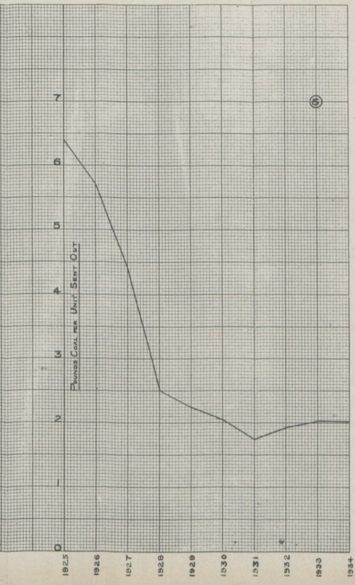
1
AVERAGE PRICE RECEIVED PER UNIT IN PENCE
REVENUE
PENCE RECEIVED PER UNIT SOLD
REVENUE POUNDS
2
UNITS GENERATED
UNITS SOLD
INDUSTRIAL UNITS SOLD
LIGHTING AND DOMESTIC UNITS SOLD
UNITS IN MILLIONS
3
RANGES
WATERHEATERS
REFRIGERATORS
NO OF APPLIANCES
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934



4
Kilowatts
4000
3500
3000
2500
2000
1500
1000
500
0
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934



5
18th June 1934
7th May 1934
Kilowatts
4000
3500
3000
2500
2000
1500
1000
500
0
Mn
2
4
6
8
10
Noon
2
4
6
8
10
Mn



6
Pounds Coal per Unit Sent Out
7
6
5
4
3
2
1
0
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934

policy of assuring the community of a supply of Power, well in advance of its immediate needs at all times.

It is with pardonable pride that those who have been privileged to be closely associated with the Undertaking, look back on its rapid evolution to its present state, from the medley of buildings, plant and transmission lines of a few years ago.

In conclusion I must thank Mr. A. E. Val Davies, Consulting Engineer, and Mr. S. Perry, Town Treasurer for assistance with facts and figures relating to the earlier days, and Mr. A. R. Metelerkemp, Town Electrical Engineer, for his advice and criticism during the preparation of this short paper.

TABLE "C"

MUNICIPALITY OF BULAWAYO.

Electricity Department.

TARRIF OF CHARGES.

1. LIGHTING.

(a) Applicable to all Business Premises Halls, Clubs, Offices, Cafes, Tea Rooms, Bars, Hotels, etc—

First 500 units per month	6d. per unit.
Balance	3¾d. „

(b) Applicable to all Private Residences, Private Hotels, Boarding or Lodging Houses and Private Nursing Homes within the Commonage Boundary—

3 units per living room	8d. per unit.
Balance	.75d. „

(c) Applicable to Private Residences, etc., situated on the Commonage and in Sauerstownship—

3 units per living room	9d. per unit.
Balance	1d. „

(d) Applicable to Private Residences, etc., outside the Commonage boundary, excluding Sauerstownship—

3 units per living room	1/3 per unit.
Balance	1d. „

(e) Applicable to Shop window lighting only—

1 — 50 units	4½d. per unit.
51—100 units	3d. „
Balance	2d. „

2. **COOKING AND HEATING.**

Applicable to all classes of premises except private residences.

Flat rate	.75 per unit.

3. **POWER.**

(a) Applicable to Consumers under 15,000 units per month—

First 5,000 units	1½ per unit.
Balance	1d. „

Subject to a minimum charge of 3/4 per month per installed Horse-power or part thereof—

(b) Applicable to Consumers who will guarantee a minimum consumption of 180,000 units per annum—

Flat rate	1d. per unit.

(c) SPECIAL TARIFFS.

Rhodesia Railways—

Guaranteed minimum of 1,000,000 units

per annum at	.9d. per unit.
Balance	.8d. „

Cement Company—

Guaranteed minimum of 2,000,000 units per annum—

1— 600,000 units	.9d. per unit.
600,001—1,200,000 units	.8d. „
Balance	.75d. „

4. SUPPLY TO MUNICIPALITY.

Flat rate (for all purposes)	1d. per unit.

5. SUPPLY TO ELECTRICAL FIRMS.

(a) For Demonstration purposes—

Flat rate	½d. per unit.

(b)

Lighting	4½d. „

DISCUSSION.

The President : The thanks of the Association are due to Mr. Lewis and also to Mr. Phillips for this paper. I should like to explain that this paper was written under very trying circumstances. Mr. Phillips was running about half-a-dozen jobs at the time he was preparing this paper. I have only been associated with Bulawayo for a short period, but I think they should take pride in the fact that they are selling juice at an average price of under 1½d. per unit. The paper is now open for discussion.

Mr. Rodwell (Johannesburg) : Mr. Phillips has presented the history of the successful development, and the present position of the Bulawayo Municipal Electricity Undertaking in an interesting and practical way. I will deal with a few items in the paper.

The author's figure of £34 per k.w. installed is, no doubt a creditable one. It is, however, necessary to bear in mind the particular fortunate position of the undertaking in having large bulk consumers and a comparatively small reticulation area, when comparing this with corresponding figures of other undertakings in South Africa. The importance of the industrial consumers is illustrated by the fact that they purchase 45% of the units sold, bringing the load factor up to 47.8%. The industrial load in Johannesburg, divided amongst many consumers, represents 21% of the total sales and the load factor is 35.9%. I do not wish to detract from the significance of the author's average price of 1.43d. per unit, but as the revenue and profit per unit is largely one of municipal policy, I would suggest that the **cost** per unit is a more suitable basis of comparison, and that the load factor and area of supply should be taken into account.

In the section dealing with domestic development, I was particularly interested in the comparatively large number of water heaters installed. The price of ¾d. per unit appears to be very reasonable for Bulawayo, but, as pointed out by the author, this is considered high for water heating. The consumption given of 968 units per head of population includes the industrial units sold and may be misleading, but the figure of 366 units per head of population for lighting and domestic consumption shows quite clearly the advanced stage of electrical development in Bulawayo. The corresponding figure for Johannesburg is 293 units per head of population, but it should be borne in mind that gas is also used for cooking and heating by a not inconsiderable number of consumers. It may be interesting to state that the maximum demand increased by approximately 7,000 k.w, at Johannesburg during the last year, and that the Electricity Department again reduced its tariff considerably and furnished a profit of approximately £180,000 to the relief of rates during the year.

It is interesting to note Bulawayo's introduction of 11 K.V. transmission lines, which is highly commendable, and that no trouble was experienced with the kerb link boxes at this voltage. I am in agreement with the author regarding the unsuitability of kerb link boxes, and more particularly underground sub-stations under public streets at voltages exceeding 11,000 when this can be avoided.

Due to the difficulties of drainage, access, heating, safety and other problems, I do not advocate the use of the transformer sub-stations under public streets. Two such sub-stations were taken out of service and discarded in Johannesburg. Due to the difficulties and expense in obtaining sites in the central city area of Johannesburg, arrangements are made with the owners of properties to furnish space on their sites, usually in the basement of buildings, to be fitted as sub-stations by the Electricity Department at its expense to furnish electricity supplies, not only to the building but to other consumers in the vicinity. A large number of these mutual service sub-stations have been installed and connected to the high tension ring mains in the central area to meet the heavy demand in these congested sections.

In suburban and sparsely populated sections, sites are purchased for the erection of sub-stations. The phenomenal growth of a progressive undertaking and some of the methods employed in that development, have been ably presented in the paper, and should inspire some of the smaller local authorities to emulate that success, so far as their particular local conditions permit. Our thanks are due to Mr. Phillips for his interesting paper. (Applause.)

Mr. Lewis (Gwelo): I think Mr. Phillips is to be congratulated on the able way in which he has presented this paper, especially, as you Mr. President mentioned, that he prepared all this data under trying circumstances.

It is remarkable when referring to the curve sheets of price per unit sold to note that during the time the Municipality had the undertaking it dropped from the high figure of 7.9d. to 1.43d., and the Council of Bulawayo is to be congratulated on the very able policy it adopted in effecting such big reductions. I understand that the profits are still mounting and a further reduction in tariffs is contemplated.

Another point which arises is that, in addition to the plant which has been installed there under

Municipal auspices, the Council have had to purchase the undertaking for £93,000 on an installed capacity of 625 k.w, Even these heavy capital charges are being met from revenue now.

Mr. Horrell (Pretoria): I would like to add my thanks to Mr. Phillips for the interesting paper he has presented. Bulawayo is to be congratulated on the results obtained, particularly in regard to power station operation. The figures are quite remarkable for such a small station, and show what can be achieved with modern plant. The coal consumption figure attained is, I think, excellent. The coal used in the Pretoria Municipal station has a calorific value of about 12,000 B.T.U.'s per lb. and during the last year the average coal consumed per unit sent out was 1.82 lbs., giving a heat consumption of 21,800 B. Th. U's per unit sent out, which compare favourably with the figure attained in the Bulawayo station, viz. 23,800 B.Th. U's per unit sent out. We are at present paying 11s. 10d. per short ton for our coal. The figures tabulated in the following table will serve as a comparison between the Bulawayo and Pretoria undertakings :—

	1932.	1933.	1934.
Units generated	43,313,820	44,848,380	52,374,240
Un'ts sold	37,947,329	38,863,010	44,613,315
Coal per unit S.O. lbs.	2.138	1.98	1.82
B.Th.U. per unit S.O.	26,250	23,700	21,800
Revenue	£208,598	£211,344	£234,692
Prices received per unit	1.32d.	1.31d.	1.265d.
Load Factor %	45.65	41.96	37.13
Max'mum Load kW.	10,800	12,200	16,100

The capital expenditure on the undertaking to date has been £1,242,415 for an installed capacity of 29,000 kW., giving an average expenditure of £43. per kW. installed. With regard to capital charges, I consider the capital charges per kW. installed is an unfair one. We should get two figures—the figure for the power station and that for the distribution system. I would welcome the attempt to try and get these figures for each of the different stations in South Africa. Where a man has a big distribution system such as Cape Town extending as far as Simonstown, how can they compare the figures favourably with a station where the consumers are all within a two miles radius of the power station?

With regard to the betterment fund, I think that appeals to everybody. It is a fund that would be wonderful if we could get our town councils to accept it. I think I may say that in the Transvaal, the municipalities take the whole of the excess profits for the relief of rates. In Cape Town they started a betterment fund many years ago, and, as has been shown by Mr. Eastman and Mr. Low, they are able to pay for a great portion of their improvements from this fund. I happened to go to Liverpool a few months ago, and found that the whole of the installation extensions are purchased out of a fund which might be called a betterment fund.

In regard to water heating the selling of current at ¾d. per unit is not a proposition which suits many people. In Pretoria we have a charge of ⅜d. for water heating, I have divided my house into three electric circuits—cooking, lighting, and water heating, and I know exactly what I do. Over a long period I have averaged 200 units per month for cooking, and the consumption for water heating is over 500 units per month. The charge of ⅜d. is high. It gives 15/- per month which is excessive for water heating. I congratulate Mr. Phillips on the way he has put this paper together.

The President : Thank you, Mr. Horrell.

The Convention adjourned for tea, and resumed at 11.0 a.m.

Mr. Gyles (Durban) : It may be of interest to members if I give some figures relative to the Durban Undertaking. The revenue per unit sold last year was 1.1d. Working expenses were

£331,375, with capital charges in addition of £214,563, of which £67,400 represented a direct contribution to the town's borough fund in relief of rates. The figures per unit sold were respectively .725d. for working expenses, and .469 for capital charges, a total of 1.194d. The total capital outlay of the department at July 31, 1933, was £1,705,423.

Mr. A. E. Val Davies (Johannesburg): Dealing with the question of underground sub-stations, none of us would prefer to go underground if we have facilities on the surface. The reason why they were compelled to construct underground sub-stations in Bulawayo was that the town is comparatively new; the programme of street levels, the system of storm drainage and the macadamising of streets had not been definitely settled at the time. In addition, the Council possesses no vacant stands whatsoever in the town. We found that if any attempt were made to build brick sub-stations on the sides of the streets, there was an immediate protest. So we had to go underground. If, in future, it is found that there is an alternative solution on the lines mentioned by previous speakers, such as the utilization of basements of large buildings, it will be a simple matter to remove the apparatus from the underground substations and to fill in the chambers.

The next point is that the paper appears to make comparisons between Rhodesia and the Union in respect of power supply. I do not think that anybody should feel that the comparisons were intended to be to the advantage of Rhodesia. They are simply meant to indicate how extraordinarily an efficient electricity supply has been appreciated in Rhodesia, and how far municipal development has advanced in this colony considering that only 44 years ago it was wild native territory. I think the best thing we can say of electricity development in Southern Rhodesia is that it is a monument to the engineers and to the Municipal Councils of this territory. (Applause).

The President: Certain comparisons have been drawn between the Union and Rhodesia. I think one must bear in mind, when comparing Rhodesian towns with towns in the Union of equal population, that the spending power in Rhodesia is higher than it is in the Union, which, I think, accounts for the higher consumption in the smaller towns of Rhodesia.

Mr. G. G. Ewer (Pietermaritzburg): I should like to draw attention to the charges, and perhaps it might be advisable to discuss one or two points. I notice that Bulawayo have a scale for lighting and for other purposes, so many units per room at 8d. or 6d. and the balance at a lower rate. I think it is a similar rate to that of certain towns in the Union; but the question of defining a living room has very often caused a good deal of trouble. It might be useful if we discussed a basis for this, In Cape Town they take the floor area. (A Member: No.) I think they do in some towns. (A Member: In Aliwal North). Well in some towns they do and other towns take the total number of rooms. They do not count certain rooms and others which may not be in use. These different purposes is in force in Bulawayo for all Municipal departments. I do not know of any other town having such tariffs, as to how they settle these troubles. A special rate of 1d. per unit for all methods cause trouble in the consumer's mind. Perhaps we may hear from some of these towns with such a rate. Personally, I do not think it is quite fair to other consumers.

Mr. Eastman (Cape Town): The important point arises out of the paper that provided reductions in tariffs are made with due regard to the possibilities of the development of further sales, that is to say, to make reductions where reductions are likely to increase consumption rather than by reducing the tariff by, say, 10% on all rates, so far from such alterations in the tariff reducing the income, and incidentally the surplusses, the income after a slight setback is increased and the profits are increased also. I agree with

Mr. Phillips that ¾d. per unit for water heating is expensive. I go so far as to say that even at ½d. per unit the bill may be so high as to restrict the development of the use of electric energy for this purpose, and therefore in Cape Town we are proposing to introduce an off-peak water heating rate on a sliding scale of ⅜d. and ¼d. per unit. It is essential, however, when quoting an extremely low rate of that kind, that the supply authority be protected from exploitation by the consumer by way of an adequate minimum charge which in Cape Town is fixed at 10/- per month for the off-peak water-heating service.

Where an undertaking is unable to give supplies at such low rates as to encourage the extensive use of electric energy for water-heating it may well be possible to obtain a considerable amount of load of this kind by instructing consumers in the possibility of combining an electrical thermal storage system with a slow combustion stove. There is undoubtedly, especially in the larger centres, a strong inclination towards the use of electric energy for all domestic purposes, and one can create and retain a very great deal of good-will in assisting consumers with advice of that nature which ultimately is of benefit to the undertaking and to the consumers themselves through the increase in sales of electric energy for other domestic purposes.

Under the Capetown Domestic Tariff (Rate A) where one or more rooms exceed 300 square feet each in area the excess over 300 square feet of all such rooms is added together and the total excess area so determined is counted on the basis of 300 square feet, or part thereof, as one room and the number so determined added to the actual number of "countable" rooms in the house up to 300 square feet each. All kitchens, bathrooms and conveniences are excluded in determining the number of "countable" rooms, and all outside rooms which are completely detached from a residence are not counted as a room for the purpose of the tariff rate if they are not wired for the use of electricity. In the case of private boarding houses, residential institutions, private hotels, etc., the number of rooms is based on 150 square feet or 200 square feet per room according to the class of premises, but outhouses, stoeps, courtyards, balconies, etc., are dealt with on the basis of 300 square feet per room.

It is a condition of supply on the Capetown Domestic Rates applying to hotels, hospitals, nursing homes, boarding houses, residential clubs, etc., that such consumers install or undertake to install and use electric cooking appliances, which will have the effect of at least doubling their normal lighting consumption.

Mr. L. L. Horrell (Pretoria): With reference to charging on the floor area, we have been doing it in Pretoria for some time in such places as clubs and hotels. We charge for so much of the area and ¾d. per unit for all current consumed. That system we hope to adopt in the new tariffs. We have got out the tariffs, and it will be on the basis of 250 square feet—1s. 8d. per month plus a unit charge, and we hope that we shall bring it to ⅝d. (five-eights). With regard to water-heating, undoubtedly water-heating is not altogether a profitable concern for everybody.

Mr. G. E. H. Jones (Mafeking): We have a similar room tariff at Mafeking. Our regulation reads :—

> "The words "living room" shall mean any separate chamber or compartment or any part of the building wholly divided from the remainder of the building by a wall, a door or a partition and capable of being inhabited, but shall not include any part of the building structurally adopted for exclusive use as a corridor, kitchen, pantry, bathroom, cellar or store room, provided that it shall be entirely within the discretion of the Council to decide whether any room is a living room or not."

Mr. B. Tubb (Salisbury): There is one small point which occurs to me in connection with the hire purchase system. I think I am correct in saying that it was Mafeking that barred refrigerators from the hire purchase system. I think that is a short-sighted policy. I have found here that several house-wives have told me that if they had their choice between a refrigerator and an electric stove, they would go in for the refrigerator. In several cases to my knowledge where a refrigerator has been installed, an electric stove has followed after.

Mr. Jones (Mafeking): Refrigerators were barred. That is because Mafeking is a small town. If six consumers desired a refrigerator each all at one time it would probably involve some financial difficulty.

REPLY. (communicated).

Mr. Phillips (Bulawayo): May I in the first place express my thanks to Mr. Lewis for reading my paper for me in my unavoidable absence from the Convention, and for the kind way in which the paper was received.

Mr. Rodwell suggested that the cost per unit was a more suitable basis of comparison than the revenue per unit. For his information our costs for the year 1933/34 are as follows :—

Working Expenses	.7828	pence per unit sold.
Capital Charges	.5604	do.
Total	1.3432	do.

The revenue per unit sold for the corresponding period was 1.4367. These figures compare very favourably with those given by Mr. Gyles on the working of his department.

Mr. Ewer raised the point of charging a flat rate of 1d. per unit to the Municipality for all purposes. This tariff arose from the consideration of the point of view that the two trading concerns Water and Electricity should supply their products to one another and to the other departments at roughly cost prices. The cost given above is 1.3432 pence per unit sold, but after deducting certain items under Capital charges which it was felt for this purpose could not fairly be included, the figure of 1d. was arrived at. In a similar manner the Water Department arrived at a figure of 3/- per thousand gallons, which is the charge now made to all departments.

The question of underground sub-stations was raised. We have realised that this is not a convenient arrangement, but Mr. Val Davies explained the difficulty that was experienced when the distribution system was installed. We are at the moment scrapping one of these sub-stations, and have purchased a small building close by which we are adapting for our purpose. I think in time to come owing to the limited capacity of an underground sub-station, this will have to be done throughout the whole Town.

In reply to Mr. Eastman on the question of coal, the coal supplied is termed "Medium Nuts" of a size plus $\frac{3}{4}''$ and minus $1\frac{3}{4}''$.

In conclusion I would like to express my appreciation to the gentlemen who took part in the discussion on this paper, and feel that while the paper was more historical than anything else, it has been of some use in indicating the possibilities of an electrical undertaking in a small Town. In making comparisons however, we realise that in Bulawayo we have advantages not enjoyed by Towns of a similar size in the Union, i.e. as Mr. Rodwell pointed out, a high percentage of Industrial Load and as pointed out by the President, a community with a fairly high purchasing power.

INFERIOR MATERIAL.

Mr. A. M. Jacobs (Electricity Supply Commission): The question has been raised as to whether anything further has been done on the point of the inspection of inferior material. Mr. President, you will remember that I spoke rather fully on the question at Port Elizabeth. I commenced by outlining the considerations which had gone through the Commission's mind when examining the question.

We ourselves felt that legislation was desirable, but in view of the great difficulties of first of all obtaining legislation and then implementing such legislation and giving it proper effect by means of inspectors and so on, it would probably mean that so much time would be taken up that we could not possibly continue to follow it up. On that account the Commission suggested, as a first step, that the Commission would be quite ready to undertake the work of establishing some sort of testing bureau where problems could be considered.

Naturally we expected to work in the fullest co-operation with all the bodies that would be interested in the question at issue. However, your Association adopted a resolution which really ran contrary to the proposals that I had put forward on behalf of the Commission, and we felt that we could not go any further. In consequence nothing further has been done by the Commission in respect of the question obtaining approval, or a mark of approval, for electrical equipment, particularly for household appliances and household wiring and the class of material we had under consideration at the time.

RAILWAY RATES ON COAL.

Mr. Adcock (Port Elizabeth): I should like to ask if an opportunity will be given for discussing the question of railway rates on coal.

The President: Certainly.

Councilor Adcqck: I was advised before leaving Port Elizabeth that you had invited representatives from our Council to join with you in meeting the Minister, who, I understand, told you that it was not possible for him to interview you at that time, that meant that they were not prepared to reduce the rate. I refused to belive that such places as Johannesburg, Pretoria and Durban, favourably situated as they are, would not pull their weight with the rest, in trying to help those places less favourably situated in regard to this matter. I, therefore, hope that the Executive will press this point. I believe that some of them believe that it is flogging a dead horse, but we should never get that belief into our minds regarding Government matters. I look at our present harbour in Port Elizabeth, not forgetting that we agitated for it over forty years ago, and we have got it to-day. You must keep on keeping on.

I bring the matter up now not from a technical point of view, but as one who has passed through the worst phases of depression. I was Chairman of the Unemployed Relief Committee in Port Elizabeth for 2½ years and I noticed how young men had fallen on evil times through no fault of their own and they had to take up pick and shovel work. It broke my heart to see them day after day on that work. So I believe that if, by means of a reduction in railway rates, we can bring down the price of coal it will mean development all round. It will mean that we can get these benefits, and these can be passed on to the industrialists, and they can be forced to pass them on to the consumer. I have this in my mind. I do want the present generation of this country to have more intelligent occupations.

The Government, in the goodness of their heart, have provided a sum of £10,000,000 for this purpose, but what is the good of it on pick and shovel work? Are you going to raise the status of the young individual in this country in that way? I am anxious that we should do all we can on this question, and I leave it to the Executive to put before the Minister and Parliament the business of passing this on. I want to see development extended to such an extent that it will mean increasing the supply of labour and giving men occupation of such an intelligent nature that the country will benefit thereby.

I leave it to the Executive at this stage to do all they can, to do all in their power to try and get a reduction in the price of coal. We pay on the average 5s. 8d. at the pithead, and 20s. 6d. per ton railage. If it were in the interests of the agricultural community something would be done at once. We must let the Government understand that we are not trying to cadge a reduction for the benefit and for the protection of industries so much as for the benefit of the country.

Councillor J. D. Low (Cape Town : Perhaps I may be permitted to say that I do not know whether the application was made through the Council of your Association or not, but I was one of those who went with the delegation to the new General Manager of Railways during the last parliamentary session. We discussed the matter of the reduction of coal rates with him and took a general point of view in advocating reduction, and particularly for those in the south—a general reduction of the coal rate. We especially laid stress on the fact that they had imposed what they called a special temporary surcharge of 10%, and we endeavoured if possible to get a remission of that if nothing else. We were unsuccessful in our application to the General Manager. Then we endéavoured to arrange an interview with Mr. Pirow during the next Parliamentary session.

Unfortunately our interview with the General Manager came towards the close of the session, and Mr Pirow was engaged and could not see us then. He however, on his return to Pretoria was communicated with, and he has informed us that no good purpose would be served by an interview in Pretoria because of the fact that the railway management themselves are opposed to any reduction. That is the position so far as it stands at the moment. I can assure you that we have done our utmost to endeavour to arrange an interview with the Minister. We may see him on his return to Cape Town for the parliamentary session.

Mr. S. V. R. Lewis (Gwelo): In reference to this question of railage on coal, we have discussed the subject at various Conventions. I should like now to suggest that we as an Association should write to the various town clerks to see whether the municipal councils themselves will not bring forward resolutions to the various municipal congresses in Natal, the Cape and the Transvaal. In that way it would come from the municipal congresses as well as from us, and it will carry weight. The councils are as interested as the engineers are.

A Member: The Municipal Congress discussed the matter at George, and they asked for the cooperation of all societies and associations. When the Executive came to the same decision I added that they should circularise members of Parliament. They are ignorant of the position, and if they had some knowledge of the subject it would go a long way to assist them.

Councillor A. Rankin (Johannesburg): This Association and the Municipal Association should make an effort to send a deputation to the Minister of Railways. It is only by pegging away at a thing like this that we can get anything, especially from the Government. I would strongly advocate that we appoint a deputation of the two bodies and ask the Minister of Railways for an interview to discuss the whole matter. The rates on coal should come down. Fortunately, we in Johannesburg do not feel it so much, but the smaller towns that you represent here feel it to a great extent, and I think that is the only solution, Mr. President.

Councillor J. D. Low (Cape Town): In our interview with the General Manager of Railways representations had been made on behalf of the Municipalities. The advantage of seeing the Minister during the parliamentary session is that on all occasions when we put forward representations, members of Parliament representing the various constituencies have accompanied the deputation, and they know the position fairly well and have been of great assistance to us in the past; but so far we have not met with any result.

Mr. E. Val Davies (Johannesburg) : I would like to emphasise that any application for a reduction in the railway rates on coal should be very emphatic and a definite reduction of at least 50% should be asked for. It is no use being satisfied with 10% or a shilling or two per ton. What we want is a reduction that will bring the value of the delivered coal to a figure closer to what it is really worth.

Mr. S. V. R. Lewis (Gwelo) : That is one reason why I suggested we should write to the various town clerks or to the councillors themselves and ask them to bring forward resolutions before the municipal congresses. One of the troubles of the congresses is that the Cape, Free Sate and Natal congresses are held at different times of the year. If the Cape Municipal Congress or the Natal, Transvaal or Free State Congress would carry a resolution at a congress during this year, and there was a combined effort of them all, it would have some effect. I agree with Mr Val Davies that we should not take two bites at the cherry. Let us go the whole hog. Therefore we should write to the various town clerks and ask them to bring forward some resolution to their municipal congresses.

Mr. Adcock (Port Elizabeth): I suggest that we write to the Municipal Association. They have the matter in hand, and they want to know if you will co-operate with them.

The President : Various valuable suggestions have been made. I think these will be very helpful. Councillor Adcock gave a very fine example of the value of pegging away at a thing for over forty years, and I am perfectly certain that this Association is unanimous in its decision to obtain lower coal rates.

Mr. Rodwell (Johannesburg): We have had very valuable suggestions, and I suggest that the best way to deal with the matter is probably to move a resolution. I have not had time to frame a proper and formal resolution, but I suggest that we should resolve :

> That we shall co-operate with all other interested parties with a view to reducing the railage on coal in view of the adverse effect of high rates on industries.

This Associatiion should take a lead and get into touch with these other bodies and arrange, if possible, for a joint meeting with the Minister to discuss the whole matter.

Mr. A. M. Jacobs (Electricity Supply Commission): I throw out the suggestion that a copy of the resolution be sent to the Electricity Supply Commission, for this reason, that we ourselves are fairly large users of coal. I think we buy 800,000 tons per annum. While a great part of the coal is used at our power station at Witbank, we haul the coal received and pay the railway crossing over charges. Nevertheless, at Cape Town we also pay a high price for coal and, of course, we have to rail from the Natal coalfields to Durban at the Congella and Colenso power stations. I think I can promise you all the assistance in this connection which the Commission is capable of giving.

Mr. Rodwell (Johannesburg): I suggest that you leave it to the Council to formulate a resolution correctly along these general lines.

It was agreed to leave the matter in the hands of the Council to draw up a resolution and submit same to the Association on Monday next.

Mr. Lewis (Gwelo): We should confine ourselves to the municipal representatives, and the the various industries can look after themselves. We shall carry far greater weight because we, as representatives of the various towns, represent thousands of ratepayers who will get the benefit of the reduction. We shall not get any profit out of it.

Mr. Rodwell (Johannesburg): I deliberately said "industries" because they represent a very considerable part of the community. I move that we should get their co-operation in that way. I do not think that we should confine ourselves to electrical undertakings.

Mr. Eastman (Cape Town): I associate myself with the proposal. In Cape Town when the matter has cropped up we have had the gas company with us. We also had a tramway company running its own power station, and when representations were made they came with us also.

Councillor A. Rankin (Johannesburg): You should incorporate all bodies using coal. The stronger the deputation to the Minister the better. If you incorporate all the bodies in the Union and in Rhodesia you have a possibility of reaching some finality.

The Convention adjourned until 9.30 o'clock a.m. on Monday, September 17, 1934.

VISIT. A large party of the members of the Convention were guests of the Municipality at the Prince Edward Dam, where tea was served.

CIVIC FUNCTION. The Convention party were the guests of the Municipality at a Dinner-Dansant—held at Meikles Hotel, which was voted an unqualified success.

SUNDAY VISIT. On Sunday the Convention party were the guests of the Municipality at the Mazoe Dam where an enjoyable day was spent.

MONDAY, SEPTEMBER 17, 1934.

The Convention resumed at 9.30 o'clock a.m. in the Beit Hall, Prince Edward School, with the President in the chair.

The President: I will now ask Mr. Jepcott to read his paper.

INTERFERENCE OF ELECTRICAL PLANT WITH WIRELESS RECEPTION

By ERNEST L. JEPHCOTT, Assoc., I.R.E.

INTRODUCTION.

Interference of Electrical Plant with Wireless Reception is a subject which is at present being widely discussed in all countries interested in the development of Broadcasting services. The prevention of interference is now becoming a great difficulty owing to the increasing sensitivity of Wireless receivers, and also through making use of the supply mains as a source of power. Extensions in overhead transmission lines and the growing popular use of additional types of electrical apparatus have introduced new sources of high frequency interference.

Interference of a high frequency nature is brought about by a sudden variation or interruption of current which produces a change of potential at one point in a circuit with respect to another point or with respect to earth. The high frequency interference may either be directly radiated from its source or may reach the receivers via the supply mains.

TYPES OF INTERFERENCE.

There are two main types of interference which for convenience may be defined as follows :—

(a) "Direct Radiated Interference" which is picked up by the aerial by direct radiation from the source.

(b) "Mains Radiated Interference" which is mains-carried, re-radiated from the house wiring and picked up by the aerial earth system of the receiver.

Interference entering the house will be conveyed throughout the interior wiring system, which will, in effect, become a transmitting aerial radiating the high frequency disturbances into space. The aerial and earth of the receiver will pick up and amplify these disturbances, producing annoying sounds in the loud speaker. Such interference has a much greater range than the directly radiated type. In some instances with all-electric sets, the interference enters the receiver via its mains leads, but in the vast majority of cases it enters via the aerial.

SOURCES OF INTERFERENCE.

The almost infinite variety of industrial applications of electricity offers unlimited possible sources of radio interference.

All electrical equipment may be looked upon as a possible source of interference. The slightest electrical spark may be an offender whose effects ruin reception at the time of discharge for a large number of listeners. The following list indicates some of the main offenders of wireless interference :

Overhead Transmission Lines, Fans, Hair dryers, Sewing machines Vacuum Cleaners, Hair Clippers, Washing Machines, Coffee Grinders, Dictaphones, Dental Drills, Calculating Machines, Telephone Plant, Refrigerators, Motors, Generators, Lift Control Equipment, Trams, Trolley Buses, Electric Railways, Rotary Rectifiers, Thermostatic Signs, Traffic Signals, Electric Bells, Neon Signs, Coil and Magneto Ignition systems of motor cars and aircraft, X-Ray, Diathermy and Violet Ray.

All such equipment may cause interference by direct radiation or mains radiation.

NOISE LEVEL.

Any attempt to increase the sensitivity of receiving sets to a point below the general radio noise level will provide unsatisfactory reception. Since every electric spark, irrespective of its source, radiates a certain amount of electrical interference, it is obvious that in modern industrial electrically equipped communities, there will always be a tendency towards increase of a general radio noise level. Interference from electrical equipment is inevitable, and must be regarded as a limitation to wireless reception. It is extremely difficult, and in some cases almost impossible to locate and eliminate the interference, unless it is comparatively large in volume and of a long duration.

METHODS OF SUPPRESSING INTERFERENCE.

If interference on all receivers situated within the range of the offending plant is to be eliminated, it must be suppressed at its source.

To suppress interference at its source resistances, choke coils and condensers are commonly used either separately or in combination. This depends on the magnitude and type of interference which is to be overcome.

In Rhodesia, up to the present, most listeners have been compelled to obtain their wireless entertainment from overseas stations operating on the shortwave broadcast band. All available literature deals only with methods of suppression of interference on medium wave bands. Experiments have therefore been conducted with a view to obtaining efficient and cheap types of suppressors suitable for both the medium of shortwave and broadcast bands.

The greater amount of interference is caused by overhead transmission lines and domestic and small commercial plant.

OVERHEAD TRANSMISSION LINES.

Power company equipment may cause wireless interference from slight defects that will not in any way effect the normal operation of the power system. Overhead transmission lines cause interference owing to bad joints and poor tee connections on the conductors, bad joints on aluminium wire, copper to aluminium joints, loose pole fuses, conductors in contact with tree branches, dirty insulators and contacts loose enough to cause slight arcing but not bad enough to disconnect the circuit.

To overcome such interference, a much higher maintenance standard is indicated than is necessary for normal operations particularly in regard to contact with tree branches and joints and tie wires on conductors. The importance of keeping overhead transmission lines free from faults of this nature is emphasised by the fact that wireless interference transfers itself from one power circuit to a paralleling circuit by induction and thus spreads itself over a large area.

Careful maintenance is an essential remedy for interference caused through street lighting circuits. It is possible for an isolated piece of metal in an electric field to discharge itself to earth and give rise to interference, consequently, all isolated metal parts ought to be carefully bonded to earth. Only in exceptional cases do high voltage transmission circuits cause continuous interference, as a slight earth on the system will usually operate the trips and throw it out of service before it has time to be noticed as a wireless disturber. Interference can, however, be caused by pin type insulators being operated at voltages very close to their rated voltage thereby causing a visible and audible glow discharge or corona on the outer shell around the binding wire and in the spindle hole. The use of insulators with a higher voltage rating will overcome this difficulty. Steel tower lines where the conductors are strung on suspension-insulators are not a usual source of interference. Figure (1) illustrates a type of suppressor for fitting on a pole and connecting to the overhead lines to prevent interfering currents from passing along the overhead conductors.

Condensers of 0.1 microfarad are connected through fuses between each phase line and the neutral. The neutral is connected through another 0.1 mf. condenser to a specially installed earth connection near the pole. The earth lead must be a steel armoured lead covered cable and the condensers with fuses should be placed in a waterproof protection box.

DOMESTIC AND SMALL COMMERCIAL PLANT.

The suppressor described below has been designed to eliminate interference arising from A-C. —operated domestic and small commercial plant— with wireless reception on the short and medium wave bands. It consists of three condensers connected as shown in Figure (2).

Provided the installation of the suppressor is carried out in the correct manner, efficient elimination of interference is obtained on both wave bands. The 0.006 mf. and 0.003 mf. condensers must be enclosed in and connected to, the machine case. The 0.1 mf. condenser may be connected across the mains to any convenient position between the plug point and the machine. Portable equipment is usually connected to the supply by means of a flexible cord fitted with a 2 pin plug or adaptor. It is possible to ensure that this plug or adaptor will always be inserted the same way round, but reversing the polarity of the mains does not affect the efficiency of the device.

It would appear that the frame of the machine enters largely into the question of radiation. For suppression on medium waves it is found necessary to connect either lead of the mains through a .006

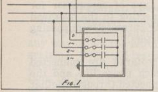


Fig. 1

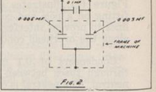


Fig. 2

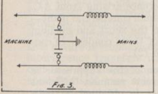


Fig. 3.

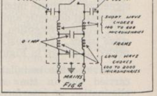


Fig 4.

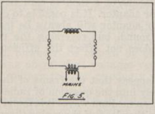


Fig. 5.

mf. condenser to the frame of the machine. The value of this condenser was limited to .006 mf. to safeguard against risk of shock. The connection of one lead only at the mains to the frame of the machine, proved insufficient to suppress the short wave interference. Here a trial indicated that by connecting condensers of .003 mf. from one lead and .006 mf. from the other to the frame of the machine, suppression of interference on both wave bands was effected. Owing to the necessity for installing the 0.006 mf. and 0.003 mf. condensers inside the frame of the machine, it will be appreciated that they must be small in size. Certain tubular type condensers, 1,000 volt A.C. test, were found to meet these requirements. A 0.1 mf. 5,000 volt test, condenser may be used across the mains the capacity value of condensers connected between the mains and the frame of the machine must be small, due to possible risk of shock to the user of portable domestic apparatus.

INDUSTRIAL MOTORS AND GENERATORS.

Sparking at motors and generators is always a possible cause of interference. D.C. motors as well as A.C. motors with commutators are particularly liable to cause disturbances. The most obvious remedy is to clean the commutator and see that is is kept in good condition.

Figure 3 illutrates a type of suppressor to be used if the simple remedy of cleaning the commutator proves ineffective.

The values are governed by the current rating of the machine. The chokes usually used are of approximately 600 microhenry inductance and are obtainable commercially. The condensers are of either 2 or 4 microfarad capacity.

Due to the fact that lifts are usually operated in close proximity to the affected receiver, greater precautions are necessary to overcome disturbances which are caused by the motors and controller. In the case of single phase repulsion induction motors it has been found that 4 mf. condensers are generally necessary, 1 mf. condensers may, in addition, be connected across the principal contacts of the controller.

MECHANICAL INTERRUPTERS.

Current-interrupting devices or mechanical rectifying devices are usually sources of interference. Perhaps the largest mechanical rectifying device in industrial use is the electrical precipitator used to prevent valuable material leaving the chimney. The high D.C. voltage used in the operation of the precipitator may be obtained from mechanical rectification. Where the precipitator is only a short distance from the rectifier there is usually little trouble but, if the leads are run overhead for any distance, they operate in the same way as an aerial radiating high frequency current. The mechanical rectifier may be enclosed in an earthed metallic screened building and shielded leads used between the rectifier and chimney. Choke coils and resistances inserted at various points in the line will help to cut down the disturbance.

The smaller vibrating or mechanical rectifiers, such as those used for battery charging, are also a source of interference, particularly in densely populated areas. Here a similar filter to that shown in Fig. 3 may be used.

For the suppression of interference on flashing signs, thermostatically-controlled plant and electric bells, a simple condenser suppressor consisting of a 2 mf. or 4 mf. condenser connected as near as possible to, and on the main side of, the contact may be used.

The following Fig. 4 shows a type of suppressor for the elimination of interference on both the medium and short wave bands.

The value of Chokes, depicted in Fig. 4 depend on the current consumed.

NEON SIGNS.

To cure the interference a 50 henry iron core choke is inserted in the tube circuit, between separate lengths of the tube near the centre of the sign. The choke should be preferably sectionally wound and have a very high insulation to earth.

MOTOR CAR IGNITION.

To suppress interference from Motor Car Ignition, resistances of approximately 60,000 ohms. can be fitted in series with each sparking plug and in the lead from the coil to to the distributor.

A .5 mf. condenser may be connected across either the coil or the magneto contacts according to the type of ignition in use.

HIGH-FREQUENENCY MEDICAL APPARATUS.

Apparatus of this type covers a large variety of equipment. X-ray diathermy and violet-ray apparatus are serious offenders. In cases of large installations suppressors are not as a rule practical due to the fact that much of the disturbance is radiated directly rather than back over the supply mains, therefore complete shielding may be necessary. To accomplish this the room in which the apparatus is installed should be completely enclosed with small-mesh copper screening which should cover all doors and windows. The screen over the door should have lapped edges in order to prevent leakage, and should be soldered at all seams. The screening must be connected to a good earth. Two large condensers should be joined across all electrical circuits entering the screened area and their common point attached to the screen.

RECEIVING AERIALS.

In certain cases of direct radiated interference a screened aerial lead-in may be usful. This type of lead-in however is effective only if the unshielded portion of the aerial is outside the field of interference.

For reception on the shortwave band a tuned horizontal halfwave aerial may be used, leading in by means of a parrallel wire feeder, which must be correctly terminated in order to eliminate stationery waves on the feeder. For reception on the medium waves some form of shielded lead-in may prove effective. The usual form is a braided metallic outer covering through which is run a single conductor held central by insulating spiders. The braiding forms one lead and being earthed eliminates pick-up by the lead in.

CONCLUSION.

One solution of the problem, and one which has already been recognised by many European countries, is the introduction of interference suppression requirements in specifications for new equipment.

In Germany to-day manufacturers of high frequency medical apparatus are compelled to make their equipment in such a form that it will not cause interference. The law in Belgium and Roumania requires owners or users of offending apparatus to remedy the interference by fitting suitable suppressors. No legislation exists in England, but the Institution of Electrical Engineers is at present studying the problem and acquainting the electrical industry with the details of interference. In South Africa there is no law compelling owners or suppliers of electrical plant to supply or use interference freed equipment.

The development of broadcasting has not been without its beneficial reactions upon the Electrical Industry not only in the direction of equipment supply but also in current supply. The fact must not be lost sight of that, with the expansion of wireless entertainment, free from extraneous noises, the popularity of the home will be more evident and as a consequence the demands upon the supply of electrical power will increase.

If the manufacturers built interference freed equipment supply undertakings would benefit as consumers would find no difficulty in obtaining interference freed plant. As the supply undertaker relies on the general and free use of current consuming equipment, and the development of the domestic load, he is just as much concerned with the problem of interference as the manufacturer, supplier or user of electrical plant.

In Rhodesia to-day the interference from Electrical plant is small, but as the towns grow the interference is likely to increase. Broadcast listeners and suppliers of wireless sets are already pressing for protection.

Manufacturers, Broadcast listeners Municipalities, designers and users of electrical equipment are beginning to recognise their common problem in keeping the ether as free from disturbances as possible. The problem of wireless interference is so interwoven with all the activities of the community, that only continued co-operation of all concerned can solve it.

One, and possibly the most effective, way of attacking the problem would be for Electric Supply Authorities and consumers to insist on Manufacturers supplying, and consumers using, interference freed equipment.

Mr. Jephcott then gave a practical demonstration of the interference of certain types of apparatus. He mentioned that each type of apparatus was in duplicate. One was normal, and the other was fitted with a suitable interference suppressor. He added that the suppressors fitted were not of the highest efficiency, but should meet practical requirements.

Several questions relating to the apparatus erected for demonstration purposes were asked, Mr. Jephcott replying and giving practical demonstrations of his replies.

DISCUSSION.

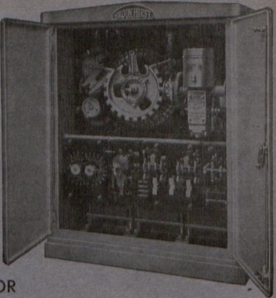
The President: I should like to express this Association's appreciation and gratitude to Mr.

Jephcott for his paper and his interesting demonstrations. (Applause.) I am of the opinion that it would be almost impossible to legislate to eliminate all intereference. The mutual co-operation of all types of electrical engineers is the key to the problem. As long as there is co-operation, and if we appreciate one another's difficulties, there should be some solution to the difficulty. Mr. Jephcott has very ably stated the benefits our undertakings receive from the operation of wireless sets. The importance of the indirect benefits, apart from the small current consumption, must not be lost sight of. I should again like to express our appreciation and thanks to Mr. Jephcott, and also to the Post-master General and to the Chief Engineer, who have made this interesting demonstration possible. The paper is now open for discussion.

Mr. Horrell (Pretoria): I should also like to thank and congratulate Mr. Jephcott on his excellent paper. At the Convention at Port Elizabeth I indicated what steps my Council had taken to assist in eliminating consumers' complaints in regard to radio interference. Since then, however, we have come to the conclusion that, as the majority of the sources of interference traced were due to consumers' appliances and only in isolated cases due to defects on the Council's system, further expense in investigating complaints of radio interference could not be justified, and a circular letter was, therefore, addressed to all local dealers in radio apparatus on those lines.

Prior to declining to undertake further investigations, the man delegated to the work was almost fully occupied in tracing the sources of radio interference.

The author's remarks in regard to the need of manufacturers supplying interference free electrical appliances and the possibilities of introducing legislation for this purpose, are particularly interesting. The importance of the subject is exemplified by the interest exhibited by various overseas organisations. For example, the International


BROOKHIRST

Electro-technical Commission organised an international conference in Paris in June last to study and report on radio interference due to the operation of electrical appliances.

The national and social importance of broadcasting, and the urgent necessity of protecting the listener from interference was fully recognised by all the delegates. The conference sought mainly to determine an international means of measuring interference, and to this end appointed a special committee which will conduct experiments in Berlin towards the end of October and report to the conference at a meeting to be held in November. It is anticipated that the decisions reached will go far towards alleviating the unfortunate position in which some listeners at present find themselves.

As the author has indicated, several European countries have adopted legislation aiming at the elimination of disturbances to radio reception, but I understand that most countries, including South Africa, are awaiting the deliberations of the above conference. It may be of interest to outline briefly the procedure adopted by the Union postal authorities and the African Broadcasting Company. On receiving a complaint of radio interference, one of the Post Office engineers investigates. When the source has been traced remedial measures are applied by the Engineering Department, and having been tried out and proved successful, the owner of the plant responsible for the trouble is requested to install similar apparatus as a permanent measure at his own expense. In the absence of legislation, it will be appreciated that owners of offending plant cannot be compelled to fit suppressors, but I understand that the owners rarely desire to be regarded as nuisances, and, therefore, comply with the request.

Legislation would appear to be desirable, but unless machinery were created to enforce it, it would hardly be effective and I am given to understand that this is one of the main reasons why such has not yet been proposed by the Union authorities. I believe that the Boroughs of Greytown and Dundee have incorporated in their by-laws clauses aiming at the suppression of radio interference, and we may possibly hear from the representatives present how these operate.

Mr. H. A. Tinson (Johannesburg): It may be of interest to know that certain instruments are being manufactured for the company I am with. They are being equipped with suppressors. I do not know whether anyone in Rhodesia is interested or not.

Mr. Harris: Continental firms are to-day sending out domestic plants including a suppressor inside the frame.

Mr. J. L. Hill (E.C.B.) : Is your suppressor made for short wave and broadcast?

A Member: For both, and they are proof against all radio interference. I believe that is also the case with the American Companies.

REPLY.

Mr. Jephcott : The Chairman has raised an interesting point regarding figure 1 on the diagram sheet. The suppressor in fig. 1 is connected to the mains near a factory where a large number of machines are running and so suppress the interference before it travels a long distance along the mains. If one of these suppressors was fitted near a factory it probably would not be necessary to fit a suppressor to each machine in that factory. If the suppressor was not fitted there would be a great disturbance on the mains, and consequently radio licensees would have to fit a similar suppressor to their house system. If that suppressor was fitted to a house system I doubt very much whether it would completely eliminate the disturbance. The suppressor does not totally eliminate interference coming from a factory; it partly eliminates it.

Mr. Horrell has given us an interesting description of an investigation of interference arising from the operation of ringing machines in a telephone exchange. Mr. Horrell did not state which of the machines was running during the test. If the maindriven machine, which was continually sparking at the brushes, was run during the test, then it is impossible for the intereference to have been carried by the supply mains. The normal operation of ringing machines employed in telephone exchanges will cause interference and, usually, the network of overhead telephone wiring tends to carry this interference. The ordinary type of suppressor will cure interference from ringing machines. Where the telephone wires, however, run underground for several hundred yards from the exchange, the interference is usually much less than where the wiring leaves the exchange overhead. In almost all modern telephone systems it is the practice to run the telephone wires in underground lead-covered cables.

Under some conditions the operation of the dial in automatic telephone systems may cause wireless intereference, particularly on the shorter wave lengths.

I have just received a letter from Mr. Lategan, engineer in charge of the Municipal power station at Boshof. He states that he is experiencing a considerable amount of interference from his power station plant, which consists of a 40 h.p. direct driven alternator and a 20 h.p. belt driven alternator. He states that the interference is being caused by the alternator itself and also by the slip of the belt on the pulley. In the case of the alternator the interference has been partially eliminated by by-passing the high frequency currents with three .2 microfarad condensers connected between each phase and the frame of the switchboard, and in the case of the belt by connecting a piece of copper wire to the frame of the alternator and bending it so as to have about 12 inches pick up along the length of the belt.

Better results might be obtained if the condensers were connected right on the alternator terminal instead of on the switchboard. The interference caused by the belt might be improved by connecting small chains to the alternator case and allowing the ends of the chains to touch the belt at various points. (Applause.)

The President: I have received a wire from Mr. Poole to the effect that he will be pleased to accept the secretaryship. (Applause.)

The Convention then adjourned to Meikle's Hotel.

The President: I will now call on Mr. Reliham to read his paper.

RURAL DISTRIBUTION

By Mr. H. J. RELIHAN.
MUNICIPAL ELECTRICAL ENGINEER OF PAARL.

The object of submitting this paper is to present in a condensed form the advantages and disadvantages of a power supply to farms in general, and recent developments in rural distribution, and the electrification of farms in the Paarl Area.

Rural Distribution, when referred to in this report, shall mean a distribution of Electrical Energy to a farming community, outside any town or village, and not under the jurisdiction of a Municipality.

In country towns, of which Paarl could be taken as an example, there are people who, although living in rural areas, are naturally desirous of having the facilities afforded by the full electric service such as experienced in the town; and coupled with this is the fact that the very wide publicity given to the residential section of the town always results in a very marked demand for the same service by a farming community.

The problem of affording a supply to these rural communities in an entirely different one from town distribution, for this reason that the consumption of current for lighting is very much lower per consumer, due to earlier hours of retiring. The cost of distribution is higher, due to the fact farms are normally built miles apart, and consequently the number of service connections per mile of line are few, together with a marked reluctance to take full advantage of the electric labour saving appliances on the market to-day when such a supply is available.

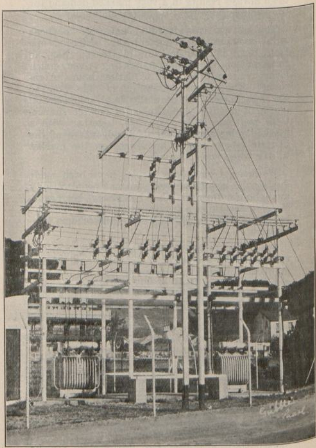
However, tremendous strides have been made during the last three years in making electricity available for farmers. Care has always been exercised in designing a transmission line so that the initial scheme should not make the scheme prohibitive.

This has involved primary transmission at voltages of 3,300 volts to 11,500 volts for short and long transmission lines respectively, and low tension distribution lines of 400/230 volts, 3-phase, 4-wire. Wayleaves for the transmission line crossing private properties have been granted in all undertakings up to now by the farmers, without any expense to the Council.

Construction of Transmission and Distribution Lines :

It is only recently that an electric supply in the rural areas has been developed, and comparatively speaking it is only in a state of infancy and subject to a great deal of improvement. Ever since its origination, we realised that the type of line required called for simple types of switch-gear, of robust construction and small cost.

The general trend taken by design can be followed by a brief consideration of the manner in which the distribution of electrical power on the



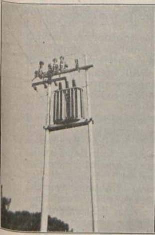
Step down Sub-Stations for Rural Distribution.

farms in the Groot Drakenstein and Simondium Areas of the Paarl District has developed. To cope with all future possible demands in this area votages of 11 kv, 3-phase, 50-cycles for transmission lines, and 400/230 volts, 3-phase, 4-wire, for low tension distribution lines were decided on.

From a general survey of the map appended hereto, it is at once apparent that the scheme under review cannot be considered as a standard of comparison, nor as a model for rural distribution, but rather as an exceptional case from the supplier's point of view.

Farms are not everywhere so close together as they are in this case.

The switch-gear employed for rural systems of this type is consequently simple in construction for controling tapping points of small capacity at about 11,500 volts. Switching operations also have to be very simple and should rarely involve more than line sectionalising—the switching of tee-off



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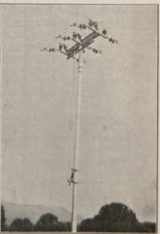
Outdoor Equipment.



1

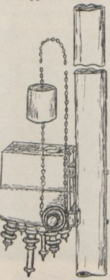
Outdoor Air Break Switch.

and spur line feeders. This type of gear can be classified under two types : (a) Outdoor pole mounting equipment, and (b) enclosed equipment.

The outdoor pole mounting equipment is the type mostly employed, both as far as simplicity goes and low maintenance costs.

The outdoor pole mounting equipment is generally used to control circuits of small capacity and simple switching characteristics. Kiosk equipment is used to control circuits of larger capacity, more complicated switching characteristics where circuits may require a co-ordinated system of protection or automatic reclosing devices which call for oil circuit breakers.

A typical outdoor equipment is shewn in Figure "A" Appendix IV) which shews a tee-off connection taken through a horn break switch and fuses to a 3-phase distribution pole mounting transformer.



Reclosing Oil Circuit Breaker.

For transformer stations controlling a group of farms, automatic reclosing oil circuit breakers are used of the type shewn in Figure "C" (Appendix 1V).

The special feature of this automatic reclosing oil circuit breaker is that it will re-set four times at definite intervals by means of a weight. This unit has several advantages over the air-break switch and fuse gear, since it has a definite rupturing capacity which, unlike outdoor fuses is unaffected by atmospheric conditions.

The automatic reclosing feature permits the resumption of supply to be made quickly following a shut-down and the need for fuse-renewals is also eliminated, whereas, if it was not for this feature, it would necessitate sending a linesman to re-set the circuit breaker miles away.

Transmission lines for serving a farming community demands a fair amount of the engineer's time. He has to survey and design the line, not only for the immediate requirements, but for all future demands.

Application for wayleaves, furnishing of plans and specifications, and the drafting of estimates for the costs of the line, and finally to submit this to the party concerned before any construction is actually done.

Application forms are supplied to the various farms interested so as to get an idea of the load and their present demand, and the types of transformer station for which the transmission line is to be designed. When all these preliminaries have been gone into, one of two schemes is adopted.

Financing High Tension : Scheme "A"

If the load catered for is far out of the way, and is entirely for lighting purposes, this scheme is recommended. In this scheme the farmers applying for a supply of electricity to their farms have to meet the entire cost of the undertaking.

The cost of the transmission line is pooled or paid jointly by the different farm owners, and all low tension distribution or private lines to the various farms are financed by the farmer; the price varying according to the amount of power required on the farm.

Scheme "B"

Should, however, the load as applied for warrant the expense to be incurred for running a transmission line out to this new distributing centre, the Council in this case bears the entire expense in connection with the High Tension Lines, transformer stations, transformer switch-gear, labour, etc., and the farmer the expense of the distribution line, and wiring the buildings.

So in 1929 the first 11 kv, 3 phase transmission line was constructed from Paarl to Simondium—a distance of three and three-quarter miles—at a cost of £1,050, and from Simondium to Groot Drakenstein—a distance of two and a quarter miles—for £760.

Ten farms were connected at Simondium from two transformer stations. A 27-H.P. load for one farm being supplied from a 20-kva POLE transformer station, and the remaining nine consumers were all grouped and served from a kiosk in which two 20-kva transformers, connected in parallel, were installed, supplying power for three motors of 25-HP, 20-HP, and 4-HP respectively.

At Groot Drakenstein a consumer of 40 kva was connected and supplied in bulk at £8 3s. 0d. per kva demand per annum plus half-penny per unit for all units consumed.

The highest maximum demand during the four months of the season is 100 kva.

Transmission lines have also been run out to Klein Drakenstein Valley—a distance of 2½ miles—supplying eight farms all within half-a-mile from the transmission lines, and another transmission line to Suid Agter Paarl—a distance of 2½ miles—to supply seven farms.

A total of 17 miles of High Tension transmission lines serving farmers outside the Municipal Boundary have so far been erected.

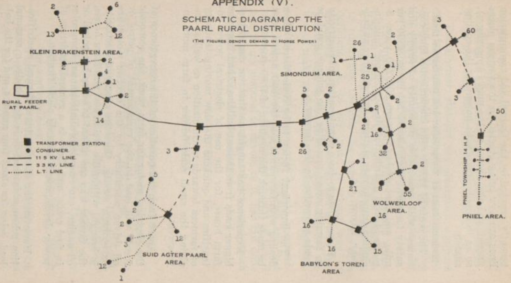
General statistics will be found in Appendix (i).

Applications from Pniel, Wolwekloof and Babylon's Toren Areas totalling 270 Horse Power were

APPENDIX (V).

SCHEMATIC DIAGRAM OF THE PAARL RURAL DISTRIBUTION.

(THE FIGURES DENOTE DEMAND IN HORSE POWER)



recently granted by the Council and transmission lines are now being erected to the various places named, and also shown on the map (Appendix v), so as to supply them with power for the coming season.

Minimum Costs of Transmission and Distribution Lines.

The costs of 11,000 volts transmission lines consistent with reasonable continuity of supply and safety for rural work should not exceed £350 per mile, and that of low tension 400/230 volts, 3-phase, 4-wire distribution lines £250 per mile including transformer stations, transformer switchgear, labour, etc.

There exists to-day a remuneration for electricity in farming areas providing the scheme could be made attractive to the farmer.

The important factor to be remembered when dealing with farmers is that the main appeal must be made through the medium of their pockets.

Experience has taught us that we can expect bigger loads from the out-buildings than from the farm house, for the use of electrical power intensifies and quickens the slow moving tendency of farmers towards mechanization as well as enabling the small scale farmer to farm more intensively.

Apart from the question of the convenience of the electrical motor for farm work, the economic forces will lead to the replacement of petrol or oil driven machinery by the electric motor are exceedingly strong. Once the supply of electricity is brought within the vicinity of the farm house, the farmer who can afford to scrap his petrol or oil engine, can reap immediate annual economics in fuel costs and there is a general tendency of power development towards electrification.

However, the disadvantage of rural electrification schemes is that it is principallv a seasonal load, being for about four months, and for the balance of the year, during the off-season, only lighting in several cases may be required for the farm, totalling 1 kva over a 10 kva transformer, resulting in transmission and transformer losses, and a poor load factor during this period.

Transformer stations are generally equipped with transformers to cope with the maximum demand on them for the peak season which is during the summer months, when power is required for pumping water, pressing grapes, etc.

The question of financing High Tension transmission lines out of the rate payers' pocket for a farming community, who could not be called upon to contribute towards the scheme in case of a deficiency, is to my mind a wrong way of financing such an undertaking, and a very impractical one, as the power requirements are too low to make such schemes economically possible.

I feel that much more could be said in connection with a rural electrification scheme and that my report, owing to the limited amount of time I had at my disposal to devote to it, has not done sufficient justice to such a subject, upon which a great deal can still be enlarged.

APPENDICES.

(i). Tariff of charges for energy for farms.

(ii). General Statistics—Paarl Rural Areas.

(iii). Synopsis of Cost of H.T. Lines.

(iv). Equipment used for Rural Distribution, shewing standard Step-down Sub-station for Rural Distribution. (Top figure).
Figure "A" Typical pole Transformer station.
Figure "B" Standard Air-break switch for sectionalising.
Figure "C" Automatic reclosing type Oil Circuit breaker used on transmission lines for rural areas.

(v). Schematic Diagram of the Paarl Rural Distribution Areas.

APPENDIX (i).

Tariff of charges to farms.

LIGHTING : 7d. per unit, minimum per month 5/-.

DOMESTIC POWER : $\frac{7}{8}$d. per unit, maximum 5/-.

INDUSTRIAL POWER : $1\frac{1}{2}$d. per unit for the first 1,000 units. All above at 1d. per unit.
Minimum per month is 2/6d. per connected H.P.

SERVICE CHARGE : A fixed charge of 5/- per month per farm for the maintenance of the H.T. Line.

APPENDIX (ii).

General Statistics—Paarl Rural areas.

	Klein Drakenstein.	*Suid Agter Paarl.*	*Simondium and Groot Drakenstein*
Line completed	1929.	1929.	1929.
Length of H.T. Line	$2\frac{1}{2}$ miles	$2\frac{1}{2}$ miles	$3\frac{3}{4}$ miles
Cost of Line	£780	£780	£1,050
No. of consumers ...	8	7	10
Demand	20 H.P.	13 H.P.	53 H.P.
Rev. first 12 months	£117	£84	£228
1934			
Length of H.T. Line	$2\frac{1}{2}$ miles	$2\frac{1}{2}$ miles	6 miles
No. of consumers ...	10	8	13
Demand	47 H.P.	31 H.P.	143 H.P.
Rev. 12 months ended May, 1934	£130	£85	£910
Cost of maintenance	£5	£5	£15

Total Number of units sold, 1929—
May 1934 .... 342,157.
Total Revenue, 1929—May, 1934 .... £3,574.

APPENDIX (iii).

Synopsis of Cost of H.T. and L.T. Lines.

High Tension Transmission Lines (11 kv) including switchgear etc., at approximately **£320 per mile**, based on the following prices

POLES : Height 27 feet; weight 258 lbs, £2 12 6 each.
Height 30 feet; weight 345 lbs (Over telephone Lines) .... £3 12 6 each.
CROSS-ARMS : Length 34 inches; 4-pin; single channel, ... 5/– each.
PIN INSULATORS : 13.5 kv (Line voltage) Dry Arc-over voltage 60 kv; Wet Arc-over voltage 40 kv; Leakage distance 8½ inches 2/9 each.
STRAIN INSULATORS : Disc type (two per set) Dry Arc-over voltage 60 kv; Wet Arc-over voltage 40 kv .... 18/6 each.
COPPER CONDUCTOR : Three-strand; .035 sq. inch .... 6d. per lb.
CRADLING : No. 8 s.w.g. Galv. Wire (112 lbs. coil .... 13/4 per coil.
POLE TRANSFORMERS : 10-20 kva 3 phase: Average price per kva .... £2 10 0 each.
EXPULSION FUSES : 11 kv 60-amp for pole mounting .... £2 10 0 each.
AIR BREAK SWITCHES : Triple Pole, for sectionalising .... £13 0 0 each.
LABOUR : £20 per mile.

Low Tension Distribution Lines, 380/220.

POLES : Height 25 feet £1 5 0 each.
CROSS-ARMS : Single channel 3/– each.
PIN INSULATORS : 1/4 each.
SHACKLE INSULATORS : 1/9 each.
COPPER CONDUCTOR : No. 8 or 6 s.w.g. 7d. lb.
LABOUR : £6 per mile.

TOTAL COST PER MILE : £250.

DISCUSSION.

The President : I wish to thank Mr. Relihan for his paper. In doing so there are certain items of interest which might be mentioned. One is the labour cost per mile of low tension transmission. We here thought we knew something about low costs for rural distribution, but cannot get down to the labour cost of £6 per mile on low tension distributiion. Under the new specification it is possible to purchase .025 sq. in. 11 K.V. cable at under £400 per mile. Where the laying costs are cheap, the estimates of an underground cable, or an overhead line, must be seriously considered.

Mr. Rodwell (Johannesburg) : The author must be congratulated on his achievements in the Paarl district. In 1931 a paper on "The Design of a Rural Distribution System" was given before the British Institution of Electrical Engineers. When comparing the cost of transmission and distribution lines in the I.E.E. paper with those supplied by the author, it appears that the costs in the Paarl area compare very favourably with those in Britain, and in some cases are cheaper, which is difficult to understand. Many pointers worthy of close investigation have been submitted.

Power production has reached a high standard of efficiency and is cheap at the generating station. Its cost is increased enormously with the necessary distribution to consumers and greater knowledge of efficient and cheap distribution is desirable.

A point is made in the paper of the low load factor of the rural area due to there being little or no demand for power during eight months of the year. The transformer iron losses are, therefore, of particular importance. It is essential to keep iron losses low, without sacrificing reliability and good regulation. It would be interesting to know if Mr. Relihan has covered this in his transformer specification.

The difficulties of furnishing supply to rural areas at a suitable tariff to the consumer and reasonable revenue to the supplier are well known. The high cost of running supply lines in sparsely populated areas with low demands, and of tapping high tension lines where these exist, often makes the proposition entirely unpayable. I am of the opinion that the costs given for reticulation are extremely low, and I would advise young engineers who may be called upon to prepare schemes not to take these costs as a standard. Whilst apparently applicable to the Paarl district they may not apply to other areas. The locality and conditions must be considered and all items must be included in the costs. Obviously, it is essential that the reticulation costs for rural supply must be kept to the lowest limit consistent with safe operation and reliability, and from the paper it appears that these desirable requirements have been attained in Paarl with credit to those responsible for the scheme.

The details furnished in the paper should be of great assistance to those contemplating supplies to rural areas.

Mr. J. H. Gyles (Durban): I have perused this paper with considerable interest, more especially as I find the Durban construction costs for lines of a similar pressure and capacity would cost nearly double, one of the contributing factors being wages. I should be grateful if the author would supply additional information of his labour costs of £20 and £6 per mile respectively.

While a municipal undertaking should, I suggest, consider it a duty to extend its lines for the supply of electrical energy to its areas where a reasonable chance exists that in the near future there is every possibility of all the overhead charges being met when even at the inception of an extension it is estimated that a loss will be incurred. I doubt the wisdom of extension outside its own area where this possibility does not exist. In appendix (ii) extensions are quoted, each of which has been in operation for five years, but it is not quite clear if the cost of the lines includes the transformers, etc., and I am unaware as to the overhead charges at Paarl, but suppose they are in the vicinity of from 8 to 10%, and the total costs are as stated. Then the Drakenstein extension is just about paying. The next is certainly not paying, and the third is making a handsome profit. It would appear from the diagram as if the Groot Drakenstein area was originally the objective, and the other two areas were subsidiary, and by taking the capital costs of the whole system as reflected in the paper, a very profitable scheme has resulted on which the Council and their Engineer are to be congratulated

Mr. H. A. Eastman (Cape Town): I am interested to see from Mr. Relihan's paper that the Paarl Municipality will extend its transmission line without guarantees of revenue. This is contrary to the practice in vogue in Cape Town under similar circumstances where a guarantee of revenue from the sale of electricity to consumers is required for five years, amounting to 20% of the capital cost involved. For that guarantee the high-tension transmission lines are installed along roads and farms as well as all low-tension conductors up to the consumer's premises.

In a recent installation of this kind in the Constantia Valley serving 44 typical rural consumers a revenue during 1933 of £1,200 was received for an initial capital cost of £950. The units sold to those consumers during that period amounted to approximately 160,000, or approximately 3,600 units per annum, all of which consumers used the supply for similar purposes to those described by Mr. Relihan in the Paarl area.

It would be interesting to know what the average consumption per consumer in the Paarl rural district referred to in his paper amounts to. Experience in Capetown is that the minimum revenue condition is no handicap in development work of this kind, and in point of fact considerable extensions are now in progress in the same district under exactly similar conditions.

Mr. L. L. Horrell (Pretoria): I would like to add my thanks to Mr. Relihan for the interesting description he has given us of the method adopted in furnishing a supply of electric energy to the rural areas in the vicinity of Paarl.

The type of construction adopted, of course, depends on several factors, and in considering the cost and payability of the scheme, a broad view must be taken. In many cases, and perhaps one might say in all cases, it is very improbable that the scheme will pay its way within the first five years, but in the end the majority of such schemes are payable and may, in fact, prove most profitable.

Pretoria has provided several small rural distribution schemes around its borders, and these I will deal with later. While in England, I was fortunate enough to spend several week-ends in the country, and was thus afforded the opportunity of examining a few of the rural electrification schemes there. One of the most striking features of these schemes was the fact that, in most cases, the primary side of the transformer was coupled solidly to the line without any intervening expulsion fuses or links. The authorities concerned maintained that the modern transformer was so reliable that it could be considered to be part and parcel of the H.T. Transmission line.

In the type of construction adopted in most cases the conductors were arranged in a vertical plane, and were supported by pin type insulators mounted on swan neck brackets screwed into wooden poles.

Returning to the author's paper, the type of construction adopted both in regard to H.T. and L.T. lines is very similar to that adopted for rural electrification around Pretoria. Our costs per mile do not, however, compare favourably with those given by the author, and it would appear that several items for which we make provision are not included in the author's scheme. For the purpose of comparison I have shown in annexures 1, 2 and 3 the detailed cost per mile of erecting 11 kV., 3,300 V. and 433/250 V. lines respectively.

Referring to the items listed in Appendix iii of the author's paper, no provision appears to have been made for line or wind stays, lightning arrestors, earth wires, or telephone nets, and as will be seen on reference to annexures 1, 2 and 3, those items cost a considerable sum.

From the costs given by the author it would appear that only steel poles are used on the H.T. lines. We find that poles treated by the Forestry Department give excellent service, and the cost is low. Including treatment, the cost of a 30 ft. poles averages about £1. I must admit that so far as erection costs are concerned the author has got me guessing. In the first place, he gives the cost of labour for a mile of H.T. line at £20; and the respective cost of L.T. lines at £6, whereas, I think I am correct in saying that there should be little if any difference for lines constructed for the working pressures stated. Then again these costs work out at about 13s. 4d. and 4s. per span of H.T. and L.T. lines respectively, and as I cannot help but feel that the costs represent only a portion of the work involved, I should be glad if, in his reply to the discussion, the author would enlarge on this point, and give us some indication of what is involved. When one considers all the preliminary and subsequent work which has to be performed before such transmission and distribution lines are completely erected, the costs must obviously be higher than those stated.

Referring to the financial arrangements adopted, could the author indicate how they decide whether the expense incurred in such a scheme justifies the Council bearing the entire expense as indicated under the heading "Scheme B."

As regards Pretoria, the Council finance the whole of the scheme, but the consumers concerned guarantee that the minimum revenue which the Council will receive in any one complete year, will be equivalent to 10% of the capital expended plus 1d. for each unit actually consumed. Such consumers pay city rates plus 100% for all energy consumed by them, and in the event of the total sum received during the year being less than the guaranteed minimum they have to pay the difference. This scheme has worked very well up to the present, and has in most cases, made the particular rural electrification system possible due to the fact that the consumers themselves were not in a position to finance the scheme. Incidentally, agreements are for a minimum period of ten years, so that the Council is protected from any loss.

The annexures I referred to are as follows :—

ANNEXURE No. 1.

Cost of One Mile of 11 kV. Transmission Line.

3	Steel Poles at £5.	£15	0	0
27	Wooden Poles at £1.	27	0	0
30	Cross Arms at 10/-	15	0	0
12	Disc Insulators at 9/3d.	5	11	0
81	Pin Insulators at 8/3d.	33	8	3
12	3" Shackles at 1/6d.		18	0
2,700	lbs. No. 4 Copper Conductor at 6½d. per lb.	74	0	0
27	Pole Tops at 1/6d.	2	0	6
4	Stay Clamps at 2/6d.		10	0
175	lbs. earth wire at 3½d. per lb.	2	11	0
8	Stays at 27/6d.	11	0	0
2	Coils ⅜" stay wire	3	0	0
	Telephone Nets	15	0	0
6	Pellet type lightning arrestors at £5 7s. 0d.	32	2	0
	Miscellaneous	25	0	0
	Labour—30 poles at £2.	60	0	0
		£322	0	9
	Transport at 5%	16	2	0

	£338	2	9
Administration 15%	50	14	3
TOTAL COST PER MILE	£388	17	0

1 Pole type transformer: 20 kVA.	£40	0	0
3 Expulsion type fuses at 25/-	3	15	0
1 H.T. Oil Circuit Breaker	25	0	0
1 Kiosk for Switch	30	0	0
Cable and Jointing	10	0	0

ANNEXURE No. 2.

Cost of One Mile of 3,300 Volt Transmission Line.

3	Steel Poles at £5.	£15	0	0
27	Wooden Poles at £1.	27	0	0
30	Cross Arms at 10/-	15	0	0
12	H.T. Shackle Insulators at 3/6d.	2	2	0
81	H.T. Pin Insulators at 6/-	24	6	0
2,700	lbs. No. 4 Copper Conductor at 6½d. per lb.	74	0	0
27	Pole Tops at 1/6d.	2	0	6
4	Stay Clamps at 2/6d.		10	0
175	lbs. earth wire at 3½d. per lb.	2	11	0
8	Stays at 27/6d. (4 main line and 4 wind.)	11	0	0
2	Coils stay wire	3	0	0
	Telephone Nets	15	0	0
6	Arrestors at 30/-	9	0	0
	Miscellaneous	15	0	0
	Labour—30 poles at £2.	60	0	0
		£275	9	6
	Transport at 5%	13	15	6
		£299	5	0
	Administration 15%	44	17	9
	TOTAL COST PER MILE	£345	2	9

ANNEXURE No. 3.

Cost of One Mile of 433/250 V. Distribution Line. (3 Phase 4 Wire).

		£	s.	d.
3	Steel Poles at £5.	£15	0	0
27	Wooden Poles at £1.	27	0	0
30	Cross Arms at 10/-	15	0	0
16	Shackles at 1/6d.	1	4	0
108	Pin Insulators at 1/6d.	8	2	0
3,600	lbs. of No. 4 Copper Conductor	97	10	0
27	Pole Tops at 1/6d.	2	0	6
4	Stay Clamps at 2/6d.		10	0
175	lbs. earth wire at 3½d. per lb.	2	11	0
8	Stays	11	0	0
2	Coils stay wire	3	0	0
	Telephone Nets	15	0	0
8	Arrestors at 25/-	10	0	0
	Miscellaneous	25	0	0
	Labour—30 poles at £2.	60	0	0
		£292	17	6
	Transport at 5%	14	12	10
		£307	10	4
	Administration at 15%	46	2	8
	TOTAL COST PER MILE	£353	13	0

4	Sectioning Switches at 25/-	£5	0	0

REPLY.

Mr. Relihan (Paarl): I think that the main difference between the erection of 11,000 K.V. high tension line is the labour cost. I do not know what you pay for labour here, but in the Paarl we pay 3s. 4d. per day for unskilled labour. For erecting the line, the linesmen are paid £15 per month. The highest paid official on that line, erecting the transformer stations got £30 per month. I may say that we put up 3½ miles of line, high tension, in 26 working days, completely energised. We used redundant copper for the low tension distribution lines to the farms which was sold to the farmers.

So far as the prices given in my list are concerned, these are all tender prices with the exception of copper and poles used for low tension distribution purposes. Those poles were made up in Paarl and sold to us completely with base plates for £1 5s. each. The ordinary standard steel poles weighing approximately 226 lbs. cost £2 12s. 6d. each. We bought over 100 of the 27 ft. poles for £2 2s. 6d.

As far as the profit and the revenue side of the line is concerned the farmers paid for the erection of the line themselves. The Council does not undertake to finance a scheme unless the load warrants the expenditure incurred. On completion the H.T. line financed by the farmers becomes the property of the Council with the condition that they could get anybody connected up who paid a pro rata share of the cost of the line when it was originally erected. So the only cost to the Council is the cost of distributing the energy.

We did not undertake the scheme unless scheme "A," as outlined in my report was agreed upon.

Mr. Gyles wants to know whether the cost of the transformer is included in this estimate. That is the complete cost per mile of line including transformers. The transformer stations are all protected by expulsion fuses, and lightning arrestors are placed at all transformer stations on the line. (Applause.)

RAILWAY RATES ON COAL.

The President : In connection with the discussion on the question of railway rates on coal, the Council recommend the following resolution :—

(a) That this Association resolves that as, in its opinion, high railway rates on coal are retarding industry and progress within the Union of South Africa to its detriment, all interested bodies are requested to co-operate in making representations to the

Government through members of the Legislative Assembly and the responsible Minister for a substantial reduction in the rates of charges and that all possible steps be taken to give this effect.

(b) That Messrs. Horrell, Macaulay, Swingler, Rodwell, and the Electrical Engineer of Port Elizabeth be appointed as the representatives of this Association with power to co-opt other interested parties for the purpose of carrying out the terms of paragraph (a) hereof.

The resolution was unanimously agreed to.

THE I. M. E. A.

The President: There is another resolution from the Council as follows :—

> That the Secretary be requested to investigate the whole matter and circularise members of the Association, pointing out the advantages of individual members becoming members of the I.M.E.A.

Mr. H. A. Eastman (Capetown): The question arose some little while ago in Capetown as to whether or not members of our Association were entitled to obtain copies of the British Standard specifications at reduced rates by reason of the fact that the Association is affiliated with the Incorporated Municipal Electrical Association of Great Britain whose members, according to the best of our information, were able to obtain the specifications at substantial discounts. Enquiries were, therefore, made, and, as our President has said, details of the replies will be issued to members.

Briefly the position is that by virtue of the Incorporated Municipal Electrical Association becoming a member of the British Standards Institution its members are able to obtain copies of the British Standard specifications at reduced rates through their Association, but these facilities are not available to members of this Association merely through its affiliation to the Incorporated Municipal Electrical Association. The City of Capetown Electricity Undertaking acordingly became a member of the British Standards Institution, and of the various grades of membership for which different fees are payable it joined the grade to which a membership fee of two guineas per annum applies.

For this subscription the undertaking receives free of charge a copy of all specifications issued in the electrical industry, and additional copies of all specifications issued by the British Standards Institution are made available to the undertaking at $33\frac{1}{3}\%$ discount.

CLOSING REMARKS.

The President : I think that Mr. Gould would like to say a few words before we close.

Mr. W. H. Milton (Electricity Supply Commission) : In view of Mr. Gould's dual position here, I have been asked by Mr. Jacobs to express his regret that he was unable to be with us this morning, and I have been asked to speak on his behalf.

The Electricity Supply Commission is grateful for the opportunity which your kind invitation provided to enable it to attend your Convention. The several papers which have been read have been of great interest, whilst the contributions to the discussions and the replies thereto, should also prove valuable. We shall look forward with interest to receiving copies of the proceedings in due course. On behalf of the Commission I also wish to thank the Mayor and Councillors of Salisbury who have extended such a hearty welcome to us, and also to those ladies and gentlemen who have gone out of their way to make those few hours when we have been at liberty, enjoyable. Our experience here has made such an impression upon me that it will live long as a pleasant memory. I thank you. (Applause.)

Mr. R. H. Gould (President, S.A.I.E.E.; Electricity Supply Commission, Johannesburg): Mr. President, I am glad to have an opportunity of saying a few words as a delegate of the South African Institute of Electrical Engineers. I congratulate you on the success of your Convention. I am sure that your efforts will be well repaid and that these yearly meetings are of definite benefit to the development of electricity supply to rural as well as to urban districts.

Your papers have been of a very high standard and of very considerable interest. The principal purpose of your Association is undoubtedly the furtherance of electricity supply, and one of your labours, an important one, is in connection with the framing of regulations. In this connection may I sound a note of warning? Let your regulations be framed in such a way that they do not stifle development.

As an illustration of what I have in mind may I be permitted to give an instance of a case where the regulations appear to work against development. I was impressed with the appearance of the transmission line to the Prince Edward Dam, but the small spacing of the poles gave me the impression that the golden line of economy had not been struck. On questioning Mr. Tubb I was informed that the spacing had been cut down to meet the Government regulations. Your Association, Mr. President, should strive to have regulations of this kind removed. I thank you.

The President : The balance sheet of the Association have just arrived, and I shall ask the Secretary to read it.

The Convention Secretary then read the balance sheet.

For convenience the balance sheet is included in the report—see first day's proceedings.

OTHER BUSINESSES.

The President : Are there any other items to be discussed?

A Member : I should like to move a vote of thanks to the Mayor and Town Council of Salisbury. I do it with pleasure, and I only wish that someone would handle it better than I can. They have been most hospitable to us in every way. Even our speeches in Convention have been accompanied with music (Laughter). They have spared no effort in their desire to make our stay pleasant. I move a vote of thanks to the Mayor and the Council of Salisbury, and I couple with it the Executive and the Chairman, and also the officials of the Southern Rhodesia Railways. (Applause.)

Councillor Adcock (Port Elizabeth) : I heartily endorse what has been said by my Councillor delegate friend, and I add my appreciation of your efforts, Mr. President, and the whole of the Association.

From a Municipal delegate's point of view it has been a pleasure, and instructive, to be present at your Convention. It is difficult to specify the different subjects which have been discussed, but they all help us to understand our own Electrical Engineer when he talks to us, and we can begin to grip the subject from what we have heard here.

I have thoroughly enjoyed the Convention, though there is, however, a sadness about us. We miss many old faces, many happy and delightful companions, and I am sorry that we cannot all be present on these occasions. The old friends I have met it has been a delight to see them and to co-operate with them. This continual bogey about subscriptions worries the Municipal Councils. I cannot see from the effort you have put into this Convention and the amount of knowledge you have disseminated, why the responsible Councils should not pay this fee, for we are all getting the benefit from the proceedings. I think an application should be made to the Chairmen of the electricity undertakings that this fee should be a contribution from the municipalities to this Association. I thank you from the bottom of my heart for everything that you have done for us. (Applause.)

Mr. Councillor J. J. Cook (Pretoria): May I express my thanks to the members of this Association through you, Mr. President, for the invitation extended to me to be present at your discussions. Councillors learn very much from the personal contacts established at these Conventions.

Mr. C. H. V. Baskerville (Salisbury): Being the only member of the Salisbury Town Council present, I thank the mover and the seconder on behalf of the Mayor and Town Council of Salisbury. I have been a member of the Association for many years, and I am now an Associate member. I was the first Rhodesian member of the Association and induced four other engineers in Rhodesia to join. I have therefore a great interest in the Association. It has been a great pleasure for us to have the members of the Association here. It will be remembered that the ast time I attended a Convention in 1926, at East London, it was on the boards then that the Convention would come to Rhodesia the following year. After a certain amount of discussion it was decided that Bulawayo might be the place of meeting. Unfortunately Mr. Young died and the whole matter was put back again. I thank you all very heartily for the way you have expressed your appreciation of the endeavours we have made to give you a happy gathering. I trust that some day you will come back again, and in the meantime you will take away with you very happy memories of Salisbury and Rhodesia. (Applause).

Mr. J. L. Hill (Electricity Control Board): On behalf of the Union Electricity Control Board I should like to express my thanks to the Association for the privilege of being present at your Convention.

Mr. W. H. Bottomley (Electrical Engineer, Union of South Africa): I take this opportunity of expressing my appreciation of the invitation extended to the Pulic Works Department to visit you at this Convention. The Secretary of Public Works is always too busy to come along, and as the engineers have nothing to do, he thought he would send me instead. (Laughter). It has been a pleasant experience from my point of view to meet all old friends here, and also to come into a new country to meet new faces and make new friendships too. I congratulate you, Mr. President, on having reached the presidential chair. I am sure that you will be a credit to it from the manner in which you have conducted the business of the Convention and kept us in order. I hope that you will have a very successful year of office.

Mr. E. R. Smith: I thank you for allowing me to attend your Convention once again.

The President: I wish to propose a vote of thanks to the Press, to all people who have assisted in organising, and to engineering people who kindly lent us their cars. I also thank the Mayoress for entertaining the ladies, and in particular, members and others who have prepared papers for this Convention.

The various votes of thanks were carried with acclamation.

Mr. R. Macauley (Bloemfontein): As the oldest member of the Association I express my personal thanks for the manner in which you have conducted this Convention.

The President: I now declare this Convention closed.

ASSOCIATION OF

Municipal Electrical Engineers

LIST OF MEMBERS, ASSOCIATE MEMBERS and HONORARY MEMBERS. as at September, 1934.

HONORARY MEMBERS.

Dr. H. J. van der BIJL, Electricity Supply Commission, Johannesburg.

JOHN ROBERTS, Electricity Supply Commission, Durban.

E. POOLE, Box 147, Durban. (Sec. & Treas.)

MEMBERS.

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GYLES, J. H., Durban, (*Member oj Council*).
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HARVEY, A. Q., Springs, Transvaal.

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SPARKS, L. B., Pietersburg, Transvaal.
STEWART, D. B., Gatooma, S. Rhodesia.
SWINGLER, G. H., Capetown (*Member of Council*).
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TORR, R., Volksrust, Transvaal.
TUBB, B. H. J., Salisbury, S. Rhodesia.
VERRYN, A. J., Middelburg, Transvaal.
WRIGHT, G. R. E., Benoni, Transvaal.

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