PROCEEDINGS

of the

Fourteenth Convention

Commemorating the "Coming of Age"

of the

Association of Municipal Electricity Undertakings.

of South Africa and Rhodesia.

(Founded 1915)

HELD AT

Johannesburg

From Monday, November 16th to
Saturday, November, 21st

1936.

PRICE FIVE SHILLINGS

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ASSOCIATION OF

Municipal Electricity Undertakings.

of South Africa and Rhodesia.

Founded 1915.

EXECUTIVE COUNCIL, 1936.

President :
A. T. RODWELL (Johannesburg).

Vice-President :
J. H. GYLES (Durban).

Past Presidents :
G. G. EWER (Pietermaritzburg).
L. L. HORRELL (Pretoria).

Councillor Members :
H. MIDDLEBROOK (Durban).
T. P. GRAY (Johannesburg).
F. MORRELL (Cape Town).
J. McLEAN (Port Elizabeth) *Alternates.*

Other Members :
G. H. SWINGLER (Cape Town).
T. JAGGER (Ladysmith).
E. A. BEHRENS (Port Elizabeth).
G. M. Pirie (Bloemfontein).

Secretary and Treasurer :
E. POOLE,
P.O. Box 147 — Durban.

Association of Municipal Electricity Undertakings
of South Africa and Rhodesia.

MEMBERS AND DELEGATES AT JOHANNESBURG, 14th CONVENTION, NOVEMBER 16th to 21st, 1936.

FIRST ROW—left to right—E. Gunther (Springfontein); Clr. J. J. Coetzee (Springs); H. Bahr (Klerksdorp) C. Runtzler (Port Shepstone); Clr. E. Spilkin (Umtata); Clr. F. Morrell (Cape Town), Member of Council, Alternate; Clr. J. McLean (Port Elizabeth), Member of Council, Alternate; L. L. Horrell (Pretoria), Past President; J. M. Lambe (East London); G. H. Swingler (Cape Town), Member of Council; J. H. Gyles (Durban), Vice-President; A. Rodwell (Johannesburg), President; G. G. Ewer (Pietermaritzburg), Past President; E. Poole (Durban), Secretary & Treasurer; J. Roberts (Durban); Clr. H. Middlebrook (Durban), Member of Council; T. Jagger (Ladysmith), Member of Council; E. A. Behrens (Port Elizabeth), Member of Council; Clr. G. Smith (Bloemfontein); G. M. Pirie (Bloemfontein), Member of Council; Clr. H. T. Allison (Pietermaritzburg); A. R. Metelerkamp (Salisbury).

SECOND ROW—G. J. Muller (Krugersdorp); — Hope (Visitor); Clr. C. Lennox (Port Shepstone); J. Balfour (Ficksburg), Visitor; A. E. Val Davies (Johannesburg), Visitor; F. Stevens (Alice); W. H. Mumford (Salisbury), Visitor; L. B. Sparks (Pietersburg); H. J. Relihan (Paarl); G. E. H. Jones (Mafeking); D. W. Ritson (Stellenbosch); Clr. W. G. Delport (Krugersdorp); H. A. Prevost (Somerset East); W. M. Mail (Kokstad); H. M. S. Muller (Upington); A. J. Verryn (Middleburg, Tvl.); A. Rossler (Cradock); C. H. Dwyer (Germiston); Clr. H. Quick (Ladysmith); L. P. Cleaver (Nigel), Visitor; W. Rossler (Ladybrand); T. M. Mocke (Piet Retief).

THIRD ROW—A. H. Tromp (Springfontein), Town Clerk; G. C. Brown (Volksrust); Clr. R. Biegel (Volksrust); P. H. Newcombe (George); R. D. Coulthard (Oudtshoorn); D. B. Stewart (Gatooma); P. C. Grandin (Vryburg); J. W. Phillips (Bulawayo); J. Kruger (Adelaide); A. Elliott (Uitenhage); S. F. Harvey, Visitor; F. Rettie (Bulawayo), Visitor; F. C. D. Mann (Worcester); W. H. Milton (Johannesburg), E.S.C.; T. P. Ashley (Queenstown); L. B. Proctor (Johannesburg); J. Iverach (Grahamstown); H. A. Morris (Kimberley); W. Wegener (Visitor).

BACK ROW—F. O. Iles (Visitor); Clr. A. Sampson (Springfontein); Clr. A. L. Koller (Springfontein); I. J. Nicholas (Umtata); W. Houreld (Randfontein); Clr. D. J. Patterson (Randfontein); W. R. Gray (Johannesburg); H. Groom (Roodepoort); G. R. E. Wright (Benoni); G. A. Dunn (Durban), Visitor; C. Dawson (Durban); D. Omerod (Umtali); Clr. M. F. de Kock (Cradock); P. de K. van Heerden (Cradock), Town Clerk; F. Castle (Cape Town); G. Dekenah (Ermelo); Clr. D. Jackson (Ermelo); Clr. J. T. Woods (Umtali); Clr. J. S. Barton (Kokstad); J. C. Robertson (Visitor).

MEMBERS AT THE FIRST CONVENTION JOHANNESBURG, NOVEMBER 15th — 20th, 1915.

BACK ROW—M. McDonough, Bethlehem; J. R. English, Heilbron; T. Jagger, Ladysmith; T. Millar, Harrismith; J. Roberts, Durban (Member of Council); T. C. Wolley-Dod, Pretoria; B. Sankey, Port Elizabeth (Member of Council); E. T. Price, Johannesburg (Hon Treasurer). F. Castle, Oudtshoorn; G. H. Swingler, Cape Town.

FRONT ROW—W. Bellad-Ellis, Queenstown (Member of Council); F. T. Stokes, Johannesburg (Hon. Secretary); W. F. Long, Cape Town (Vice-President); J. H. Dobson, Johannesburg (President); A. S. Munro, Pietermaritzburg; W. H. Blatchford, Greytown; E. Poole, Durban.

ASSOCIATION OF

Municipal Electricity Undertakings.

of South Africa and Rhodesia.

PAST OFFICERS AND MEMBERS OF COUNCIL.

	Past Presidents :		Sec. and Trea. :
1915-17	J. H. DOBSON,	Johannesburg.	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,	Johannesburg.	R. G. Tresise.
1927-29	J. M. LAMBE,	East London.	P. Adkins.
1929-31	R. MACAULAY,	Bloemfontein.	E. Poole.
1931-32	L. L. HORRELL,	Pretoria.	E. Poole.
1932-34	L. F. BICKELL,	Port Elizabeth.	F. A. P. Perrow.
1934-35	A. R. METELERKAMP,	Bulawayo.	E. Poole.
1935-36	G. G. EWER.	Pietermaritzburg.	E. Poole.

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.
1934-35	T. Millar; J. H. Gyles; G. H. Swingler; A. Rodwell.
1935-36	Councillors J. McLean; T. P. Gray; H. W. Daly (alternate) G. H. Swingler; J. H. Gyles; T. Millar; E. H. Behrens.

RULES AND CONSTITUTION.

The Association of MUNICIPAL ELECTRICITY UNDERTAKINGS of SOUTH AFRICA and RHODESIA.

1. TITLE.

The name of the Association shall be "The Association of Municipal Electricity Undertakings of South Africa and Rhodesia."'

2. OBJECTS.

The objects for which the Association is formea are :—

(a) To promote the interests of Municipal Electricity Undertakings.

(b) To bring Municipal Electrical Engineers and Chairmen and Members of Municipal Electricity Committees together.

(c) To arrange and hold periodically meetings for the reading of papers and discussions of subjects appertaining to Municipal Electricity Undertakings.

(d) To take such action as may be lawful and expedient for the protection and defence of the rights or interests of Municipal Electricity Undertakings.

3. MEMBERSHIP.

The Association shall consist of :—

(a) Honorary Members.
(b) Councillor Members.
(c) Engineer Members.
(d) Associate Members.
(e) Associates.

All Hon. Members and Members of the Association of Municipal Electrical Engineers shall ipso facto become Hon. Members and Engineer Members of the Association of Municipal Electricity Undertakings and existing Associate Members shall be eligible to transfer to the class of Associate.

4. QUALIFICATIONS.

The qualifications for admission to the Association shall be as follows :—

(a) **Honorary Members** shall be distinguished persons who are or who have been intimately connected with Municipal Electricity Undertakings and whom the Association especially desires to honour for exceptionally important services in connection therewith.

(b) **Councillor Members.** The Member whose Chief Electrical Engineer shall have qualifications acceptable to the Council of the Association shall be the Committee appointed by the Municipality or Local Authority to have control over its Electricity Undertaking and shall be represented as regards its qualifications to vote by one member of such Committee.

(c) **Engineer Members.** The Member shall be the Chief Electrical Engineer engaged on the permanent staff of an Electricity Undertaking owned by a Municipality or Local Authority and who has had a thorough training in Electrical Engineering and is otherwise acceptable by the Council of the Association. Any duly qualified Assistants in an Undertaking with sales of over 20,000,000 Units per annum may also be admitted to this Class on the recommendation of the Chief Electrical Engineer.

(d) **Associate Members.** The Member shall be a Technical Assistant engaged on the permanent staff of any Electricity Undertaking represented by its Councillor Member and/or Engineer Member.

(e) **Associates.** Any Member resigning from the class of Engineer Member or Associate Member shall be entitled to apply for transfer to the class of Associate.

An Associate may also be an Engineer in the employ of the Victoria Falls and Transvaal Power Company or the Electricity Supply Commission, who may be engaged in the public supply of electricity to Municipalities.

5. **ADMISSION OF MEMBERS.**

(a) The election of Honorary Members and other classes shall be vested in the Council.

(b) Councillor Members may be admitted on an application signed by the Town Clerk of the Municipality or Local Authority concerned.

(c) Every candidate for election into the Association as Engineer Member shall make application on the prescribed form suitably endorsed by two supporters who shall be either Engineer Members, Councillor Members or Members of the Committee of the Municipality or Local Authority in charge of the Electricity Undertaking of which the applicant is Chief Electrical Engineer.

(d) Every candidate for election into the Association as Associate Member or Associate shall make application on the prescribed form suitably endorsed by the Engineer Member on whose staff he is engaged.

(e) Every candidate for transfer to the class of Associate shall make application in writing for transfer.

6. **CONTRIBUTIONS.**

Contributions shall become due and payable annually on the 1st day of September which shall constitute the new Financial Year of the Association.

(a) **Honorary Members** shall not be required to pay any contribution.

(b) **Councillor Members.** In the case of the Committee appointed by a Municipality or Local Authority to have control over the Electricity Undertaking the undermentioned scale of contributions shall apply :—

up to ½ million	2 guinneas.
up to 1 million	3 "
up to 10 million	4 "
all over 10 million	5 "

(c) **Engineer Members.** The contribution of an Engineer Member in the service of a Committee making a contribution shall merge into and form part of such contribution. When a Committee is not a Member or resigns from Membership the Engineer Membership contribution shall be two (2) guineas.

(d) **Associate Members and Associates.** The
(e) contribution of Associate Members or Associates shall be one (1) guinea.

Part Year contribution. All members shall pay the contribution for the year in which they are elected without reference to the period of the year at which their election takes place and they shall be entitled to receive a copy of the Proceedings or any other publications issued during such year.

Arrear Contributions. No class of Member whose contribution is six months in arrear shall be entitled to attend or take part in any of the meetings of the Association or to receive any of the Association's publications.

Any class of Member whose contribution is in arrear at any Convention shall deem to have forfeited claim to membership and his name may, by the Council, be removed from the register of the Association, but he shall nevertheless be liable for such arrears up to the date of his name being removed.

7. COUNCIL.

Management. 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.

Members of Council. The Council shall consist of a President Vice President, two Immediate Past Presidents, all of whom shall be Engineer Members, and six other Members, two of whom may be Councillor Members.

Officers of Council. The Officers of the Council shall be the President, Vice President and Secretary & Treasurer.

Election of Council. Officers and Members of the Council (other than the Secretary & Treasurer) shall be elected by nomination and ballot at the Convention, and shall hold office until the next Convention. In the event of a vacancy occurring during the year the remaining members shall have power to appoint a member to fill the vacancy.

Co-option. The Council shall have power to co-opt any members of the Association or other person for any special purpose whose services in their opinion may advance the objects of the Association.

Election of Secretary & Treasurer. The Council shall appoint and from time to time determine the remuneration (if any) and prescribe the duties of the Secretary & Treasurer who shall hold office during the pleasure of the Council.

8. MEETINGS.

Council. The Council shall meet as often as the business of the Association may require and at any meeting three shall constitute a quorum.

Convention. The Association shall hold Conventions yearly, (of which the local Press of the town in which the Convention is held shall be given full particulars) as far as may be conveniently arranged, and at that meeting the Secretary & Treasurer shall present the Report and Balance Sheet of the Association for the immediate past period.

Quorum. At any meeting of the Association 15 shall form a quorum.

Chairman. 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.

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.

Resolve into Committee. 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.

Sectional Voting. When a motion is before any Convention or meeting of the Association it shall be competent for any member of either the Councillor or Engineer sections to apply to the Chairman for a "Vote by Section." This application shall be granted by the Chairman whereupon each of these sections shall vote separately on the motion and unless a majority shall be obtained in each section the motion shall be lost. On a sectional vote being called for, Associate Members and Associates shall not be entitled to vote.

Fourteenth Convention

JOHANNESBURG.

PROGRAMME

Monday, 16th November.

8.30 a.m.—Meeting of Council.

9.30 a.m.—Registration, Issue of Programmes, etc.

10.0 a.m.—Official opening of Convention by His Worship the Mayor of Johannesburg.

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

AGENDA

1. Annual Report of Secretary and Treasurer.
2. Election of President.
3. Valedictory Address by Retiring President.
4. Presidential Address.
5. Place of Meeting of next Convention.
6. Election of Officers.
7. General Business.

The following are the Retiring Officers :—

President—G. G. Ewer : Pietermaritzburg.

Vice-President—A. Rodwell : Johannesburg.

Past Presidents—L. L. Horrell : Pretoria.
G. H. Swingler : Capetown.

Other Members :

Councillors—T. P. Gray : Johannesburg.
J. McLean : Port Elizabeth.
H. W. Dely : Pretoria (Alternate).

Electrical Engineers—

E. A. Behrens : Port Elizabeth.
J. H. Gyles : Durban.
F. C. D. Mann : Worcester.
G. M. Pirie : Bloemfontein.

12.45 p.m.—Luncheon in Selborne Hall. Guests of Mayor and Councillors of Johannesburg.

3.0 p.m.—Paper by Mr. C. Dawson (Durban): "A Survey of Municipal Peak Loads." Discussion.

8.0 p.m.—Bus Tour of Jubilee Illuminations. Coffee at Zoo Lake.

Tuesday, 17th November.

8.30 a.m.—Council Meeting at Hotel. (Convention meets at Kelvin House, 100 Fox Street.)

9.30 a.m.—Paper by Mr. Liebbrandt (S.A.R. & H.): "The Electrical Department of the S.A.R. & H."

11.0 a.m.—Paper by Mr. Kane (Johannesburg): "Distribution Sub-stations of the Johannesburg Electricity Department."

1.0 p.m.—Luncheon Adjournment.

2.30 p.m.Visit to Municipal Power Station.

4.30 p.m.—Tea at Selborne Hall.

8.15 p.m.—Guests of City Council at Colosseum Theatre.

Reception at Carlton Hotel.

Wednesday, 18th November.

8.30 a.m.—Council Meeting at Hotel.

9.0 a.m.—Official Photograph.

10.0 a.m.—Paper by Mr. Le Mare (E.S.C., Johannesburg): "A Note on a Channel for National Propaganda for Electricity in South Africa."

1.0 p.m.—Luncheon Adjournment.

2.30 p.m.—Golf. Bowls. Tennis.

Evening Free to attend Exhibition.

Thursday, 19th November.

8.30 a.m.—Council Meeting at Hotel.

9.30 a.m.—Paper by Mr. Milton (E.S.C., Johannesburg): "The Engineering Aspect of small Municipal Electricity Undertakings."

11.0 a.m.—Discussion and General.

12.30 p.m.—Luncheon Adjournment.

2.0 p.m.—Visit to Klip Power Station. Guests of V.F.P. Co. and E.S.C.

8.0 p.m.—Combined meeting at Kelvin House. Guests of S.A.I.E.E. and A.Cert.(S.A.)M. and E.E.

Friday, 20th November.

8.30 a.m.—Council Meeting at Hotel.

9.30 a.m.—Paper by Mr. E. A. McWilliam (Pretoria): "Testing of Coal Ash and Water at the Pretoria Municipal Power Station."

1.0 p.m.—Luncheon Adjournment.

2.30 p.m.—Paper by Mr. Read (Johannesburg): "Testing Equipments for smaller Electrical Undertakings."

8.15 p.m.—Empire Theatre and Cabaret at Hotel.

Saturday, 21st November.

8.30 a.m.—Council Meeting at Hotel.

9.30 a.m.—Discussion and General Business.

Convention terminates at 11.30 a.m. to allow Members and Delegates to catch down country trains.

Ladies' Programme

Monday, 16th November.

10.0 a.m.—Official Opening of Convention by His Worship the Mayor of Johannesburg.

12.45 p.m.—Luncheon in Selborne Hall Guests of Mayor and Councillors of Johannesburg.

3.30 p.m.—At Home. President's Residence. (Bridge, Tennis.)

8.0 p.m.—Bus Tour of Jubilee Illuminations. Coffee at Zoo Lake.

Tuesday, 17th November.

10.30 a.m.—Demonstration at Home Economics Section of "The Star."

4.30 p.m.—Tea at Selborne Hall.

8.15 p.m.—Guests of City Council at Colosseum Theatre.

Wednesday, 18th November.

10.30 a.m.—Mannequin Parade at Paramount Stores, Kerk Street.

Free Afternoon and Evening.

Thursday, 19th November.

2.30 p.m.—Tour of City and Suburbs. Tea at Zoo Kiosk. Guests of the Mayoress.

8.0 p.m.—Social Evening. Guests of President's Wife.

Friday, 20th November.

8.15 p.m.—Empire Theatre and Cabaret at Hotel.

Saturday, 21st November.

Free Morning.

Convention terminates at 11.30 a.m. to allow Members and Delegates to catch down country trains.

Association of

Municipal Electricity Undertakings.

of South Africa and Rhodesia.

MEMBERS AND OTHERS ATTENDING THE CONVENTION.

ENGINEERS AND COUNCILLORS :

ADELAIDE—
J. Kruger.

ALICE—
F. Stevens.

BENONI—
G. R. E. Wright.

BOKSBURG—
T. S. Fitzsimons.
W. J. Seller.

BLOEMFONTEIN—
G. M. Pirie.
Councillor G. Smit.

BULAWAYO—
J. W. Phillips.
Councillor C. M. Harris.

CAPE TOWN—
G. H. Swingler.
Councillor F. Morrell.

CRADOCK—
A Rossler.
Councillor M. F. de Kock, (Mayor).
P. de K. van Heerden, (Town Clerk).

DURBAN—
J. H. Gyles.
C. Dawson.
Councillor H. Middlebrook.

EAST LONDON—
J. M. Lambe.

ERMELO—
G. Dekenah.
Councillor D. Jackson.

FICKSBURG—
J. Balfour.

GEORGE—
P. H. Newcombe.

GATOOMA—
D. B. Stewart.

GRAHAMSTOWN—
J. Iverach.

JOHANNESBURG—
A. T. Rodwell.
Councillor D. MacKay (Mayor).
,, J. S. Fotheringham.
,, T. P. Gray.
,, J. W. Watt.
,, R. J. Tillett.
,, E. Boylan.
,, E. Stevenson.
,, J. F. Hilson.

KIMBERLEY—
H. A. Morris.

KLERKSDORP—
H. Bahr.
Councillor J. J. Oosthuizen.

KOKSTAD—
W. Mail.
Councillor J. S. Barton.

KRUGERSDORP—
G. J. Muller.
Councillor A. J. Tinker (Mayor).
,, W. G. Delport.

LADYBRAND—
W. Rossler.

LADYSMITH—
T. Jagger.
Councillor H. Quick.

LYDENBURG—
H. T. Turner.

MAFEKING—
G. E. H. Jones.

MIDDLEBURG (Tvl.)—
A. J. Verryn.

NIGEL—
L. P. Cleaver.

OUDTSHOORN—
R. D. Coulthard.

PAARL—
H. J. Relihan.
Councillor D. Nelson.
,, A. S. Reyneke.

PIETERSBURG—
L. B. Sparks.
Councillor J. Brenner.

PIET RETIEF—
T. M. Mocke.

PIETERMARITZBURG—
G. G. Ewer.
Councillor A. T. Allison.

PORT ELIZABETH—
E. A. Behrens.
Councillor J. McLean.

PORT SHEPSTONE—
C. Runtzler.
Councillor C. Lennox.

PRETORIA—
L. L. Horrell.
Councillor H. F. Jacobs.

QUEENSTOWN—
T. P. Ashley.

RANDFONTEIN—
W. Houreld.
Councillor D. J. Paterson.

ROODEPOORT—
H. Groom.
Councillor F. B. Allen.

SALISBURY—
J. S. Clinton.
Councillor L. B. Fereday (Mayor).
,, R. L. Philips.

SPRINGS—
A. Q. Harvey.
Councillor J. J. Coetzee.

SOMERSET EAST—
H. A. Prevost.

SPRINGFONTEIN—
E. Gunther.
Councillor A. L. Koller (Mayor).
,, A. Sampson.
A. H. Tromp (Town Clerk).

STELLENBOSCH—
D. W. Ritson.

UITENHAGE—
A. E. Elliott.

UMTALI—
D. Ormerod.
Councillor J. T. Woods.

UMTATA—
I. J. Nicholas.
Councillor E. Spilken.

UPINGTON—
H. M. S. Muller.

VOLKSRUST—
G. C. Brown.
Councillor R. Biegel.

VRYBURG—
P. C. Grandin.

WORCESTER—
F. C. D. Mann.

ASSOCIATE MEMBERS :

B. Marchand, Witbank; F. Castle, Capetown; L. B. Proctor, A. R. Campbell, J. H. Dobson, H. Purves, G. Stewart, C. H. Dwyer, Johannesburg.

SUNDRY DELEGATES :

Electricity Supply Commission :	J. H. Van der Bijl (Hon. Member) Johannesburg. J. Roberts (Hon Member) Durban. A. M. Jacobs; P. Furness; W. H. Milton; G. W. R. Le Mare; R. H. Gould; E. T. Price, Johannesburg.
Rhodesia Electricity Supply Com. :	A. R. Metelerkamp (Associate Member) Salisbury.
Electricity Control Board :	J. L. Hill, Pretoria.
Union Government :—	
S.A. Railways & Harbours :	D. Liebbrandt; W. R. Owens, Johannesburg.
Labour & Social Welfare :	C. H. Clutterbuck (Chief. Insp. Factories) Pretoria.
Mechanical Laboratory :	C. Mullins.
Public Works (Electrical) :	J. S. Clelland; W. H. Bottomley, Pretoria.
Southern Rhodesian Government :	J. G. H. Holdgate, Johannesburg.
Public Works (Electrical) :	W. H. Mumford, Salisbury.
R. & M. Railways :	F. Rettie, Bulawayo.
S.A. Iron & Steel Corporation :	A. C. McColm, Pretoria.
Chamber of Commerce :	W. F. Boustred, Johannesburg.
Empire Exhibition :	L. B. Maggs, Johannesburg.
Rand Water Board :	M. Udwin, Johannesburg.
Victoria Falls Power Co. :	B. Price; V. Pickles; T. C. Otley; —, Pickles (Jr.) Johannesburg.
Kindred Institutions :—	
Institution of Electrical Eng's :	C. T. Cocks (President) J.H.Burg.
Institution of C.M. & E. E. :	E. V. Perrow (Pres.t) J.H. Burg.
Institution of Engineers :	W. G. Sutton (Pres't) J.H.Burg.
Bowling Club (Zoo Lake) :	A. Furness, Johannesburg.
Various :	G. G. King; M. E. Cooper; F. H. Mitchell; R. Hamilton; D. H. Wheeler; A. E. Val Davies; M. Rothkugel.

ELECTRICAL TRADES :

A.E.G. Engineering Co. (Pty) Ltd :	A. Heydorn ; J. Harris ; G. Neumann.
Bartle & Co., Ltd. :	F. H. Tyler.
"Beama"—	
C.M.A. :	G. Grover.
English Electric Co. :	H. Simmonds.
British General Electric Co., Ltd. :	W. M. Winstanley ; J. McMurray, H. Littlewood, J. P. Thomas.
B.I.W. Co., Ltd. :	F. Castle.
Boksburg Brick & Fire Clay Co. Ltd. :	M. Gee.
Chloride Battery Co., Ltd. :	A. C. Tilley.
Crompton Parkinson, Co., Ltd. :	A. B. Stratford.
English Electric Co., Ltd. :	T. A. Brown ; B. E. Mahon.
Fraser & Chalmers, Ltd. :	G. Dunn.
Hubert Davies & Co., Ltd. :	S. F. Harvey ; E. C. Carter ; J. M. Druce ; C. Ruther.
Metropolitan-Vickers Co., Ltd. :	A. L. Olsen.
Petters Ltd. :	W. E. Goose.
Parsons & Co., Ltd. :	N. O. Curry.
Reyrolle & Co., Ltd. :	W. J. Gibbons.
Reynolds Sons & Partners, Ltd. :	N. Reynolds ; H. Shermer.
S.A. General Electric Co., Ltd.	H. A. Tinson.
S.A.C.M.A. :	E. R. Smith.
Siemens British, Ltd. :	F. A. Edwards.
Siemens S.A., Ltd. :	H. J. S. Cremer.
Stewarts & Lloyds, S. A. Ltd. :	E. F. M. Davies ; H. G. Reid.
Vacuum Oil Co. of S.A. Ltd. :	J. M. Templeton ; J. C. Robertson.

LADIES :

Mesdames : Allinson ; Ashley ; Balfour ; Boylan ; Behrens ; Brown ; Boustred ; Biegel ; Bottomley ; Campbell ; Curry ; Clinton ; Cocks ; Clutterbuck ; Clelland ; Cooper ; de Kock ; Dekenah ; Dobson ; Davies ; Ewer ; Elliott ; Fotheringham ; Furness ; Fraser ; Gyles ; Gray ; Gibbons ; Grandin ; Gould ; Hilson ; Harris ; Houreld Horrell ; Harvey ; Hill ; Holdgate ; Hamilton ; Jones ; Kruger ; King ; Kane ; Klopper ; Littlewood ; Le Mare ; Liebbrandt ; Marchand ; Mail ; McMurray ; Mumford ; McColm ; Muller ; Milton ; Maggs ; Mitchell ; McLean ; Newcombe ; Oslen ; Otley ; Owens ; Phillips ; Privett ; Perrow ; Poole ; Price ; Rossler ; Rodwell ; Read ; Relihan ; Reynolds ; Reid ; Rettie ; Rothhugel ; Ritson ; Reyneke ; Roberts ; Runtzler ; Swingler ; Stewart ; Stevenson ; Shermer ; Sutton ; Spilken ; Sparks ; Tillett ; Taylor ; Thomas ; Udwin ; Van der Bijl ; Watt ; Woods ; Winstanley ; Wheeler ; Wright and the Misses Allison and Gyles.

OFFICIALS :

F. C. Rigby, Reporter (Johannesburg) ; E. Poole, Sec. & Treas. (Durban).

PROCEEDINGS

OF THE

Fourteenth Convention

MONDAY 16th November, 1936.

INTRODUCTORY.

THE Fourteenth Convention of the Association of Municipal Electricity Undertakings (Union of South Africa and Rhodesia) was opened in the Conference Hall, Empire Exhibition : Johannesburg, on Monday, November 16th 1936 and was attended by 63 Engineer Members; 38 Councillor Members and Delegates; 30 Engineer Visitors; 34 Trade Representatives, also a large number of ladies accompanying members and others.

The President, Mr. G. G. Ewer (Pietermaritzburg (in the Chair: Ladies and Gentlemen, I have great pleasure in introducing to you His Worship the Mayor of Johannesburg, who has come here this morning officially to open our Convention. (Applause).

CIVIC WELCOME.

His Worship the Mayor of Johannesburg (Mr. Donald MacKay) said : Mr. President, Ladies and Gentlemen, it is with real pleasure that, on behalf of the Council and Citizens of Johannesburg, I welcome your members and delegates to our City.

It is satisfactory to note that this function is a record one as regards numbers, and from the comprehensive programme, I feel sure that the Convention will break many records.

I understand that you have attained your majority, having reached 21 years of age this month. Since your inception this City has sent its engineers and delegates to your Conferences at various towns in the Union and Rhodesia. I am told that you have visited our City on two previous occasions, and we are glad of the opportunity to again reciprocate your hospitality.

These Conferences provide an excellent opportunity for the Electrical Engineers and Councillors to meet and discuss their affairs and problems, to exchange ideas and formulate new and improved methods, to our mutual benefit. It is right and proper that the Municipality which has an electricity undertaking should be represented by one or more of its Councillors at functions such as this.

In welcoming you to this young City of only 50 years of age, I feel I can justly say that we are welcoming you to an important City which fully appreciates the importance of a cheap and abundant supply of electricity. Here, the output and maximum demand are the largest for a municipal area in the Union of South Africa, with tariffs amongst the lowest in the country.

From the programme, I note that you will have the opportunity of visiting large undertakings, not only in Johannesburg, but particularly the super-generating stations of the Electricity Supply Commission, and the Victoria Falls and Transvaal Power Company, at Klip, and the facilities of collaborating with your kindred electrical engineering society of the Associated Scientific and Technical Societies of South Africa.

I wish you every success in your deliberations, and trust that you may find time to indulge in some of the recreations we are able to provide, and take away to your respective cities and towns, valuable and very happy recollections of your visit to our City.

I have pleasure in declaring this, the Fourteenth Convention of the Association of Municipal Electricity Undertakings of South Africa, duly opened. (Applause).

REPLY TO CIVIC WELCOME.

The President (Mr. G. G. Ewer): Mr. Mayor, on behalf of the Association I wish to thank you for being with us this morning, and for your very hearty welcome to your City. We are very pleased indeed to be able to visit your City at this time, and particularly to be able to visit the Empire Exhibition, which, I think, we are all agreed is a credit to Johannesburg, to South Africa, and to the Empire.

I would also like to take this opportunity to thank the Johannesburg City Council for the facilities given us for our Convention this week, also for the entertainments which have been so generously arranged for us.

On behalf of the ladies, too, I would like to thank the City Council, and all those concerned, for the very generous hospitality which is being extended to them. Mr. Mayor, I thank you. (Applause).

APOLOGIES FOR NON-ATTENDANCE.

The President : We have only two apologies this morning—which is a good sign; it means that all concerned are present. The apologies are from Mr. Bottomley of the P.W.D. who hopes to be with us later on in the week, and Mr. G. A. Stewart.

ANNUAL REPORT and BALANCE SHEET.

I now call upon the Secretary and Treasurer to give his Annual Report.

The Secretary and Treasurer **(Mr. E. Poole)** then read the 14th Report and Balance Sheet as follows :—

FOURTEENTH REPORT and BALANCE SHEET of the Association of Municipal Electricity Undertakings for the Period ending August 31st, 1936.

Mr. President and Gentlemen

I have the honour to present herewith the Fourteenth Report and Balance Sheet covering the affairs of the Association since the 1935 Convention held at Pietermaritzburg.

MEMBERSHIP.

The membership of the Association as by the last report and as at present existing is as follows:

	1935:	1936:
Honorary Members	3	3
Councillor Members		51
Engineer Members	61	63
Associate Members	15	4
Associates		16
	79	137

During the past year our membership has been added to by the addition of 51 Councillor Members and 10 Engineer Members, against which were various other changes and transfers but the nett gain of 58 in the total membership is a highly satisfactory one.

TRANSFERS.

Among the transfers is that of our Past President Mr. A. R. Metelerkamp who has transferred from the class of Engineer Member to that of Associate on his relinquishing his appointment as Municipal Electrical Engineer of Bulawayo, in favour of his appointment as Chairman of the Rhodesian Electricity Supply Commission, an appointment on which he is to be heartily congratulated.

Another transfer is that of our Member of Council, Mr. T. Millar of Harrismith, who on leaving municipal service has transferred from the class of Engineer Member to that of Associate, and as one of our Foundation Members and a Member of Council for many years, it is with much regret that his seat on the Council becomes vacant.

EXECUTIVE COUNCIL.

The two transfers referred to created vacancies on our Executive Council and as is provided by our Rules the remaining members of the Council elected Mr. G. H. Swingler of Cape Town to fill the vacancy of Past President (vice Mr. Metelerkamp) which in turn brought about another vacancy for a Member of Council, which was filled by the election of Mr. F. C. D. Mann of Worcester, the other Member of Council elected being Mr. G. M. Pirie of Bloemfontein (vice Mr. T. Millar).

NEW RULES AND CONSTITUTION.

The adoption of new Rules and Constitution as approved at the P.M.Burg Convention by which Municipal Councils are now admitted to membership, has met with very satisfactory support, and it is pleasing to note that so large a number of our Engineer Members have been supported by the enrolment of their respective Councils as members.

There are only a few Councils who have not as yet supported their Engineer Members, but there are still a number of towns (mostly the smaller ones) who are not represented either by the membership of their Council or Electrical Engineer, and in view of the many problems confronting Municipalities in connection with the rapid advances in Electricity Supply, there is every reason to expect that our membership will steadily grow by the addition of both Councillor and Engineer Members.

S.A. STANDARDS REPRESENTATION.

At our last Convention Mr. L. L. Horrell of Pretoria was elected as our representative on the S.A. Standards Institution with Mr. G. R. E. Wright of Benoni as alternate.

Unfortunately, towards the close of this financial period, they both found they were unable to carry on, and with the approval of the President and Vice-President, Mr. A. Q. Harvey of Springs, who was agreeable to act, was elected to this vacancy.

LICENSING OF ELECTRICIANS.

As an outcome of the Resolution passed at our last Convention in regard to the Licensing of Electricians, I am pleased to report that our request to the United Municipal Executive of S.A. to have the positions legalised has borne fruit, in so far as a further advance has been made by the matter being now in the hands of the Department of Interior and this subject will be included in the Agenda for further discussion at our Johannesburg Convention.

FINANCIAL.

The financial position of the Association is a much improved one, and is very gratifying, the £40 loss of last year being this year converted into a gain of £45, largely through our increased membership.

The arrears only amount to £9 8s. 0d. for this year, a good deal of which is I feel recoverable, but there is still an amount of £9 9s. 0d. outstanding for the period 1934-5, which I recommend should now be written off as all attempts to collect same have failed, and the names of those in arrear up to September, 1935, should be removed from our register.

In terms of authority given at the last Convention a sum of £21 3s. 6d. was authorised to be written off as being irrecoverable, but £4 4s. 0d.

of this amount has since been collected, leaving a balance of £16 9s. 6d. which has been written off.

The sales of Proceedings and the Revenue from Advertisements is much the same as last year and it is hoped will still further increase. On the Expenditure side the items are of normal amount and call for little comment.

I am,

Mr. President and Gentlemen,

Yours faithfully,

September 1st, 1936. E. POOLE, Secretary and Treasurer

Mr. Horrell (Pretoria) : I have pleasure in moving the adoption of the Report and Balance Sheet. I think we can congratulate ourselves that the Association has gone forward to such an extent that our membership has increased, and that we are in such an excellent financial condition.

Councillor A. M. Jacobs (Pretoria) : seconded. The Motion was agreed to.

ELECTION OF PRESIDENT.

The President : Ladies and Gentlemen, our next duty is to elect our President for the ensuing year, and I have very great pleasure in moving from the Chair that Mr. Arthur Rodwell, of Johannesburg, be elected President for the ensuing year. (Applause).

Mr. Horrell (Pretoria): Mr. President, Ladies and Gentlemen it is with very great pleasure that I have this morning to second this. I have known Mr. Arthur Rodwell for many many years, and it would be very pleasing to see him in that position, and I hope his year of office will be very happy. I am sure he will have the support of all his fellow members. (Applause).

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS
of South Africa and Rhodesia.

REVENUE AND EXPENDITURE ACCOUNT FOR THE PERIOD
4th September, 1935 to 31st August, 1936.

Expenditure :

	£ s. d.	£ s. d.
Convention Expenses—		
Reporting	25 4 0	
Secretary's expenses	6 12 6	
Printing advance papers	3 16 6	
Programmes and Badges	10 0 0	
Teas, &c.	3 8 8	
		49 1 8
Audit		3 3 0
Statistical Tables		10 0 0
Donation (World Power Conference)		10 0 0
Printing Proceedings		119 11 7
Sundry Printing, Stationery, &c.		17 12 9
Salary		60 0 0
Secretarial expenses—		
I.M.E.A.	4 12 1	
Postages and Railage	16 2 0	
Tel. and Phones	1 7 8	
Sundry printing, &c.	2 2 3	
		24 4 0
Bank charges	4 15 2	
less recovered	6 9	
		4 8 5
Written off—		
Subscriptions	15 15 0	
Proceedings	10 0	
Photo	9 6	
Tables	5 0	
		16 19 6
Balance being excess Revenue over Expnditure		45 18 7
		£360 19 6

Revenue :

	£ s. d.	£ s. d.
Subscriptions		225 15 0
Proceedings		63 5 0
Advertisements		46 4 0
I.M.E.A.		5 15 6
Statistical Tables		20 0 0
		£360 19 6

BALANCE SHEET AS AT 31st AUGUST, 1936.

Liabilities :

	£ s. d.	£ s. d.
Subscriptions paid in advance		4 4 0
Accumulated Fund—		
Balance as at 4th Sept. 1935	300 13 1	
Add surplus for year ..	45 18 7	
		346 11 8
		£350 15 8

Assets :

	£ s. d.	£ s. d.
Union Loan Investment ..		200 0 0
Sundry Debtors—		
Current year	9 8 0	
Balance, 1935	9 9 0	
		18 17 0
Cash at Bank		131 18 8
		£350 15 8

E. POOLE,
Secretary and Treasurer.

I certify that I have examined the books and vouchers of the Association and that the above Revenue and Expenditure Statement and Balance Sheet are correctly drawn up so as to exhibit a correct view of the affairs of the Association, according to the information and explanations given and as shown by the books.

8/10/36.

J. C. JOHNSTON,
Chartered Accountant (S.A.)

The President : Ladies and Gentlemen, I take it from your applause that the decision is unanimous. I therefore have pleasure in announcing that Mr. Rodwell is appointed President for the ensuing year. (Applause).

Mr. Rodwell (Johannesburg): Mr. Mayor, Mr. President, Ladies and Gentlemen, I appreciate very much indeed the honour you have conferred on me in electing me to the Chair; but I can assure you I shall appreciate much more the confidence thereby expressed. I shall have the pleasure of addressing you later on this subject, during my presidential address. I thank you. (Applause).

(**Mr. A. T. Rodwell** then occupied the Chair).

VALEDICTORY ADDRESS.

Mr. A. T. Rodwell (newly-elected President) : My first duty is that of calling upon our Retiring President to present his valedictory address.

The Retiring President (**Mr. G. G. Ewer**) then delivered his valedictory address as follows :—

Retiring President's Valedictory Address

by **Mr. G. G. EWER, D.S.O., T.D., M.I.E.E.**
City Electrical Engineer and Transport Manager,
Pietermaritzburg.

Gentlemen,

No matters of outstanding importance have come before the Executive Council since the last Convention, but it gives me great pleasure to state that the new Rules and Constitution adopted last year, have proved their worth, and, as stated in the Secretary's Report, have resulted in a substantial increase in membership.

At our last Convention, 35 Towns were members of the Association. During the year under review, 16 other Towns have joined us, making the total 51. I think you will all agree that this is highly satisfactory, and when it is noted that these 51 Towns have a total of approximately £13,000,000 invested in their Electricity Supply Undertakings, it will be appreciated that the Association has very considerable interests in all matters appertaining to Municipal Electricity Supply.

South African Electricity Undertakings provide employment for over 10,000 Europeans and Non-Europeans, and the salaries and wages paid amount to over £1,600,000 per annum. They supply the constantly increasing demands for Electricity to a large proportion of the population of South Africa and Rhodesia, and incidentally, they contribute largely to the relief of rates of many of the towns concerned.

The Secretary mentioned in his Report that there are still a few Towns which have not yet linked up with the Association. It is to be hoped that these few Towns will, in the near future, see their way to do so, and so assist in making the Association a fully representative body of all Municipal Electricity Supply Undertakings of the Union of South Africa and Rhodesia. The Secretary also mentioned the loss of two Executive Council members during the year — Mr. A. R. Metelerkemp and Mr. T. Millar. Whilst heartily congratulating Mr. Metelerkamp upon his important appointment, it is with regret that we record the termination of Mr. Millar's services as a member of the Executive Council, and on behalf of the Council, I wish to express grateful appreciation of his work for the Association since its inception.

One of the most important subjects to be dealt with at this Convention is the question of the Licensing of Electricians and Electrical Contractors. This has been under discussion for several years, and at last it appears that something may be done to place it upon a satisfactory basis. I trust that this Convention will consider carefully, and will adopt such measures as may tend to this end. Closely connected with this matter is that of Standard Electricity Supply Regulations. This has also been under consideration for some time, and it is anticipated that the draft proposed Regulations will be available at an early date. In this connection, I am wondering if anything will ever be done to compel Consumers and others always to replace fuses correctly. I mean, of course correctly as regards capacity. There are, of course, many types of fuses available, which prevent any but the correct size being used, but to the large majority of consumers any piece of wire, irrespective of metal or size, is good enough —even sometimes a hair pin!

Last year, the retiring President mentioned in his address The British Electrical and Allied Industries Research Association. This resulted in several communications being received from that Association, together with full details of its work. A circular letter dated the 18th September, 1936 has now been received. This letter is written for the information of Electricity Supply Authorities and Engineers in South Africa and Rhodesia, and copies are available to members of our Association on application to the Secretary. The British Electrical and Allied Industries Research Association is carrying out very valuable work on behalf of the Electricity Supply Undertakings of the Empire, and I commend it to the members of our Association for such support as may be available. Copies of the Annual Report and List of Reports available to members of the Electrical Research Association may be seen on application to the Secretary.

The question of affiliation of our Association with the "Scientific and Technical Societies of South Africa," which was raised at the last Convention, has been dealt with by Mr. Rodwell, and I understand that he will report the position at this Convention.

As resolved last year, a circular letter dealing with the use of Electricity profits in Relief of Rates was sent to the Town Councils. Nothing has transpired, except that, according to a Press report, the question was discussed at the recent Conference of the South African Federated Chamber of Industries, when the following resolution was proposed :—

> "This Convention urges the Government to amend the Electricity Act of 1922, so as to bring Municipal Electrical Undertakings under the control of the Electricity Control Board, in so far as the framing of industrial tariffs is concerned, and, to make it illegal to utilize such industrial electricity tariffs for the purpose of alleviating rates or for any other purpose not directly connected with the supply of Electricity."

This resolution was referred to the Executive.

The Press report referred to was brought to the notice of the Natal Municipal Association at its Conference held at the end of last month, when I understand the proposal was strongly opposed.

I am glad that I can hand over the Association to our new President in a very sound state, both financially, and as regards membership and usefulness to its Council and Engineer members. The Convention programme before us to-day gives a list of the valuable and important papers which are to be read and discussed, and I am certain that these will be of great interest to all members, and of assistance to many.

For the sound state of the Association I feel that we are greatly indebted to our energetic Secretary and Treasurer, Mr. E. Poole, who has worked whole-heartedly for the Association for many years, and particularly since his appointment as permanent Secretary & Treasurer, two years ago. Our sincere thanks are due to Mr. Poole for his work and I desire personally to thank him for his assistance at all time during my office as President. I also wish to thank all members of the Executive Council for their assistance and loyal support during the year and for their prompt response to all requests made to them.

Mr. President, I offer you my hearty congratulations on your appointment, and now hand over to you the reins of office, trusting that you will meet with every possible success during your term as President.

The President : Ladies and Gentlemen, our Retiring President, Mr. Ewer, will, I am sure, realise from your applause how much we appreciate his inspiring address dealing, as it does, with this record of successful achievement, and indication of problems for the future—which I am sure the Association will successfully overcome.

SUNDRY ADDRESSES.

We have with us to-day Dr. van der Bijl, who, as you know, is the head of the Electricity Supply Commission in this country, and I feel this would be an opportune time, before I present my Presidential Address, for him to address us. I will now ask him to do so.

Dr. H. J. van der Bijl (Johannesburg) : Mr. Mayor, Mr. President Ladies and Gentlemen, let me thank you very much for the hospitality you have extended to me, and for inviting me to attend your Conference which I know is always extremely interesting.

I am a firm believer in engineers coming together from time to time, especially when those engineers are municipal engineers. Some of you do your work in the larger centres, and some do your work in the smaller towns, well away from the beaten track, and, by coming together periodically, it affords you an opportunity of comparing notes and of benefitting by one another's experience. We know that every electrical engineer does his best for his own community, but, by being afforded this opportunity of meeting others, they can render even better service to their own communities, and thereby the whole country benefits.

Apart from the technical questions which are usually discussed at Conventions like this, although I do not believe that engineers should busy themselves with politics, there are broader questions which, I understand, this Convention has dealt with in the past, and which probably fall within the scope of engineers' conventions; for example there is the question of tariffs which, I think, can still be improved upon and simplified, and the simpler the tariffs are, the better for us who try to sell electricity.

Then there is the question of safety, not only of the users of electricity, but also of property, and the question of safety not only applies to wiring but also to apparatus. In this respect, I think your convention can do a great deal of good in driving our thoughts in the direction of safer wiring, and safer apparatus.

There is also the other matter of finding out what are the best means whereby it can be brought home to the people of South Africa as to what electricity itself means for the community, for its welfare, and for the general development that every town in South Africa is keen on acquiring.

Probably the most imposing structure at this Exhibition is the Tower of Light. That Tower symbolises the extent to which our civilisation rests on the use of electricity;—the position of the Tower which the Exhibition authorities have been kind enough to let us have, and its general design, symbolises the position that South Africa has gained among the nations of the world, in the use of electricity (Applause). -Every time I go abroad, I try to look into things there and make a comparison with the extent to which electricity is used there, with South Africa. Just recently, I have had an opportunity of making the comparison by looking into the supply and use of electricity in what is always regarded as the world's leading country in that matter, namely, the United States of America; and I can say this, that South Africa is right in the forefront of the countries of the world in the use of electricity. (Applause). You will find many more shall I say, non-municipal in the lights in New York, London, and many other cities, but that is of course, because the people over there believe in more advertising than we do. I remember, only 15 years ago, our streets all our South Africa were very badly lighted; but to-day one finds that our streets are just as well lighted and in some cases better lighted than the streets of these overseas cities which are not illuminated with advertising lighting.

The Municipal Electrical Engineers of South Africa deserve a great deal of credit for this improvement.

A Convention such as this also creates very healthy rivalry between the different towns. That is all to the good, and I believe it is this rivalry which has helped them to put South Africa in such a good position as compared with the rest of the world; and I am sure, seeing now, what South Africa has done—what you gentlemen have done—that I can cherish the hope that we may yet take the lead. That, however, will not be possible until the Town Councils of South Africa see that it is not a wise thing to take too much of the profits of their electricity departments for the relief of rates in other directions. It may possibly be argued that, to some extent, that policy can be justified; that may be so, but I think it is going a little too far.

I understand that you are going to visit the Klip Power Station. Let me take this opportunity of personally extending to you a very hearty welcome to Klip. I hope that you will see something very interesting there. I am not asking you to be impressed with the size of the Klip Power Station, for I do not wish to see what I may call a "super-sized complex" develop in South Africa. The size of Klip is only an indication of the rapid development of the Rand, but you will see other features about it, which as electrical engineers you will find extremely interesting.

It gives me great pleasure to see that this Association co-operates with our northern neighbours—the Rhodesias. (Hear, hear). I believe that co-operation between the Union and the Rhodesias, should be manifest in other directions as well; but I suppose, as usual, it must be left to the engineer to set the eyample—(Laughter)—and if South Africa and the Rhodesias will follow in other respects, both countries, I am sure, will benefit thereby.

In conclusion, Mr. Mayor, Mr. President, Ladies and Gentlemen, let me express the hope that you will have a very interesting and instructive week at the Convention in Johannesburg. (Applause).

The President: I now have pleasure in calling upon Dr. Bernard Price to address the meeting. He, as you know, is the General Manager and Chief Engineer of that great power undertaking, known as the Victoria Falls and Transvaal Power Company.

Dr. Bernard Price (Johannesburg): Mr. Mayor, Mr. President Ladies and Gentlemen, I appreciate very much having been asked to address the Meeting this morning as it gives me an opportunity of welcoming your Association and of congratulating you, Sir, on your election as President. I hope your Convention will be a very successful and enjoyable one and that your year of office will be all you could desire.

Yours is an Association of public bodies whereas I represent a Power Company and must therefore I presume, range myself on the side of private enterprise. There was a time, now long past, when the General Manager of the City's Electricity Department would have preferred that I should not be seen in his company (Laughter). You may remember an historic occasion on which the V.F.P. was cartooned in the local press as a very disreputable black cat that would insist on coming back over the garden wall to annoy the Town Council of that date (Laughter). I shall always remember too the occasion when the late Mr. Sankey, for whom we all have such a high regard, referring to my Company as the voracious spider which tried by every subtle means in its power to inveigle the timid Municipal fly to enter its parlour (Laughter).

Well, Ladies and Gentlemen, that time has long gone by and it is due largely to the broadminded attitude of your newly elected President that our respective undertakings, operating so closely alongside one another, have come together and found it possible to co-operate effectively for the benefit of the community.

It is, I think, opportune that you should hold your Convention this year in Johannesburg. You will be able to see this great Exhibition, and electrical development on the Rand has reached an interesting stage. The Electricity Supply Commission and my Company are, as you know, working closely together in this connection and we are having our work cut out in trying to keep pace with the expansion now taking place in the requirements of the Mining Industry and other consumers.

For and on behalf of the Commission my Company is operating the new Klip Power Station which we are looking forward to showing you on Thursday. It is laid out for an ultimate capacity of 400,000 K.W., one-third of which is already installed and running, and in order to keep pace with the further expansion still in prospect further 33,000 K.W. sets will have to be installed at the rate of one every six months.

The Rand Undertaking is, I believe, the largest of its kind in the British Empire. The total sales to Mines and other consumers exceeds 2,000 million units of electricity per annum and well over a quarter of a million units of compressed air. But Gentlemen, the importance of an undertaking supplying a public need is not to be measured by its size alone. Most of my Company's output is sold to the Mines but a bulk supply is being given to every Municipality within the area (except Johannesburg), representing an aggregate of more than 50 million units of electricity per annum sold to Municipalities. These responsibilities are similar to those which you carry in your various Cities, Towns and Districts and their importance cannot be put into figures. Whether we are representatives of Municipalities or private undertakings we all aspire to a common ideal, namely that of serving to the best of our ability, the public in South Africa (Hear, Hear).

In conclusion, Ladies and Gentlemen, allow me to express the hope that this your Fourteenth Convention will be memorable in the history of your Association and that the time you spend amongst us here on the Rand will be a most interesting and happy one. (Applause).

The President : Ladies and Gentlemen, we feel that we should not let this occasion pass without mentioning two of the very oldest and foundation members of the Association. I refer to Dr. Dobson, who was the first President of our Association, and to Mr. John Roberts who has been so closely associated with the Association since its inception. There are many others : there is Mr. George Swingler, of Cape Town, and numerous others, who have whole-heartedly worked for the Association ever since it was founded. I mention particularly Dr. Dobson, because he was the first President, and this happens to be our twenty-first birthday.

We shall adjourn now and partake of refreshment, after which I shall present my Presidential Address, and after that, as we have a twenty-first birthday cake, I shall ask Dr. Dobson to blow out the 21 candles, symbolising over 21 years' life.

(The meeting adjourned at 10.40 p.m.)

(On resuming at 11.20 a.m.)

The President : Ladies and Gentlemen, before proceeding with the election of officers, I feel it would be a nice gesture to ask two of our oldest members to address us. I refer particularly, in the first case, to Dr. Dobson, the first President of our Association. I will now ask him to address you for a few minutes (Applause).

Dr. J. H. Dobson (Past-President) : Mr. President, Ladies and Gentlemen, this is a very memorable occasion in the history of the Association of Municipal Engineers, in that it is its 21st birthday, and, as your first President, it has given me very great pleasure, first of all, to be here to-day and to blow out the twenty-one candles on the birthday cake, signifying the completion of 21 years. On the occasion of a twenty-first birthday everybody is supposed to be happy and enjoy themselves, and, because you are in this City, which is celebrating its jubilee, I hope you will enjoy yourselves.

I need not expatiate on the history and policy and the work of the Association; that has been done already very ably by our two previous Speakers. Mr. Rodwell has an important Presidential address, which will follow and I take this opportunity of congratulating you, Mr. President and all the line of Past-Presidents, and your members, for having kept alive this excellent institution which began with thirty-three members in the first year, and as I gather from the Secretary's report, there are now 137 members.

Mr. President, Ladies and Gentlemen, I hope this will be a successful week with regard to technical matters, and I hope you will enjoy everything that is to be seen in the Jubilee Exhibition, and I wish the Association many many happy returns of the day (Applause).

Mr. John Roberts (Durban) : Mr. President, Ladies and Gentlemen, I also prepared a few remarks for this very auspicious occasion, when this Association comes of age; but I have been warned that there are only two or three minutes left, so I must cut out most of what I intended to say.

I very well remember the time when this Association came into being, as a result of a letter I wrote to Mr. Dobson 21 or 22 years ago. For a long time we Electrical Engineers were the only municipal officials to meet in Convention; and I am sure it has been greatly to the benefit and advantage of the important work that we have done all these years. Then other officials got busy. The Town Treasurers formed an Association and began to take a great interest in our finances (Laughter). I do not know whether altogether to the advantage of ourselves, or to the electrical municipal industry (Hear, hear). At any rate, the result as we find it to-day is that all those undertakings who find themselves in the happy position of having a surplus at the end of the financial year, find themselves also in the position of being robbed of it (Laughter) : and it is having a very serious and detrimental effect, in my opinion on the work which the Municipal Electrical Engineers are doing. For instance, now in Durban, there is no revenue obtainable for street lighting which has to be done by the Department for nothing, and I understand that Durban's example is being followed by others, judging by the remarks that I saw in a Leader in the Cape Times the day I landed there from my recent visit overseas. How can a town expect an electrical engineer to actively pursue one of his most important duties—that is to improve street lighting when his department gets nothing for it. It is one of a town's most pressing needs at the present time—I know it is in Durban with its rapidly increasing fast motor traffic: how can he be expected to do that when it is going to have the result of producing, not a real but a paper deficit on the finances of his department. These enormous appropriations from Electricity Revenue in relief of rates is having the effect of preventing the main object of the Electricity Supply Commission, and, I think, of every one of us—that is, the provision of the cheapest possible supply of electricity, not only for domestic purposes, but for industries, and I believe that thinking people to-day are of the opinion that what we want in South Africa more than anything else is a development of our industries. I know that in Durban, if it were not for the extent to which the electrical finances are robbed every year, the price of electricity for power could very easily be reduced by 25 per cent. Those are practical aspects of the matter which should make a very strong appeal to the Municipal Electrical Engineer. We have aired this subject in our Conventions many times, with absolutely no results. Of course, in England, legislation has been brought to bear. The authorities there, realising what a serious effect the unrestricted appropriation of electrical revenue for other than electrical purposes might have in preventing the extension of the use of electricity, passed legislation limiting these appropriations to 1½ per cent of the Loan Funds. In many instances of course, even this modest appropriation is not made whereas in South Africa it is becoming the practice to make up deficits in the general rates out of their electrical concerns. This is a great pity because I believe that if this practice could be prevented the cost of electricity could be distributed in all the larger towns of the Union at figures lower than anywhere else in the World and it is, of course, largely due to the very high consumption per head of population due to the rapid extension of the use of domestic electricity in the past few years.

I think, Ladies and Gentlemen, that we, as Engineers with the good of the electrical industry at heart, should not let this matter rest. We feel ourselves, I know, in many cases up against a brick wall, and the argument is, of course, that it is only handing money out of one pocket and putting it into another. But I have shown you, I think, that that is having a very bad effect, and I do hope that at every Convention, including this one, the subject will be aired, and some resolution will be passed (Applause).

The President : Ladies and Gentlemen I now have to deliver my Presidential Address.

Presidential Address

by A. RODWELL, M.I.E.E., M.I.Mech.E

Johannesburg.

Gentlemen,

I am deeply sensible of the honour you have conferred on me by electing me President of our Association and I realise fully that the confidence thereby expressed imposes responsibilities.

We all feel pride and pleasure in the important position which this Association now holds, representing as it does important phases of electrical interests in South Africa and Rhodesia. This fine achievement it will be my constant endeavour to maintain and advance. I gladly accept your confidence and the responsibilities imposed.

This Convention celebrates the coming of age of our Association which was inaugurated 21 years ago. The first Convention was held in Johannesburg in November 1915. It is a memorable year for the Association and our responsibilities have materially increased. A comparison between electrical engineering at our inauguration and now, not only here in Southern Africa but in other countries, shows that our engineers in South Africa have anticipated rather than waited on events. They have generally planned and organised their operations intelligently with a full consideration of all the essential factors and have not been lacking in the vanguard of progress.

The 21st anniversary of the Association coincides with Johannesburg's Golden Jubilee and the establishment in this city of an Empire Exhibition, which is the first Exhibition of its kind to be held in a Dominion or Colony. As one who has now spent the major portion of his life in Johannesburg I feel I may be pardoned for dealing in this address briefly with a few facts concerning this city, and discussing a few of the problems encountered and lessons learned in dealing with them.

Johannesburg is the industrial and commercial centre of South Africa which is endowed with mineral wealth beyond computation. The colossal yield of gold from the Witwatersrand during the last half century has been the greatest factor in the progress of the country in general and of this city in particular. The supply of electricity dates back to an early period in its existence. The South African town to pioneer electricity supply (and this for street lighting only) was Kimberley, in 1882. Johannesburg was the next to follow in 1891 with plant which consisted of two gas engines and dynamos of 30 H.P. each generating current for light and power. This plant was superseded by the President Street steam station with a nominal capacity of 23,000 kilowatts which has now practically been replaced by the Jeppe Street

Station of 70,000 kW nominal installed capacity with a further 40,000 kW of plant under manufacture and sanctioned. In addition, supplies to the extent of 16,000 kW are available from the Victoria Falls & Transvaal Power Co. Ltd., which supply is normally for use at peak load periods. Of the 208,993,736 units sent out from the Council's generating stations during the last financial year ending 30th June, 1936, 6,229,405 units were supplied to the Victoria Falls & Transvaal Power Co. Ltd., during their day peak load period. A maximum demand of 67,400 kilowatts was reached, this being an increase of no less than 12,500 kilowatts over the preceding financial year. The total output represents 20% increase, with an increase of approximately 22% on the maximum demand over the previous year, and the growth of the output and demand are accelerating. This phenomenal growth has been accompanied with consistent reductions of the tariff scales and is being met on a sound development and financial basis.

It may be noted that it was found necessary for the whole of a 10-year extension programme proposed during the year 1932 and based on the forecast load demands at that time, to be completed during the present year that is within four years, to meet the accelerating demand for additional supply. The whole of this plant is now in operation.

Looking in retrospect and reviewing the chief activities during the last decade, there has been no undue restricted outlook or parochialism in Johannesburg in dealing with the undertaking. A determination to ensure that there shall, as far as possible, be an adequate, economical and suitable supply of electricity has always permeated its activities. It has sometimes been difficult to envisage the true path of progress and development, but is is infinitely more difficult to reconcile conflicting interests when the scrapping of comparatively large inefficient plants and the recasting of systems is involved. Due to these problems and the difficulty in obtaining the rejection of obsolescent plant and methods, initial progress is often retarded.

In common with the majority of local authorities' systems the peak load period is attained during the late afternoon and evenings, whilst the peak load period of the Victoria Falls & Transvaal Power Company's system is reached during the week day mornings. The principle of interlinking power supply systems is desirable from the point of view of interchange of supply and continuity of supply in emergency. This is generally accepted.

The frequency of the Council's system is the recognised standard of 50 cycles per second. The frequency of the Power Company's system differs from that of the Council's system and at times varies. For these and other reasons the interlinking of the two systems is impracticable. Arrangements have been made for a partial supply to the city during its peak load periods from the Power Company by separating generating plant from the Power Company's system in their generating stations, operating this plant at the Council's frequency and feeding into its system. The scheme is therefore not an interlinking of systems or designed to interchange supply, thereby taking advantage of the diversity of the load factors of the two systems, but is merely a supply by plant from an independent outside source, which supply is available for peak load periods on the Council's system at its standard frequency of 50 cycles per second but at other times is operated on the Power Company's frequency and utilised on their system. It is interesting to note that the City Council has at times of stress furnished a supply to the Power Company during the peak load periods on its system under similar conditions. Were it possible to interconnect the two systems in the true sense of the word, the generating plant of the Electricity Supply Commission and of the Company on the one hand, and of the City Council of Johannesburg on the other could be used to yet greater advantage to the mutual benefit of the consumers connected to these systems.

In a report by the Committee appointed to review the National Problem of the Supply of Electrical Energy in Great Britain during the year 1927 (generally known as the Weir Report) the following statement appears :—

> "Interconnection on the complete scale which we recommend is the first essential towards bringing about subsequent and far-reaching improvements in our present system, and interconnection cannot be entirely effective without standardisation of frequency."

Since that date great changes have taken place and Special State Orders, Acts and Borrowing Powers were promulgated to remedy the position in Great Britain. South Africa and Rhodesia are fortunate in that the majority of its centres have adopted the standard frequency of 50 cycles per second, and this frequency is stipulated in the South African Electricity Supply Act.

The Electricity Supply Commission, Victoria Falls & Transvaal Power Co., and the City Council of Johannesberg have co-operated in every possible way to meet the phenomenal conditions of expansion and increased supply demands, and the tradition of the engineering profession of rendering mutual assistance in times of stress has been fully upheld by the respective engineering staffs, so far as possible under the existing conditions.

The city power station is situate in an industrial area or zone, approximately in the centre of the municipal area and is near the load centre. These conditions present many advantages of considerable value in lower reticulation capital costs and reduction in distribution losses. Coal is delivered from the coalfields by the Government Railways, and the water supply is taken from the Rand Water Board through the city's water reticulation system.

The phenomenal accelerating growth of demand in Johannesburg has hitherto made it impossible to make forecasts of demand with any degree of accuracy, and practical judgment based on past and present conditions and experience must of necessity to a large extent dictate the policy of provision for the future. This problem cannot be reduced to an exact science.

Power stations are usually located on predetermined sites governed largely by the availability of water and coal supplies, and should as far as possible be remote from residential, business and commercial sections or zones. Such a site with ample water supplies near a railway for a new additional power station has been acquired for development and interlinking with the existing station to provide additional supplies to the city when the size and capacity of the existing Jeppe Street Station has reached its economic limits, which will be attained in the near future.

Electricity is now an indispensable service in all phases of our modern existence; the control, safety and perfect regulation of processes to which it may be applied is still a revelation to many, but its hygienic and economic use in cities is well understood.

A survey of the layout of the large cities of the world affords striking examples and contrasts as between those which have been marked by a tendency to wait on events rather than anticipating them, with unsatisfactory results, and those which have adopted schemes characterised by boldness of conception based on experience and co-ordinated expert advice.

Taking into account the large new power plants and extension works being installed by the Electricity Supply Commission, Victoria Falls & Transvaal Power Co., and the large municipalities, South Africa has every reason to be proud.

The common delusion of the individual and even communities that existing conditions are the best, that no public service can be improved upon, must be dispelled and advantage taken of every new development as a result of investigation and advance in method and design.

An examination of the city shows that there has been no lack of courage, initiative and resource in the activities during its comparatively short existence, but these alone are insufficient for successful modern city development; the solution of many problems which arise can be effected only provided that the city authorities have all necessary powers conferred upon them by the higher authorities.

The idea is erroneous that where large sums of money have been expended on machinery, plant and reticulation schemes, their use should be continued when it is possible to substitute more efficinet plant and apparatus. The annual saving effected by a change may be more than sufficient to amortise the old investment and to cover the interest on new capital. Rapid progress in design may render costly plant obsolete, and this appears to point to the necessity of building plant for efficient operation with low repair and maintenance costs for a reasonably limited period. We must not lose sight of the possibility that some new discovery may upset the basis of established methods and that science with the industries depending on its application stands ever on the brink of an upheaval. It is necessary to keep in view the growth of obsolescence and discard inefficient for new and modern methods ensuring greater reliability and creating new facilities and benefits to the communities.

With the progress and development of any urban area it is essential to assist in guiding such development along definite lines so that expansion may be achieved at reasonable expenditure without congestion in any one direction, and to as far as possible ensure that the equipment is of such design that it may be utilised and extended throughout its useful life economically without interference with other works or amenities. The general tendency in recent years is to reticulate the sections of an area in zones for residential, commercial and industrial requirements.

Much has been done along these lines, large land companies having laid restrictions on purchasers of land precluding commercial and industrial activities in many suburban townships. The Electricity Department has reticulated certain sections for the supply of industrial power, and the City Council has established an area designated "Industria" served with railway sidings and reticulated with water, power and other public amenities for industrial purposes. Other large areas south of the city which were formerly mining areas, having railway, water and power facilities, are being rapidly and successfully developed by private enterprise.

Whilst splendid work for development has been performed by this sectionalised effort, much greater benefits by reason of elimination of waste accrue to the community as a whole where all these zoning activities are co-ordinated. Wasteful reticulation for public supplies should be forestalled, this being more constructive and satisfactory than belated elimination of waste.

Generally, distribution costs are of necessity high as compared with power production costs. The greatest expense in furnishing electric energy in urban areas is in its distribution, and this applies more particularly in sparsely populated areas. The increase in the height of buildings is, however, adding rapidly to the number of persons accommodated on comparatively small sites, and to the density of the population in central city areas.

In planning or extending a distribution system for urban areas there are certain general provisions to be made which are dependent to some extent on the size and character of the community. It is usually possible with the assistance of census figures, a civic survey and other statistics to estimate approximately the progression and direction of the load to be expected.

The feeder system and low tension network must of necessity be designed in as flexible a manner as possible in order to allow the various stages of expansion to be met with a minimum amount of idle capital during the period of such expansion and without rearrangement of the general plan. It is imperative that the system should be designed to continuously furnish adequate and reliable supply and to reduce, as far as possible, the necessity of disconnecting supplies for fault, repairs and additions to a minimum.

With an established system one of the most difficult problems is to determine the future rate of growth, and it is essential to utilise all possible data to anticipate and forecast load demands. It is necessary to consider the various items not only individually but also in relationship to one another and with due regard to all possible supplementary schemes for existing networks,

To anticipate demand an enormous amount of analysis is, rightly carried out, and whilst it may sometimes be problematical as to whether the work involved is economically justifiable, thoroughness in this regard is desirable and is economically sound on the whole. This applies more particularly with established systems of steady growth.

Whilst the knowledge and instinct of the engineers based on local knowledge of past and present trend of events and development schemes may be a surer guide than can be obtained by theoretical calculations or hypothetical predictions of future requirements, an intelligent anticipation of the growth of the system, coupled and co-ordinated with a careful study of the results of a complete analysis of all available statistics and data, gives the best results.

Apart from technical considerations of design and apparatus dealing with the problems affecting the reliability and security of supply, there are many latent possibilities of trouble which may occur should vigilance be relaxed. From the records and tabulation of interruptions, causes, and period of cessation of supply, the efficiency of methods used and apparatus installed may be checked to ensure that schemes for the future may be of a nature best suited to the area to be served and the more important items should be considered in conjunction with a town planning scheme.

A few years ago, owing to the congestion of public services in the streets of the central city area, it was found increasingly difficult to find sufficient space for electric cables, and a system of well ventilated, illuminated and drained underground cable subways or tunnels fitted with cable racks was installed in the form of a ring and branches from the generating station, through and round the central city area.

The necessity and convenience of these cable subways have been demonstrated fully; they have proved of tremendous value to the city, having reduced the cost of installing feeder cables and obviating the inconvenience and expense of excavating public streets. Since their introduction large numbers of feeders have been laid at a minimum of expense and without interruption to traffic. In addition, a large number of ducts and pipes for drawing in cables have been installed to obviate the necessity to excavate important streets for repairs or future additional feeders. Owing to the comparatively high capital cost this provision may not be possible except in the larger towns.

In addition to ease and safety of operation, provision for additions and extensions, æsthetic and architectural considerations, when designing sub-stations it is necessary to arrange the spacing so that intermediate sub-stations may be installed when required to furnish additional supplies, restrict the size of low tension networks, and shorten low tension distributors.

The difficulties experienced by public authorities in obtaining suitable sites for sub-stations in developed areas are well known. It is essential that prior to development sites should be set aside for this important public service in all sections taken into municipal areas.

The high value of sites in the centre city area, followed by the increase in height of buildings, greater number of persons accommodated and increase in demand for electric energy, necessitated a departure from the use of low voltage networks, and 6,600 volt high tension three-phase ring mains looped into basement transformer sub-stations in large buildings have been laid and connected. When low tension reticulation is necessary in the central area, this is effected largely by arranging with the owners of buildings to furnish sufficient space in their buildings to be fitted and used by the City Council as a "mutual service sub-station" for low tension supplies, both to the owner's premises and to other of the Council's consumers in the vicinity. This system is efficient of mutual benefit and is being extended.

The importance of adequate and efficient street illumination for safeguarding life, protecting property and brightening cities cannot be overestimated. Modern traffic conditions with high vehicle speeds demand the amenity of good street illumination for the safety and comfort of pedestrians, users of vehicles, and the public as a whole. Good street illumination raises the value of adjoining properties, taxable values and encourages progress. In dealing with the design of lighting schemes in streets and open spaces, those responsible have to face difficult problems. There are many variables which it is difficult, if not impossible, to reduce to simple terms.

The street area to be illuminated is generally large, and its length is greater than its bredth, the surfaces have varying reflection characteristics and glare must be eliminated as far as possible. The problems of intensity, visibility, capital and maintenance costs must be given full consideration.

The elimination of haphazard methods of using miscellaneous types of lighting units and the adoption of standard designs most suitable for the various streets and areas in accord with the intensity of illumination desired, coupled with definite planning and zoning schemes, achieves the most satisfactory results.

The first four-way electrically operated traffic signal unit was installed in Johannesburg as far back as the year 1928. This was removed during the same year and replaced by one operating on the system of synchronised control now in use in the centre of the city. At that time little information of the operation and success or otherwise of such signals was available. Taking into account the short distances between intersections and consequent synchronising and timing difficulties encountered in those early days of traffic signals, splendid service has been obtained from their inception. It is interesting to note that a system of traffic signals of the same design was selected and installed in London at a considerably later period. Subsequently the vehicle-actuated and push-button-actuated systems of traffic control were evolved and sets of this apparatus have been installed at suitable positions.

Public streets are one of the most valuable assets possessed by a community under present-day conditions, and in business operations their use is all important. Heavy expenditure of public funds is necessary for the construction and maintenance of streets and to obtain a maximum return on this investment they must be utilised with a maximum of efficiency. An important factor is the time required for traffic movement; the more expeditiously both vehicular and pedestrian traffic is moved, the greater the return on the investment. Public convenience, however, demands consideration and the speed of movement should be the maximum consistent with safety and efficiency.

Improved designs and methods of operation are constantly being devised and a large number of systems under different names giving similar results are now obtainable and may be depended upon to perform the required functions.

The traffic cycle of operation should be fixed only by traffic officials in consultation with the Engineer, and this can only be effected by observation and accurate deduction in the local conditions.

Standardisation as between the cities is particularly desirable, as visitors to a city may become confused and unintentionally violate local regulations by reason of the regulations being different from those to which they are accustomed.

The necessity and demand for traffic control is obvious. The science of traffic control of our cities presents a problem of great magnitude and complexity, and progressive development must continue to take place to cope with the ever increasing traffic on our roads. This development will be successfully achieved by co-ordination and united effort.

It has generally been conceeded in Johannesburg that the most efficient service can be obtained by the acceptance and utilisation of modern machinery and equipment, and this sound axiom has been acted upon. Enforced by modern conditions the keynote of progress is improvement of service with simultaneous reduction of prime costs. The employment of electricity for motive power, lighting, communications and improved working conditions is inseparable from these attainments. An abundant supply of cheap power is often the determining factor in development, and the growth of communities having material advantages has sometimes been retarded owing to lack of these facilities.

Those cities and towns which dispense the greatest amount of power per capita will to a large extent attain to the position of furnishing the inhabitants with the whole of their requirements and in promoting industry.

The opportunities for progress will not be realised by the individual group or engineer working in isolation, but by co-operation and the interchange of ideas with colleagues.

The age in which we live demands co-operation. Inspired by enthusiasm in its work for the advancement of electrical science and service, our Association has brought Municipal Electrical Engineers and Chairmen and Members of Municipal Electrical Committees together as members of the Association in the interests of municipal electrical undertakings and the benefit of the community as a whole. Our Association has attained its majority and is proceeding on its career of usefulness. Its work is promoted by this spirit of helpfulness which finds fitting expression in its diverse activities and co-ordination of ideas, to promote progress and achievement in the municipal electrical field.

Mr. Horrell (Pretoria) : Mr. President, Ladies and Gentlemen, in expressing our appreciation of the President's Address, I feel certain that I am expressing the sentiments of all present. He has given us an interesting review of the electrical progress which has taken place in Johannesburg during the last decade or so, and he has every reason to be proud of his association with these achievements.

His reference to the attainment of our Association's majority on the occasion of this Convention has reminded me that of the original, 22 members, only four are still actively engaged in electrical municipal undertakings, these being Messrs. Swingler, Jagger, Ross and myself. Looking back over our Association's period of minority, one can appreciate much that has been achieved, and realise the important place it now occupies among the various Associations and Institutes existing in the Union to-day.

Our President's engrossing survey of the numerous factors which have to be considered in planning progressive development of Urban electricity supply, indicates clearly the qualities necessary in those to whom the Administration of such undertakings is entrusted, while the amazing electrical development which has been witnessed in the majority of the larger towns leaves no doubt as to the immensity of the task which these undertakings are called upon to perform.

Our President is to be congratulated on the manner in which the electrical requirements of Johannesburg are being met, especially in view of the rapid growth during the past few years and our Association is fortunate in its choice of President for the ensuing year, since the qualities which he has evidenced in dealing with the many problems which have confronted him are now at its disposal.

With these few remarks I thank you Mr. Rodwell for your interesting address and trust that your year of office will be a most successful one. (Applause).

The President : Thank you, Mr. Horrell. The next item on the programme is to confirm the minutes of the meeting held at the last Convention.

MINUTES OF LAST PROCEEDINGS.

The President : The Minutes have been circulated and I would like your permission to confirm them. Is that agreed, that they be taken as read and confirmed?—Agreed.

VENUE OF NEXT CONVENTION.

The President : We now have to deal with the venue of the next Convention. I believe that one Councillor Member has something to say on the subject.

Councillor Middlebrook (Durban) : Mr. President, fellow members, and guests—especially those who occupy the platform this morning—it affords me the greatest pleasure to convey to you the unanimous resolution of the Electricity Committee of the Durban City Council to extend a hearty and warm-hearted invitation to this Association to hold its Fifteenth Annual Convention next year in the City of Durban (Applause). The City—it has been recently elevated to that position and has been enlarged from 11 square miles to 57 square miles. The City, which is the chief port of the Union, handles 1,320,000 tons more shipping than all the other ports of the Union put together, and I think we will have something to show you. It is some years since you had your Convention in Durban, and, as I say, we will have something to show the Association when you come down. I understand, it is Cape Town's turn next, but owing to certain circumstances, it is not convenient for the Association to hold its next convention there; hence, we are extending this invitation to you in the hope that you will accept the invitation from Durban; but do not come in July, unless you wish to be overloaded to your "peak capacity" and extra demands, it might be, on your purse strings, and we have to inflict upon you a survey of peak loads on race horses, hotels, etc., and when there might be a "rupture" in the point of our good relations, which cannot for one moment be thought of. Do come in September October, or November, and we will give you a warm welcome (Applause).

The President : I take it from your applause, gentlemen, that we very gratefully accept the invitation to Durban so nicely put forward by Councillor Middlebrook, and, on behalf of the Association I have to thank him and his Council very sincerely for the invitation to visit Durban next year. I understand it has been suggested that we should go to Cape Town the following year, and it is problematical as to how far this Convention can deal with the matter so far ahead. That will have to be left to the next Convention. But on your behalf I thank Cape Town as well for the suggestion and offer, which will, of course, be dealt with at the next Convention.

ELECTION OF VICE-PRESIDENT.

The President : Ladies and Gentlemen, we will now proceed to the election of officers. I invite nominations for the position of Vice-President of the Association.

Mr. Ewer (Pietermaritzburg) : I have pleasure in nominating Mr. Gyles.

Mr. Jagger (Ladysmith) : I have pleasure in seconding that.

There being no further nominations, Mr. Gyles was declared duly elected Vice-President of the

Association for the ensuing year, and was asked by the President to take his seat on the platform (Applause).

ELECTION OF MEMBERS OF EXECUTIVE COMMMITTEE.

Councillor J. McLean (Port Elizabeth) : I have pleasure in nominating Councillor Gray (Johannesburg), and Councillor Middlebrook (Durban).

In nominating the latter, I wish him to understand that I do not accept his statement that he represents the chief port in the Union (Laughter). Mr. President, I think this new suggested arrangement is a good one. Although I am on the Executive to-day, I think that the Councillor where the Conference is being held should have the honour of being on the Executive Committee, and the Councillor should be one from Durban next year, where the Convention is sitting. I therefore have very much pleasure in nominating Councillors Gray and Middlebrook.

The President : Ladies and Gentlemen, I take it from your applause, and if there are no further nominations, that Councillor Gray of Johannesburg and Councillor Middlebrook of Durban are declared members of your Council (Applause).

For some years, we have co-opted two alternates from among our Council members who, would take the place of either of these Councillors during their absence from any meeting for any reason. We would like them to serve with us on the Council and assist us in our deliberations, but would suggest that although appointed as alternates, they would not have a vote on the Council but would sit as alternates with the Council. I suggest that to you, and with your permission now call for nominations for two alternate Councillors.

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1924.	**"The Commercial Development of Electricity Undertaking"**	H. A. Eastman.
1926.	**"A.C. Sub-Stations and their Equipment for Urban Areas"**	A. Rodwell and P. Fraser.
1927.	**"Electricity Meters"**	A. M. Albertijn.
1929.	"Domestic Use of Electricity"	J. Roberts.
	"Some Notes on Supply Tariffs and Metering Problems"	B. Sankey and L. L. Horrell.
1931.	**"A.C. Distribution in Residential Areas"**	D. J. Hugo.
1933.	**"A Change over from Generating D.C. System to Bulk Supply A.C."**	D. W. Ritson.
	"The Utilization of Surplus Power or Heat for delivery to a Public Electrical System"	J. Roberts & C. Dawson.
	"Depreciation in relation to Electricity Undertakings"	Councillor J. D. Low.
1934.	**"Brief Notes on Gaseous Discharge Lamps"**	B. H J. Tubb.
	"The Development of the Domestic Load in Cape Town"	G. H. Swingler.
	"Thermal Storage"	J. S. Clinton.
1935.	**"Some Considerations in the Selection and Maintenance of Electricity Meters"**	A. M. Albertijn.
	"Street Lighting"	H. Littlewood.
	"High Tension Feeder Protection"	D. J. Hugo & J. Wilson.
	Some Notes on Power Station Water Problems"	A. R. Sibson.

Councillor E. Spilken (Umtata) : Speaking as the member for one of the smaller municipalities of South Africa we should make it our business to have one of the Councillors of the smaller cities represented on the Executive. I do not know who to propose, but I put it to you, Mr. President, as you might be better acquainted with the members of the smaller municipalities; but I do feel that you should include at least one member from the smaller municipalities of South Africa as your Executive Committee.

The President : I invite nominations.

Councillor Fereday (Mayor of Salisbury) : I have a lot of sympathy with the proposal made by the previous speaker; but, speaking as one who comes from a small centre—we do not admit Salisbury as small, but when we come to a city like Johannesburg, we have to—I do feel that we smaller towns have a lot to learn from the larger ones, and I rather feel, in this particular matter, at any rate, you might be wise in having Councillor members on your Council from the larger cities of the Union. There are other reasons for that; I think you would find it perhaps more accessible, more easy, to keep in touch with any matters which you have to consider. I do not know whether you do meet during the year, but it is conceivably possible that you might have to, and they might be more accessible. That is just a little point. However, that may be I have pleasure in nominating Councillor Morrell of Cape Town, and Councillor McLean of Port Elizabeth.

Mr. Ritson (Stellenbosh) : I have much pleasure in seconding.

The President : Councillor Morrell of Cape Town, and Councillor McLean of Port Elizabeth have been nominated and seconded as alternate Councillor members on your Council. Is that agreed, gentlemen? Agreed.

The President : The next item is the election of four Engineer members.

Mr. F. C. D. Mann (Worcester) : I have pleasure in proposing the following four members : Messrs. G. H. Swingler, G. M. Pirie, T. Jagger, E. A. Behrens.

Mr. Wright (Benoni) : I have pleasure in nominating Mr. Harvey of Springs.

Mr. Groom (Roodepoort) : I have pleasure in seconding Mr. Harvey.

Mr. Horrell (Pretoria) : I have pleasure in seconding the nominations of Messrs. Behrens, Swingler, Pirie and Jagger.

Mr. Spilken (Umtata) : I have pleasure in nominating Mr. I. J. Nicholas of Umtata.

Mr. Barton (Kokstad) : I have very much pleasure in seconding that.

The President : The following gentlemen have been proposed and seconded : Messrs. Swingler (Cape Town); Jagger (Ladysmith); Bahrens (Port Elizabeth); Pirie (Bloemfontein); Harvey (Springs) and Nicholas (Umtata). It will have to go to the ballot; there are four members only to be elected.

Mr. L. L. Horrell (Pretoria) and **Councillor J. McLean** (Port Elizabeth) were appointed as Scrutineers, the ballot being taken by show of hands.

The ballot resulted in the following gentlemen being elected to the Council as Engineer members:

Mr. G. H. Swingler (Cape Town).
Mr. T. Jagger (Ladysmith, Natal).
Mr. E. A. Behrens (Port Elizabeth).
Mr. G. M. Pirie (Bloemfontein).

(Applause).

The Convention then adjourned for Lunch given at the invitation of the Mayor and City Council of Johannesburg in the Selbourne Hall.

(On resuming at 3 o'clock p.m.).

REPRESENTATIVE ON WORLD POWER CONFERENCE

The President : Gentlemen, the next item is the election of representatives of various bodies. The first representative we have to appoint is one for the World Power Conference, South African National Committee. In this case, I might say Mr. Horrell of Pretoria is acting at present for us there. I will call for nominations.

Mr. Behrens (Port Elizabeth) : I propose Mr. Horrell of Pretoria.

Councillor Allison (Pietermaritzburg) : I second that.

The President : Gentlemen, Mr. Horrell of Pretoria has been nominated and seconded for the position of our representative of the World Power Conference, South African National Committee. Is that agreed?—Agreed.

REPRESENTATIVE ON SOUTH AFRICAN STANDARDS INSTITUTION.

The President : During the last year, Mr. Horrell was the representative, and Mr. Wright of Benoni was the alternate. Due to unforseen circumstances and pressure of work, they were unable to devote the time they wished to this work, and during the year Mr. Harvey was appointed in their place.

Mr. Gyles (Durban) : I have much pleasure in proposing the re-election of Mr. Harvey.

Mr. Pirie (Bloemfontein) : I have great pleasure in seconding.—Agreed.

The President : Gentlemen, on that sub-Committee were Messrs. Ewer, Gyles, the Secretary and myself. I now ask for nominations for that sub-Committee.

Councillor McLean (Port Elizabeth) proposed and **Councillor Allison** (Pietermaritzburg) seconded the re-election of the previous Papers Sub-Committee.

It having been moved and seconded that the sub-Committee be re-elected **en bloc**, this was unanimously agreed to.

The President : Gentlemen, the next item is a paper by Mr. C. Dawson of Durban, entitled "A Survey of Municipal Peak Loads." This paper should be very interesting to us as it deals with that bugbear of the Municipal engineer, the short period 'peak load. I will ask Mr. Dawson, to now present his paper.

A Survey of Municipal Peak Loads

By Colin Dawson (Durban).

INTRODUCTION :

Practically all Electrical undertakings and particularly Municipal undertakings have been established purely for the purpose of supplying a lighting load. In fact early generating stations were generally known as "Electric Light Works." It was usual for the generators in these early stations to be shut down during the greater part of the day and to operate only during the evening, the comparatively small demand for the rest of the day being met by the storage battery. This, therefore, was definitely a plant supplying only a peak load during the evening. Since those early days the supply of electricity has entirely changed from a pure luxury for lighting only, to a necessity for almost all everyday uses in the domestic and industrial fields.

With all the development however, which has taken place during the comparatively short time that has elapsed between electricity being a necessity instead of a luxury, there has been no solution to the problem of regulating, by means of tariffs or other inducements, the demand for electricity so that the load on the generating station or stations is even a reasonably constant value, or in other words a 100% load factor.

A glance through power station statistics show that only a few stations approach even 50% of the ideal so that the problem of providing plant to meet a short peak once a day for a few months per annum is one which has to be faced by practically all undertakings. The extent and nature of this peak varies greatly with local conditions and although in Durban it occurs in the early evening, the geographical and weather conditions prevailing in other centres may alter its incidence to the morning or midday.

A considerable amount of investigation has recently been carried out in Durban, firstly, with the problem of dealing in the most economical manner with the peak which now exists and secondly of devising tariffs to induce off peak supplies in an attempt to reduce its proportions. The subject is so wide and complicated, containing as it does so many variable factors that the investigations have not yet been completed, but when asked to read a paper at this conference the author thought that sufficient data was available to bring this important subject before the members.

THE PEAK :

The numerous factors which contribute to the peak vary to such a great extent that comparisons between undertakings are difficult, while even in the same undertaking they are liable to change from year to year. This will be evident when it is considered that the main influencing factor is the weather. In Durban it has been found that the peak occurs on a cold rainy evening which may happen at any time in May June or July, the earliest for the last few years being the 30th May and the latest the 10th July.

With regard to the peak, Durban is geographically, the most unfortunately situated in so far that it has earlier darkness with respect to the clock than any other South African town. By 5.30 p.m. in winter it is dark with the result that Domestic lighting, heating, cooking, street lighting and traction loads all coincide to produce a sharp peak at about that time. Briefly the position is that in summer there are two distinct peaks, the first due to cooking, traction, etc., at about 5.30 p.m. and the second mainly to lighting at 7—7.30 p.m.

As the evenings draw in the later peak becomes earlier until a combined peak occurs at about 6.0 p.m., which gradually becomes earlier until the yearly maximum is reached when the peak is about 5 30 p.m. This is shown clearly on chart No. 1 on which five typical monthly charts are shown superimposed. Some figures will clearly show that this problem is one which warrants close study. During the last winter the peak was some 20,000 K.W. greater than the average day load and 16,000 K.W. higher than the maximum load at any other time of the day.

If the output be separated into two parts with 30,000 K.W. as the dividing line then for the three months of May, June and July last it is found that the load factor of the output over 30,000 K.W. is 2.6% 3.7% and 3.8% respectively or 3.1% over the three months while below 30,000 K.W. the corresponding figures are 66%, 67.7%, 68.5% and 67.2%, while for the whole supply the load factor is 40%, 40.8% 40.6% and 39.7% respectively.

Some two fifths of the demand upon the system has therefore a load factor which would be about 2% over the full twelve months, and it is with this portion that it is intended to deal with in this paper.

MAXIMUM DEMANDS OF VARIOUS CONSUMERS :
The first essential in attempting to devise means of reducing the proportions of the peak is to know the amounts which various classes of consumers contribute to the maximum demand and with this object in view numerous readings were taken last winter in the substations. Unfortunately circumstances did not permit fully detailed and separate readings being recorded, but it is hoped this will be done next winter.

However I give below the divisions of demands as between the various classes of consumers for one particular year estimated from the details and records available.

Domestic	27,500 K.W.
Business	5,500 K.W.
Power	4,500 K.W.
Trams	3,500 K.W.
Street lighting	1,200 K.W.
Government and bulk supplies	5,000 K.W.
TOTAL	47,200 K.W.

The domestic demand exceeds by a substantial margin the total of all the other demands and, therefore, the time of its maximum fixes the peak. Although the above may represent with reasonable accuracy the allocation of one winter's peak, the week day upon which the inevitable cold and rainy day occurs may easily cause a marked reallocation.

For example the above peak occurred on a Thursday at the height of the "Season," the afternoon was dark by a quarter to five and a heavy storm occurred at the same time.

Friday is the late shopping night and had the weather been unfavourable on that day instead of the previous one, the proportion of the "Business" demand which includes all lighting other than domestic would have been much greater.

TARIFFS :

Having dealt with the peak as it exists, it would be of interest to next consider some means which have been tried with the object of either reducing its dimensions or encouraging the use of current at other times to reduce its proportions.

It is not the intention to discuss at length the question of tariffs but only those designed for the purpose under discussion. One of the earliest tariffs designed to encourage the use of current at off peak times and one which is still in use, is the two rate tariff in which two meters and a time switch are installed and all units used during the evening hours are charged at a high rate while for the remaining 18—20 hours a much reduced rate applies.

Special lower tariffs are offered for such demands as shop lighting, etc., the supply for which is controlled by time switch or other means which ensures its not being used until after 6 or 6.30 p.m. before which time the high rate is charged.

A tariff which was introduced with the object of increasing the use of current except at the peak hours and which has been taken advantage of to some extent in Durban by large manufacturers, is the restricted hours tariff in which the consumer undertakes to substantially reduce his demand over the peak hours. The demand on peak is included in the maximum demand charge as portion of the fixed costs of supply, and so long as this is not exceeded the consumer obtains the benefit of a cheap unit supply. Any excess over and above the stipulated demand on the system peak is charged at the full maximum demand charge or a correspondingly high unit rate.

A tariff of this nature must be applied only after careful consideration as to its possible effects, as of course it would defeat its object if for example it created a higher peak at another period of the day. Further it would be applicable only to certain industries which are capable of regulating their factory working to suit the above conditions, and where one undertaker only is concerned.

REDUCTION OF PEAK DEMANDS :

In addition to those tariff inducements mentioned earlier in the paper, which in the main are inducements to use current off peak, numerous schemes have been put forward at various times with the object of reducing the actual peak. These are mainly aimed at reducing the domestic demands by switching off water heaters, heat storage type stoves, etc., and, it would be interesting to attempt to estimate, in the case of Durban as an example, the extent to which this particular aspect may be practical in view of the predominance of the Domestic demand.

The possible reduction in peak is the amount by which it exceeds the maximum load at any time of the day and in the case of Durban this is, as stated, at the present time to be some 16,000 K.W.

It is impossible to ascertain exactly what proportion of the demand on the Power Station can be allocated to each of the domestic services and appliances, but in order to arrive at some estimate, the amounts are assumed as follows :—

Lighting ..	.3 K.W.	average at P. Stn.	7,000 K.W.	total
Cooking ..	.6 K.W.	,,	12,500 K.W.	,,
Water H'ting	.2 K.W.	,,	4,000 K.W.	,,
Miscellaneous *(radiators, refrigerators, etc.)*	.2 K.W.	,,	4,000 K.W.	,,
TOTAL	1.3 K.W.	,,	27,500 K.W.	,,

This somewhat arbitrary division may at first sight appear to be open to criticism particularly with regard to the cooking load but careful consideration of the probable demands from lighting, heating and miscellaneous would indicate that these estimated demands are reasonable if not under estimated and the balance must, therefore, be the cooking demand. It must also be remembered that all consumers contribute towards at least the lighting and miscellaneous demands, whereas only some 2/3rds. have stoves installed.

STORAGE STOVES :

There have been several articles lately in the technical press dealing with the thermal storage cooker, the chief advantage of which is claimed to be its reduction in peak demand, this being based on the fact that the average stove consumes, when all elements are on full, some 6 K.W., whereas a storage cooker would have a controlled maximum of ½ up to 2 K.W.

Mr. E. L. Damant in his Presidential address to the Natal Institute of Engineers recently, put forward the suggestion that the storage cooker offered such an economical advantage over the ordinary stove that it would be cheaper for the Electrical Department to supply the consumer, free of charge, with one of these stoves rather than allow him to instal a stove of the ordinary kind. This revolutionary idea, at any rate for the electrical industry, is worthy of serious study of all its probable consequences, but for this paper only its likely effect on the peak will be considered.

The inducement of a free stove would undoubtedly result in a 100% stove installation and a large increase in unit sales.

It has been deduced from above that the maximum demand from stoves is some 12,500 K.W. or .85 K.W. per stove installed, the number of stoves installed being based on the Departmental records, although it is probable that the actual number is in excess of those recorded. This demand would require a searching investigation before any such scheme as outlined above could be considered, but as a rough guide of its practicability the following details will be enlightening. To ascertain the correctness of the cooking demand arrived at above should be the first consideration, and one of the first features obvious from an examination of load curves is the difference between demand on Sunday and the evening demand given above.

On Sunday the peak occurs about midday, and can be reckoned as comprising practically all cooking load. This peak is about 22,000 K.W., of which it may be assumed that cooking accounts for some 20,000 K.W. or 1.4 K. W. per stove, and it is necessary therefore, to find some satisfactory explanation for the large difference between the Sunday and weekday cooking demands. In the author's opinion this is due entirely to diversity.

During the week some people have their principal meal at midday; while the others dine at any time between 5.30 and 8 p.m.; and these two factors would account for a large diversity factor. On Sunday however, the large majority of consumers would take their dinner at between 12.30 and 1 p.m. which narrows down the time from two and a half hours to one half hour, and further includes the consumer who habitually dines at midday.

Many years ago the Durban Electrical Department experimented with thermal storage for hot plates only. Two 3 plate cast iron blocks were made, one solid and one hollow and filled with zinc, and it was then realised that unless very low loading elements were used the value of the storage principle would be nullified. The economic rating was first fixed at 300 watts but it was soon realised that this was insufficient for practical use and it was increased to two elements totalling

800 watts but eventually the results obtained discouraged further experimenting even at the increased rating.

What actually happens is that in the morning the storage is up to its maximum heat, but after being in use during the day it had insufficient reserve, and was cooling off just when most required in the late afternoon. This may have been overcome by increasing the size of the block but it was unwieldy as it was and additional weight was out of the question. The author is not aware of any successful method of providing stored heat for the oven, this being supplied by the usual elements.

The maximum loading for one of these types of stove is given in a recent issue of the S.A. Electrical Review and Engineer as 2 K.W. of which 500 watts was used for the continuous heating of the hot plates and the switching is so arranged that when the oven is on full the hot plate element is off. The author has been unable to obtain details of this stove and is therefore, unaware of its size, weight or of the medium by which the heat is stored. At least 500 watts however, per stove would be used over the peak leaving very little above the present diverse average demand for the oven and it is doubtful whether any saving in maximum demand would result, in fact, as it would be impossible to prohibit the use of extra hot plates, etc., the present demand may be exceeded. With current at .45d. per unit the consumer would undoubtedly react unfavourably to restrictions or any apparatus which requires continuous attention. Further, to obtain the best results, the stove would be heavy and probably require more skill in operation than the native is capable of, and lastly would consume more current, owing to the 24 hour radiation losses.

WATER HEATING LOAD :

In the estimates made above, a load of 4,000 K.W. is allocated to water heating at the time of peak. As most of the domestic water heating could be done off peak, this represents a potential saving of some 4,000 K.W. The value of this reduction in peak is problematical but assuming it amounted to as much as £4 per K.W. per annum this would amount to the large sum of £16,000 per annum. Some expense would be involved in installing and maintaining apparatus to control the demand and for the 8,000 water heaters installed this may be at the least about £4,000 leaving an optimistic saving of some £12,000 per annum. Spread over all the domestic consumers this would mean about 1/- per month per consumer or 2/6d. per month per water heater consumer.

If an attempt were made to control this water heating demand by an inducement of some 2/6d. per month to those consumers who would consent to restrictions, the difficulties confronting the supply undertaking can easily be visualised. The lot of the person concerned in trying to explain to 12,000 consumers why their 8 000 neighbours have half a crown deducted from the minimum charge because they have a water heater installed, or again why they are "wasting" money in installing expensive gear to prevent some consumers using the heater at certain hours when they 'never' use or want to use the heater at that hour would be an unenviable one.

Unless some inducement were offered, consumers would not agree to restrictions for the benefit of others, particularly as there are no such restrictions in force for the heaters now installed.

PLANT TO MEET PEAKS :

Having dealt with the peak which has to be met by all undertakings to varying extents and some of the means which have been suggested and adopted to reduce it, the next step should be to investigate the methods employed to provide the necessary plant to cope with the demands.

In the early days of direct current generation the storage battery formed a valuable means of regulating the generation, in such a manner that at times of low loading the battery would absorb the surplus current generated, to be re-used during the maximum period to supplement the generators.

The load on the machines could therefore be regulated practically independently of the demand, and also would permit of the shutting down of the plant altogether at times of very light loads.

There being, as yet, no substitute for the battery for alternating current, the machines must be run continuously, and the loading varies directly with the demand. This means that during the early hours of the morning, only about 1/6th or 1/7th of the plant required to meet the peak will be running, and that turbines and boilers have to be put into commission as the load increases towards the peak, after which they have to be shut down again.

As was shown earlier in the paper the load factor in Durban for the demands above 30,000 K.W. is at the most 2% per annum, the actual maximum being some 20,000 K.W. in excess of this figure. Without standby, therefore the capitalised value of the plant which is used to the small extent of 2% load factor would be about £350,000 or at 8%, £28,000 per annum in capital charges alone.

This therefore is the reason why old and comparatively inefficient plant is kept in commission where peaks of the dimension given above have to be met. The comparative inefficiency of the plant is entirely overshadowed by the saving in capital expenditure on new plant which would remain idle for the greater portion of the year. Where there is one generating plant only, the newer machines are run to supply the base load and the older ones run only as spares and for the peak. The English Grid is an example of where a large number of stations are interlinked, and where, in order to obtain the maximum economy the newer and larger plants are run fully loaded as long as possible to supply the base load and the older plants brought into commission only in the winter, to run one, and in some cases, two shifts per day to cope with the peaks. When the Grid was planned it was estimated that within a comparatively short time all the old stations would be discarded; but practice has shown this to be far from being the case and the latest information available is that very few indeed of the old plants have been scrapped.

The fundamental differences between the duties required from a plant to deal with a base load, and that for a peak load, will probably lead, in the future, to two separately designed plants, the one for high efficiency and load factor and the other for quick emergency starting, low capital cost and low load factor.

THERMAL STORAGE :

An attempt has been made to replace in part the functions of the D.C. Storage battery, by storing energy in the form of heat in water at times of low boiler requirements for use again to assist the boilers at the peak. Two methods have been used, one of which has been based on the principal of the generation of steam at falling pressures, and the other in storing heat in the feed water and utilising the difference between the normal feed and Boiler saturation temperatures. It is unnecessary to amplify this description as an excellent paper was read before the Association at the Salisbury Convention by Mr. Clinton on this subject.

Both these methods were originally developed to equalise the loading on boilers supplying continuously fluctuating loads such as in factories supplying process works and to replace, in effect the large water content of the shell type of boiler, which acted in a similar manner to the variable pressure accumulator. They have, however, been adapted for supplying the seasonable peak on generating stations. The variable pressure type requires specially designed turbines which can be used only in conjunction with accumulators and whose efficiency must be low, whereas the feed water type has the advantage of permitting the use of the normal turbines, the only difference being a small variation in superheat temperature.

There are a number of important features to be considered in regard to the adaption of thermal storage to a municipal generating station which cannot be detailed in this paper. The variable pressure type, when charged, can be looked upon as a standby, capable of an electrical output for a definite period without assistance from the boilers, while the constant pressure type is secondary to the boiler but capable of increasing the output of the remaining boilers, by a limited percentage, should say, one of the number steaming fail. The value of this storage depends, therefore, upon the load at the time of the outage. Taking for an example the case where the difference in feed and saturation temperatures permits the storage a margin up to 25% increased output, and for convenience the boilers will be rated in equivalent Kilowatts.

Firstly, assume a boiler failed during a light load when only the one boiler were carrying the load, the storage would, in this case be of no assistance.

Secondly. if two boilers capable of a maximum output of say 6,000 K.W. were supplying a load of say 10,000 K.W. and one failed. By bringing the storage into commission, the output of the remaining boiler would be increased by 25% to 7,500 K.W. giving a value to the storage of 1,500 K.W. the remaining 2,500 K.W. would have to be switched off.

Thirdly, with any number greater than four of such boilers steaming the output should one fail would be ample to make up the deficiency.

Generally the author is of the opinion that purely from an operator's standpoint, the boiler would receive preference from the large majority, and therefore it should have marked economical advantages as an essential feature.

PEAK SUPPLY FROM WASTE HEAT PLANT :

In connection with the investigations now being carried out by the Electrical Department with regard to the most economical methods of meeting its peak demands, a scheme is under consideration by which it may be possible to obtain a cheap peak supply from the Waste Heat Steam Plant now being operated by the Durban Corporation Electrical Department.

Members will recall the paper read before this Association in 1933 by Mr. John Roberts and the writer, which gave a full description of this plant. Since that date the plant has operated very satisfactorily to the benefit of both the Corporation and the Company and it will be of interest to give the results of the last financial year which are as follows :—

Units generated	..	9,425,000.
Total cost	.. ..	£4,000.
Cost per unit	.. ..	.102 pence.

The total cost includes 10% capital charges in addition to all operation and maintenance costs.

Briefly this plant consists, at the present time, of two turbines coupled to generators through which the steam from the boilers at 200 lbs. per sq. inch is passed and reduced in pressure for process work. The generators are paralleled with the Corporation's Electrical system and the whole of the energy available from the steam required for process work is utilised for generating electrical power. The surplus over that required for the factory being delivered to the City Mains.

The Company recently installed a Ruths variable pressure type accumulator operating between the boiler and process pressure, one result of which has been the maintenance of a practically constant process pressure.

With this constant pressure it has been found practical to operate the factory at about 5 lbs. lower pressure, which is of course equivalent to a similar reduction in back pressure on the turbines. This appreciable lowering of the back pressure increases the output of the turbines to such an extent that consideration must be given to the installation of larger plant. Numerous steam flow meters are being installed by the Company, and it will shortly be possible to ascertain the steam flow at all boilers and consumption points and when these are all in commission the details and economies will be calculated.

In connection with the investigation to increase the size of the plant the scheme for obtaining, at the same time, a peak output at a minimum of cost, occurred to the author, and as will be seen from the following outline is worthy of full consideration and is, as far as he is aware, quite novel.

Its application in other cases will of course depend upon local conditions and the shape and nature of the peak.

The method which it is proposed to examine will be more easily followed from the diagramatic sketch No. 2 and the probable extent of the economic benefit will be evident if certain assumed steam flows are made, and approximate costs given, and, therefore, 100,000 lbs. of steam per hour will be taken as the average flow through the turbines, this flow being practically constant, the normal fluctuations being taken care of by the accumulator. The capacity of the variable pressure storage installed is 40,000 lbs. steam.

The electrical output from 100,000 lbs. steam, exhausting against a back pressure of 15 lbs. per sq. inch is about 3,000 K.W. whereas if the steam were passed into a condenser at say $27\frac{1}{2}''$ vacuum the output from the same quantity of steam would be about 6,500 K.W. which is therefore 3,500 K.W. greater than the normal output and this amount would be available for delivery to the electrical system at the time of peak if there were some source from which a supply of process steam could be obtained while the boiler steam was being passed directly to the condenser. With an installation of thermal storage such as the one working at the factory, there would appear to be no difficulty in obtaining such a source of supply so long, of course, as the capacity of the storage were sufficient. If a triangular peak were assumed the quantity of steam which would be diverted from the process and discharged to the condenser would be about 33,000 lbs. It would however be necessary to allow liberal margins to cover all contingencies and at least one other storage shell of equal or greater capacity than the present one would be required.

There are two possible arrangements with regard to turbo-generating plant, these being firstly one 6,500 K.W. pass out set and secondly two smaller and separate machines. The choice would be governed by economics and space available, the only difference being that with a pass out machine a small quantity of steam would have to be continuously passed into the condenser, but the amount would be small and would be partly balanced by the increased electrical output, and reduced first cost.

In the case of the Refinery one of the existing machines generates at 6,600 V. and the other at 500 V. and it is probable that the E.H.T. machine would have to be replaced with a pass out set on account of space restrictions. The second machine would be retained on account of its generating at factory pressure and thereby providing an additional safety factor as well as a standby to the transformers.

A supply of cooling water is available, but allowance has been made for an increase in the size of the cooling plant or alternatively a small cooling plant for the condenser supply only. In the first case the factory would benefit generally by the increased cooling facilities, while in the second a simple small pond would suffice for the short period of the peak occurring as it does during the cold weather.

It is probable that the simple and inexpensive jet type of condenser used extensively for other purposes in the factory would be quite suitable for this plant and the capital and operating costs would thereby be reduced.

The operation costs would be practically unaffected by this additional plant and the increased maintenance costs would be very small as the overhaul is carried out by the operating staff during the shut down season. Coal burnt to recharge the storage for the loss of process steam passed to the condenser is included as a cost against the peak supply.

Dealing, therefore, with the additional costs only, it is estimated that these would be roughly as follows :—

Additional cost of Turbo-generator and condenser	£10,000
,, Cooling pond	1,000
,, Switchgear	500
,, Thermal Storage	6,000
Contingencies	1,500
Additional Capital	£19,000
Additional charges at 10%	1,900
Additional coal burnt for recharging storage ..	180
Additional Maintenance and contingencies ..	100
Total additional cost per annum	£2,180

For an extra annual cost, therefore, of some £2,180 a peak supply of 3,500 K.W. is secured or a matter of 12/6d. per K.W. This figure is remarkably low and warrants close investigation where any conditions such as those assumed above may exist. Further it must be borne in mind that whereas a simple back pressure turbine installation is dependent entirely upon the quality of steam required for process work, the addition of a condenser together with the coal fired boilers as used in this factory, renders the plant independent of the factory demand and in fact probably independent of whether or not the factory is in operation.

So long as the output is a function of the process demand, and therefore dependent upon the factory working as a whole, it is impossible to credit the plant with anything in the nature of a Kilowatt charge. In fact, if the main supply is purchased in bulk or even if the supply undertaker operates his own Power Station, they are always liable, in the event of failure of the waste heat plant, for the additional cost of the bulk supply, or its equivalent in stand by plant at its own power station. In fact the factory under discussion has on more than one occasion recently not been in operation at the time of the winter's peak.

With the addition of the condensing unit, however, the whole electrical supply may be considered as a separate and independent unit in which case, therefore, the output which should be credited to the extra cost of £2,180 is the full amount of 6,500 K.W.

This reduces the cost of a peak supply of 6,500 K.W. to the astounding figure of 7/– per K.W.

Summarised the results expected from this waste heat plant would appear to be truly astonishing and something like an Electrical Engineer's dream.

Maximum Peak load	6,500 K.W.
Practically costant load (Sunday evening to Saturday morning)	3,000 K.W.
Cost per K.W. of maximum demand	7/-
Cost per unit generated ..	.102 pence.

These results are due in a large measure firstly to the fact that as the electrical output available from the steam required in the factory at the comparatively low boiler pressure of 200 lbs. per square inch is ample to give a large margin for delivery into the Council's Electrical System, no superpressures and costly pure feed precautions are necessary and secondly because the factory is situated in the centre of a large load and no costly transmission is required.

CONCLUSION :

The paper deals only in a general way with the numerous problems involved in the investigations which have been commenced. A large amount of data has been collected but this has not yet reached the stage when definite conclusions and figures could be included in this paper. I have no doubt, however, that should the subject prove of interest to members another paper dealing with the conclusions arrived at, could be given at a later conference.

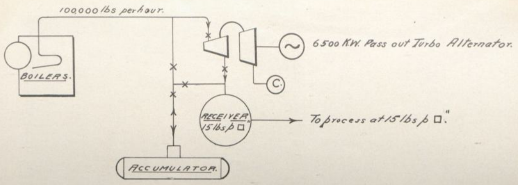
Finally I would like to express my thanks to the Durban Electrical Department for the permission to use the information contained in this paper.

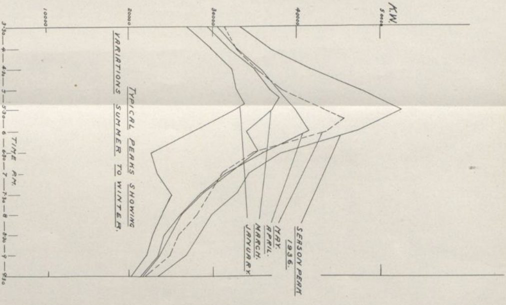
DISCUSSION.

The President : Gentlemen, you have shown by your applause your appreciation of the paper which is now open for discussion.

Mr. Geo. H. Swingler (Capetown) : Mr. President and Gentlemen, I wish to thank Mr. Dawson for his interesting paper on which I would like to make a few observations.

DIAGRAMATIC ARRANGEMENT OF PEAK LOAD FROM WASTE HEAT PLANT.





Electricity supply engineers are in the rather difficult position that while on the one hand they must make provision to meet the demands of load and consumption made by consumers as and when the consumers require the supply even if by doing so the supply authority is involved in additional expense to provide for short period peak demands, on the other hand it is their duty to introduce such arrangements as will tend to cause the consumers' demands to occur in such a way as to reduce that additional expense to a minimum.

Of the various factors mentioned by Mr. Dawson as bearing on the question I would like to refer particularly to what in my opinion has the greatest effect in the desired direction, namely the two-part tariff. This, I think, has a much greater influence in inducing the consumption to be spread over a longer period of the day than even the two-rate metering system. This, of course, applies particularly in connection with industrial supplies where the tariff rate consists of a charge per month or per annum per kVA. (or kW.) of maximum demand, representing the "fixed" costs, plus a low charge per unit supplied, covering only the "running" costs. What influence the two-rate metering system had in improving the load factor when the higher rate of charge, namely for lighting purposes) was in the region of 6d. to 9d. per unit has in my opinion fallen to very small, if not neglible, proportions now that the high rate in corresponding undertakings is from 3½d. to 4d. per unit.

It may be interesting to observe that although solar time in Capetown is about one hour later than Durban our peak load period occurs only a very short time after that in Durban and the load factors of the two supplies are about the same. This, I think, indicates that climatic or geographical conditions are not necessarily important factors in producing unfavourable loading conditions in one centre as compared with another.

I personally do not think that the thermal storage cooker would prove to be an unmixed blessing. From the electrical point of view the base load of the cooker being 100% must necessarily come on the peak load of the station, and I am still open to conviction that a cooker working on that principle in any case is suitable for use under the conditions generally appertaining in culinary work in this country.

In regard to making provision for meeting short period peaks, I would mention that in the course of my recent visit overseas I found that there is a strong wish on the part of Electricity Supply Engineers to get manufacturers to agree as a matter of course to design generating plant with 25% overload capacity which may be placed upon them at any time. As a typical example of this I would mention that while the alternators for the Table Bay Power Station are of 40,000-k.W. C.M.R. rating at 0.8 lagging or leading power factor they are capable of carrying 50,000 kW. for one hour twice a day at any power factor between those limits provided that they have run at not less than four hours at not more than 32,000 kW. before delivering 50,000 kW.

I agree with Mr. Dawson that it is preferable to have a spare boiler in hand to deal with overload conditions rather than have some types of thermal storage system.

A point not touched upon by Mr. Dawson as a means of dealing with peak loads is that very interesting one propounded many years ago, I think, by Dr. V. Z. de Ferranti whereby during the off-peak periods water would be pumped to a height and used later for meeting the peak load conditions. The economic considerations in a system of this kind make it difficult to justify except under favourable circumstances, but I found it interesting at one time to consider the possibility in Capetown of pumping sea water to a height and using it for generation of electricity during the peak periods, running the water to waste through the circulating water system, thereby temporarily saving the cost of pumping water for that purpose from the sea.

Mr. G. J. Muller (Krugersdorp) : We, on the Reef, as you know buy power in bulk, so that the same position as in Durban applies. We cannot, do anything at the station end to counteract the high cost of current over a short period so we must attempt to alter our load. But in supplying electricity, I think the main consideration is to worry your consumers as little as possible; therefore, in any scheme that you may put up, you must first of all consider your consumers. Then the question of tariffs immediately crops up. I think there is quite a nice little bit of danger. A two part tariff may suit us to-day, but in my particular case there is only about 300 kilowatts difference between evening and day, except for the middle of the night. The difference between the day load and the peak night load is round about 8 to 9 in the evening.

Now, if we frame a tariff which builds up a load say, from 7 a.m. to 5 p.m., we may find ourselves properly saddled in about a year's time with a load which we then want to try and take away from the people. Once you have given the facilities, you cannot go back on them. Therefore, I think the safest thing to do is to frame tariffs in such a way that you can meet all conditions. What I have been thinking of is, instead of looking for that wonderful tariff which suits all conditions, rather to set about looking for a load which you can change and control. I think Mr. Swingler has mentioned the question of hot water; I think that is probably the one load which you can play round with a bit, and which, in our case, being I should say, 70% or 80% domestic load, would play quite an important part on our load. In this connection, I had rather an interesting experience. At the Exhibition I saw a high frequency control equipment. This gave me the idea I have been looking for for a long time, to control the hours of hot water from your control point; in other words you would have supervision. I have got a set out on my system now on the street lights, to see how the switching goes. So far, it has not been very successful, on account of minor earths on the system which is worked on the neutral; and, of course, one does not notice it : it does not show up under ordinary conditions.

For the consideration of the meeting, I would suggest thatthey go into this question of remote control. Its use is also very convenient for street lighting. With this apparatus you can control, if not a city of the size of Johannesburg, you can at least control the suburbs, each individually instead of having a multitude of time switches (Applause).

Mr. John Roberts (Durban) : It was with considerable interest that I perused the advance copy of Mr. Dawson's paper entitled "A Survey of Municipal Peak Loads," as it has for some time been in my mind to collect data on the character of the various Municipal peak loads which have to be dealt with in South Africa, from which survey perhaps very useful information on how peak loads were influenced by the character of the load supplied could be obtained. But if Mr. Dawson had set himself at the outset to make a survey, he apparently completely altered his mind before he got to the end of it, because his paper is confined entirely to the peak load of the Durban Corporation system and a description of a special scheme of his own devising to deal with it.

He brings out a point in the sixth paragraph which has been made before, viz : that Durban being "unfortunately" the most easterly large town, daylight fails earlier according to the clock than in any other town in the Union, and in winter time causes the demand for lighting, cooking, power and tramways to coincide to a considerable extent resulting in a high peak of short duration, but the additional energy sold for lighting on this account every day throughout the year probably far more than offsets the disadvantage of the extremely heavy peak for a short time in winter. Incidentally, Mr. Dawson mentions in his paper that the maximum winter peak occurs at about 5.30 p.m. A remarkable thing is that this statement of time could be made much more precise because it is a most extraordinary fact that in normal weather the winter peak occurs at exactly 5.32 p.m. night after night and year after year. Strange as this coincidence may at first appear, it is perhaps only to be expected in view of the fact that—firstly, the habits of people in a mass are remarkably uniform and secondly our South African weather is on the whole also very uniform and daylight consequently fails and darkness sets in almost precisely at the same time according to the time of year every evening and every year. I should not, in fact, be surprised if with more accurate methods of measurements the maximum power generated occurred at the same time within a few seconds.

In regard to methods which could be taken to reduce peak demands, I quite agree with Mr. Dawson that if such means could be found as would not interfere with the reasonable requirements of the average electricity consumer, it would be of advantage to the undertaking in some reduction of its costs, but it must be remembered that the electric supply industry is not the only one which has to deal with peak demands. It must be at least 30 years ago since I ventured to suggest to electric supply engineers that many other businesses suffered from extremely heavy peak loads. Take the average restaurant. If a restaurant proprietor were to analyse his costs in the precise manner in which electrical engineers do, he would find, in exactly the same way as does the electric supply authority, that he could furnish meals at far less cost if he could get his consumers to come in steadily from say 7 o'clock in the morning to 10 o'clock at night instead of feeding practically all at the same time — say 8 a.m., 1 p.m. and 7 p m. He woul also find that the total costs of his business could be divided under two main headings :—

Consumable materials, and
Standing charges.

In the one case consumable materials consist of fuel, lubricants, etc., in the other, they consist also of fuel in the form of food and lubricants of various kinds. He would further find that the cost of his fuel was probably very much less than that of his standing charges and that it is just as impossible to provide a cup of tea at a figure anywhere near the cost of its ingredients as the electrical engineer finds it impossible to supply a unit of electrical energy at the cost of coal and oil employed in producing that amount of energy. It is, in fact, necessary to charge, say 3d. for tea which may not cost more than ¼d. in its materials.

Of course, if the convenience of the consumer and the benefits which he derives from electricity are not adversely affected, means should be explored to reduce peaks if possible, and the suggestion Mr. Damant made in a recent paper to instal thermal storage shelves, was a very reasonable one and it was with this end in view that many years ago I carried out the experiment referred to in Mr. Dawson's paper on a stove with such internal capacity for storing heat that it could be supplied with a small amount of energy continuously through the 24 hours and give up this heat at high rates when the consumer required it. The attempt made, however, was crude and a trial of the stove in practice was not encouraging. Other attempts have been made on the same lines, particularly in Switzerland, but I am not aware that a satisfactory appliance has yet been put on the market. It is, I think, impossible to make a thermal storage cooker to meet the needs of the housewife as well as does the modern electric stove. It is its great flexibility and readiness for service which makes electrical kitchen equipment so extraordinarily successful in South Africa. The electric stove never lets her down. It will make her afternoon cup of tea or stand up to the heavy demand she makes on it say on Christmas Day without a sign of overstrain. It is more than likely that a thermal storage cooker, unless it were designed for a very heavy overload capacity which would greatly increase its cost and size, could not roast a turkey, cook enormous quantities of vegetables, boil the Christmas pudding and warm the mince pies without sitting down under the job. Moreover, the probability is that if the housewife were asked to use a stove of this type she may be induced to try exactly the same kind of stove heated with coal, which would give her the same results at perhaps 1/10th of the cost.

I will not follow Mr. Dawson through his brief summary of thermal storage systems used in power stations particularly that part which deals with the storage of hot feed water. But I am greatly interested in Mr. Dawson's ingenious proposal to use the waste heat plant for peak load purposes which I designed and established some years ago at Messrs. Hulett's Refinery by agreement with the firm on the recommendation of my dear old friend the late John Malcolm, their progressive chief engineer and an enthusiast on all thing electrical. My object was to put into practice a principle I had preached for many years previously, viz : that whenever steam is used in large quantities for process work an opportunity occurs to generate electricity at an efficiency approaching 100% instead of 15% which which was a good figure in those days. The plant was an outstanding success from the start. The notion of using it specially for peak load service was not exploited as factory operation is seasonal and output at the time of the Corporation's yearly peak could not be relied upon and the Company received no credit for peak load service.

Mr. Dawson's proposal raises new aspects from the point of view of the Company, the Corporation and perhaps the Commission for he proposes to make the plant capable of production at any time whether the factory is using process steam or not.

As the plant is now working with a steam storage shell in use the output can be increased up to 3,000 Kilowatts of which the factory takes 1,000 Kilwatts, leaving 2,000 Kilowatts available for delivery to the mains but the generators being capable of only 2,000 Kilowatts, this larger output can not be used. If they were made capable of this output and if Mr. Dawson's idea of using them whether the factory is running or not, then by steaming them and opening up the exhaust to atmosphere when the factory is not in operation, they could be relied upon to supply 2,000 Kilowatts to the mains at the time the Corporation's peak and at a figure of say £3. per Kilowatt the Company could be entitled to at least half the proceeds, viz: £3,000 per annum. Mr. Dawson may argue that as the Corporation's Alice Street plant is in reserve, then the Company would only be entitled to the saving to the Corporation by not using their own Alice Street plant, and if this is sound then the value of the Refinery plant for peak load supply largely falls away.

Turning now to the proposal that the plant should be adapted for use as condensing sets during peak times, the factory relying on stored steam by installing another shell of the same or larger size than the present one, Mr. Dawson is quite right that around 6,500 Kilowatts should be available from the new condensing turbines he suggests should be put in and on paper a very large revenue would accrue to the plant if it were legitimate to credit it with a standing charge saved to the Council at the price the Council pays the Commission for standing charges, but again, if it can only be credited with the savings effected in not using Alice Street, its value as peak load plant largely falls away.

Here I might say, however, that Mr. Dawson's estimate of the cost of operating the plant when the factory is idle so as to make it available whether process steam is wanted or not does not seem to me to be sound. He puts it down at £2,180 per annum of which £1,900 goes in capital charges. But if the factory is not working then boilers have to be brought into use and banked all day ready for the short evening run. Staff have to be retained in quite large numbers even if the actual daily use lasts only half an hour unless the whole staff are at present retained for repairs during off-season.

The plant is apparently designed to take care of a triangular peak service, and I understand that the capacity of the cooling plant at Alice Street is also such as to confine the total energy output to a peak of this character as is also the Congella thermal storage plant. If these three plants are all to be used together for peak service, only one can be used on the top of the triangular peak. The others would have to be operated on a lower maximum output over a longer time.

Mr. J. W. Phillips (Bulawayo) : I should also like to congratulate Mr. Dawson on his paper on a very important subject to municipal engineers. I have a few comments to make : the first is as to the question of restricted hour supply, which has been mentioned, I do feel that if we wish to make electric cooking popular we must not only sell it cheaply but we must make no restrictions whatsoever of which the consumer is conscious; we must not have any method whereby the load is switched off at certain times. It has a strong psychological effect; people will say, "I do not want this if I can only have it at certain time." We have got the peaks and we must deal with them as they come. If one could devise some means whereby the consumer is not conscious of any restriction, it is all right. With large consumers, that can be done of course, with a two-part or two rate tariff.

I disagree with Mr. Swingler with regard to the thermal storage heater and stove. Recently, I have been trying out one of these stoves very thoroughly, and although I quite agree they are not of any value to a large family or a family that entertains a lot, at the same time I think there is a definite scope for them. I think they are of great value for outside areas, where it is not economical to run heavy copper for stoves of 6 to 8 kilowatts peak load. These stoves have a constant load of 400 to 500 watts which is switched off when the oven is switched on, the maximum demand being only 2 kW. I might say they are very efficient. We have been trying one for three months now, and it has used on a average 9 units a day, catering for all our meals; which is quite good.

To come to the question of thermal storage, Mr. Dawson evidently appreciates the difficulties that are met with in an installation employing the falling pressure type of water storage as special type turbines have to be installed and one might say they are therefore not in general operation.

In connection with peak supply from Waste Heat Mr. Dawson mentioned that he obtained a reduction of back pressure of 5 lbs. I assume, to a certain extent, that is due to the fact that high grade heat is degraded in the Ruth's Accumulator by the admission of high pressure steam. It would be interesting to show from actual operating results as to whether any saving is effected due to this, as if that steam had been fed to the turbine, useful work would have been done in its passage through the machines, which may entirely off-set the gain due to the change in back pressure.

It is also interesting to note that Mr. Dawson has realised the advantages the pass out machine has over back pressure machine where flexibility is essential and recognises that the condenser, so frequently malagined by these seekers of high thermal efficiency can be an extremely useful buffer for balancing out changes in load.

We in Africa can hardly appreciate its usefulness to station engineers in Europe, where in Russia for instance they have extreme seasons of heat and cold—but according to the Press they have some of the most modern thermal lay-outs.

Mr. Dawson also mentions the jet type of condenser on account of its simplicity.. One must not lose sight of the fact that a jet condenser usually entails very heavy pumping costs and loss of condensate. Further, if the existing equipment was used in a refinery. surely sugar pollution or differences of vacua would render its use prohibitive.

The author deals with the case of a municipality which has within its boundaries unique consumers who in general are in a position to deliver power to them, but the majority of us are not in this position and we shall have to look elsewhere for means of solving our power problems.

One of the latest developments, yet in its infancy is, the variable pressure boiler, and various authors have dealt with its influence on the development of Power Stations. We may find in the future that such or other schemes may revolutionise our ideas of peak loads.

Mr. A. R. Metelerkamp (Salisbury) : I entirely disagree with Mr. Dawson. Three years ago, I actually got out a thermal storage cooker, and gave these to various consumers with a view to getting their opinion. Well I am afraid I cannot give them to you. The fundamental fact is that you cannot get anything more out of a thermal storage cooker than you put into it. I personally do not think that thermal storage is the solution to our problems. I can quote an institution which installed thermal storage, but they have now had to put in an electrical stove (Applause).

Mr. Harvey (Springs) : With regard to the load curve; I found it very easy to fill up the gap. Instead of arranging your tariff to suit the consumers, why not get the consumers to suit the tariff?

The President : I understand, Gentlemen, that Mr. Damant has sent a contribution, which Mr. Milton is prepared to read.

Mr. E. L. Damant (Durban) : Two or three days ago I became aware of the fact that I had been given some, perhaps, unmerited publicity in Mr. Dawson's Paper, so I made a point of reading this paper as soon as possible. I found the paper extremely interesting and have much pleasure in making a few remarks on one or two aspects of it.

I gained the impression on the first reading that the suggestion which had been put forward in my recent Presidential Address to the Natal Institute of Engineers with regard to the use of Thermal Storage Stoves, was reduced to an absurdity in its application to the conditions applying to Durban. I was at a loss to understand this because my arguments appeared to be sound enough and the only reason that could account for the conclusions arrived at by the Author would be some difference in the premises made in the two cases which were studied respectively by himself and myself. I must confess that I did not go into very great detail, mainly because I had not access to statistics with regard to the Durban load; but if I remember correctly some enquiries were made before the assumed figures quoted by me were arrived at. These figures are :—

That a 6 k.W. stove of the ordinary type would probably cause an increase in the peak load of the system of 1½ k.W.

I also assumed that the power of the ordinary Thermal Storage Cooker was 500 watts and I know of at least one such cooker which has found successful application in Great Britain. There is a good paper on these Electric Thermal Cookers which was written by Messrs. Humphreys & Walton in 1932, and much valuable information is given therein, so that on the latter score I feel I was justified in my assumptions.

Mr. Dawson, on the other hand, has assumed that the loading of the Thermal Storage Stove is as high as 1,500 watts or even 2,000 watts. I have no doubt that Thermal Storage Cookers of this size are manufactured but in all probability they are designed for a comparatively large household.

Mr. Dawson has also deducted that one ordinary cooker connected to the Durban system would be responsible for only .85 k.K. at the period of maximum demand on the system. The total number of stoves connected to the Durban system last year was 14,000 approximately, and therefore the connected stove capacity might be in the neighbourheed of 60,000 k W. These stoves, Mr. Dawson states, are responsible for a load at peak period of only 12,500 k.W. I question this figure, but of course Mr. Dawson has access to statistics which should enable him to estimate fairly accurately. I note however, that these statistics are not complete enough for him to state that the figures quoted are reasonably accurate.

I think, personally, that a much higher figure should be accepted for the Stove load. If my original proposal of 1.5 k.W. per stove be accepted and 14,000 stoves be assumed, the total load due to stoves at the peak period would be 21,000 k.W. This checks up fairly closely with the cooking peak on Sundays. Mr. Dawson has attempted to prove that this cooking peak on Sundays is not necessarily the same as that during the week days, but I doubt very much whether the difference between the 22,000 k.W. and the 12,000 k.W. can be explained away satisfactorily in this manner. I think that he has probably assumed too high a figure for water heating. For example, there are about 7,000 Water Heaters installed and the average power of each of these heaters might be taken at 1.3 k.W. so that the total installed k.W. Water Heaters would be 9,100 k.W. These heaters, according to his estimate, cause a load during peak period of 4,000 k.W. whereas 60,000 k.W. of cookers cause a peak load of only 12 500 k.W.

The point, however, that I wished to make in my Presidential Address, was that in some cases it might be advisable for a Supply Undertaker to encourage the use of 24 hour load consuming appliances by some form of subsidy rather than to instal new generating and distribution plant to deal with the peak load, and on the assumption which I made I proceeded to show that it might even be possible to donate a Thermal Storage Cooker to the consumer and show a profit to the Undertaking. I would quote the following to indicate the sense of my remarks :—

"Fundamentally to encourage load by preferential tariffs is probably not the best practice although it undoubtedly has the effect of reducing costs on account of the greater production of Electricity and the soundest principle on which to work in the business of load building is to encourage a constant continuous load.

"Only by this means can both the Distribution System and the Power Station receive the full benefits of a good load factor."

Personally I would prefer to see more time and thought devoted to the question of load building, rather than to the question of providing plant for the supply of peak loads, and I do think that it is in this direction the maximum gains will be obtained in the reduction of the cost of Electricity, and this is, of course, apart from the idea of combining Thermal Electric Stations to work in conjunction with factories requiring process steam which is, it is admitted, a very economical method of generating electricity.

I think too that the case for the Thermal Storage Cooker might be made more attractive if an automatic switch be incorporated so as to cut off supply as soon as the temperature of the hot plate reaches a predetermined maximum. A measure of diversity will be obtained by this means and the energy consumption will be reduced. However, Mr. Dawson has devoted considerable space in his paper to the types of plants which are designed to meet such peak loads and I congratulate him on his proposal to employ Thermal Storage Plant in conjunction with the Process Steam Factory in the manner which he has suggested.

The Author's Scheme is a very novel one and I congratulate him on its conception. I would very much like to see the investigation carried a step further and a careful estimate of the capital costs of such a scheme made, due regard being paid, of course, to necessary reliability of supply.

The President : There are one or two items I would like to mention. There is Mr. Reed's paper on "Testing Equipments for smaller Electrical Undertakings;" I would like those of you who are interested in that particular paper, to read it, because we are visiting the municipal power station to-morrow, and there you can visit the test department where some of the apparatus described in this paper will be on view. It may be advantageous to read the paper before undertaking the visit.

NEW MEMBERS.

I have to announce the election of Mr. G. E. Gregor of Standerton as an Engineer member, and Mr. W. J. Sellar of Boksburg, as an Associate member (Applause).

After some general announcements by the President, the Convention adjourned at 5.3 p.m.

The Convention resumed at 9.45 a.m. in the Assembly Hall, Kelvin House, with the President in the Chair.

The President : Gentlemen, we have two papers before us to be read this morning, and I feel we should take these papers first by reason of the fact that we have the use of the epidiascope, and can only use it in this hall, and we have not suitable equipment at the Exhibition. It is proposed to have these two papers, one by Mr. Kane, and one by Mr. Liebbrandt, read first, and then take discussion afterwards, to ensure that the papers are read here. I therefore have pleasure in calling upon Mr. Liebbrandt of the South African Railways and Harbours, to read his paper first.

The Electrical Department of the South African Railways and Harbours

By D. Leibbrandt, B.Sc. M.I.M.E., Consulting Engineer and W. R. Owens, B.Sc., Chief Electrical Engineer, S.A. R. & H. Johannesburg.

The object of this paper is to give an outline of the work of the Electrical Department of the South African Railways and Harbours. The organisation of this department is best understood by reference to the following diagram :—

CHIEF ELECTRICAL ENGINEER,
Headquarters : Johannesburg.

District Electrical Engineer and Staff **Transvaal.**	District Electrical Engineer and Staff **Natal.**	District Electrical Engineer and Staff **Cape Western.**	Assistant Engineer (Electrical) and Staff **O.F.S.** and **Cape Northern.**	Electrical Officer and Staff. **Cape Eastern.**	Electrical Officer and Staff. **Cape Midland.**	Electrical Officer and Staff. **South West Africa.**

The actual work in the various systems, both maintenance and constructional, is carried out by the system electrical staff. Each staff, for disciplinary purposes and pay, is under the control of the local system manager. In all other respects, the head office has control; Technical matters, shop organisation, increase or decrease in staff, is dealt with by the head office organisation.

The work of the head office falls under the following sections :—

(1) **Traction :** Under this section is included overhead equipment for electrification, track bonding, transmission lines, substations and electric rolling stock (locomotives, motor coaches and trailers).

(2) **Electric Light and Power :** Under this section is included all electric light and power distribution work, power stations (oil and steam plant), and all electrical plant in connection with harbours, mechanical workshops, locomotive sheds and grain elevators, etc.

The Test Department is located at Johannesburg, and carries out work for both sections (1) and (2).

(3) **Communications :** Under this section is included all telegraph and telephone installations, train control apparatus and marine wireless. A

separate test section is maintained for communications, and a fully equipped test coach is available for use in any part of the Union as occasion demands.

(1) TRACTION:

Electric traction to-day is the principal activity of the Department, and to introduce this section it is necessary, briefly to outline the history and subsequent developments leading to the present day position.

Electrification in this country owes its inception to the late Sir William Hoy. In 1919 he was responsible for the visit of Mr. Charles Merz, and the latter's report on the power supply of the Union resulted in the passing of the Electricity Act of 1922, which forms the basis of the control of electricity in South Africa.

In the same year, at the Administration's request, Mr. Merz reported on electric traction and his report on the introduction of electric traction in the Union took into consideration the following sections :—

Cape Suburban Areas.
Cape Town—Touws River.
Durban—Glencoe.
Reef Areas, including Witbank and the Main Line to Komatipoort.

Of these sections, it was decided to proceed with the following :—

(a) Durban—Pietermaritzburg.
(b) Cape Suburban.

Due to the fact that in 1922 traffic congestion was more serious on the section Pietermartizburg-Glencoe it was decided to apply electrification to this section firstly.

The technical details of this work have been fully dealt with in many publications, probably the most comprehensive being a paper by Mr.

Lydall. It is not necessary, therefore, to refer to them again. Reference to the period following the construction will be made later in this paper.

The Cape Suburban Electrification was started at the end of 1926, and was completed in 1928. It comprised the conversion to electric operation of the line between Cape Town and Simonstown, and between Cape Town and Sea Point. Here again, the technical details have been fully dealt with, and it is, therefore, unnecessary to make further reference to them.

The Pietermaritzburg–Glencoe Electrification came into full operation in 1928 and no undertaking made a more unfavourable beginning or had so many features calculated to make a bad impression. Firstly, the capital cost of the construction was exceeded by over 50%. The cost of the overhead equipment estimated by the Consultants at £565,500 cost £1,279,972. The cost of transmission lines, substations and power stations, estimated at £1,109,190, cost £2,070 030. The first under-estimate resulted in high interest charges and the second in high cost of power. Power costs for the first four years were :—

		Units:	Cost:
April 1927—March 1928	..	107,751,000	£368,348.
April 1928—March 1929	..	111,085,000	£355,558.
April 1929—March 1930	..	113,153,000	£343,579.
April 1930—March 1931	--	100,224,000	£287,216.

In 1930, by mutual agreement with the Electricity Supply Commission, the redemption charges, amounting to 2% on Capital, were dropped for a period of 10 years, and this temporary expedient certainly was a very big help. The recent conversion of the treasury loans to a lower rate of interest, fortunately, has enabled redemption fund contributions to be re-established.

The financial side was not the only cause for uneasiness for, coincident with the commencement of electrification, traffic began to fall off. The figures over the 4 years, 1925—1929, were :—

Year :		Tons South of Ladysmith :
1925	..	6,968,000
1926	..	6,959,000
1927	..	6,594,000
1928	..	6,662,000

The lower consumption of electricity, due to the decrease in traffic naturally increased the price per unit still further.

Electrification also had plenty of teething troubles of which lightning was definitely the worst. In the early days we had virtually no protection against lightning, and every storm put locomotives and the overhead equipment out of action; delays from an hour to three hours were comparatively common. In one heavy storm we had no less than 13 locomotives damaged and during the first year of operation, the number of line faults were 145. Later on other difficulties arose, in the shape of electrolysis in mast foundations and excessive wear on the contact wire and pantographs. It is not an exaggeration to say that the Natal Electrification was regarded a failure during the first years of operation.

The position in the Cape was little different. When electrification was introduced in 1928, bus competition had then reached its peak, and due to this cause traffic fell off considerably.

The following figures will serve to illustrate the effect of bus competition :—

	1927:	1928:	1929:
Ordinary Ticket Issues	5,392,000	4,546,000	4,587,000.
Season Ticket Issues	200,727	179,520	167,903.

Here again the capital costs of the power stations, substations and transmission lines were under-estimated by nearly 50%, and the cost of power was in consequence greater than the estimate by some £30,000 per annum. Fortunately, to offset the poor financial aspect, the operating side was a marked success, and the working of the suburban electrification in the Cape has given virtually no trouble since its inception. It is no exaggeration to say that the outlook both in Natal and in the Cape during the early years of electrification was black and that this state of affairs obtained until 1931, in which year the Electrical Department of the Railways made a close analysis of the position and arrived at the following conclusions :—

(1) Financially the existing electrification schemes could not be a success unless considerable extensions were undertaken, with a view to spreading the heavy capital charges over a much increased consumption, (Capital charges for Power in Natal in 1929 accounted for £253,400 and in the Cape £97,000).

(2) Extensions could not take place unless they could be carried out at a much lower cost per mile than either the Pietermaritzburg—Glencoe or Cape Surburban Electrifications. Extensive experiments were carried out with a view to reducing the cost per mile for overhead equipment and by adopting a totally new method of construction. The savings expected were more than realized on the extensions subsequently embarked on.

The principle of carrying 88,000 volt transmission lines along the track on extensions to the track structures was also adopted. The cost of this item was reduced from £2,000 per mile for cross-country routes to just over £500 per mile for the route along the track. Regenerative mercury arc rectifier substations were introduced on the Daimana-Harrismith section in collaboration with the Electricity Supply Commission, and were the first of their kind in the history of Railway traction to be successfully installed. This had the effect of reducing substation costs considerably.

The cost of a single unit rotary substation is £42,000 as against £11,000 for a single unit mercury arc rectifier substation.

Without going into too much detail, the cheaper methods of construction have, from 1931 to date made possible the following extensions :—

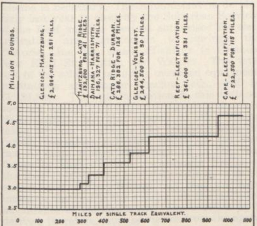
Extensions :	Total	Track Mileage:	Cost per Mile:
Durban-Cato Ridge	.. 151,000	126	1,198
Salt River-Bellville ..	.. 30,000	31	968
Cape Flats	.. 21,367	12.5	1,710
Daimana-Harrismith	.. 86,327	71	1,216
Glencoe-Volksrust ..	.. 120,000	90	1,333
Reef :			
Randfontein-Springs	.. 210,793	223	
Germiston-Pretoria	.. 80,000	78	
Germiston-Wattles-Alberton	11,000	13.5	956
Canada-Booysens-New Native Station, Eloff St.	.. 15,000	16.75	
	316,793	331.25	

The spread over capital against mileage electrified is shown in Figues A. and B. In addition, the extensions have resulted in the cost per unit falling to the figures given below :—

COST OF ELECTRIC POWER.

Period:	Cape Town:	Colenso:
NUMBER OF UNITS (TRACTION) :		
July—December, 1932	.. 14,822,193	41,982,881
January—December, 1933	.. 31,509605	88,994,630,
January—December, 1934	.. 44,484,787	101,824,630
January—December, 1935	.. 47,243,966	126,960,347
January—June, 1936	.. 23,966,801	65,654,413
COST PER UNIT :		
July—December, 1932	.. 1.0073d.	.8151d.
January—December, 1933	.. .9562d.	.7767d.
January—December, 1934	.. .7985d.	.7045d.
January—December, 1935	.. .7659d.	.6119d.
January—June, 1936	.. .7403d.	.5828d.

Nothing could better indicate than these statistics the justification for the economic extensions undertaken. The time available for this paper does not permit of this feature being enlarged upon and it will, therefore, be sufficient to say that electrification has been converted from what was considered an economic failure to what is now an outstanding success and a very noteworthy achievement. It has taken nearly ten years to arrive at the present satisfactory position.

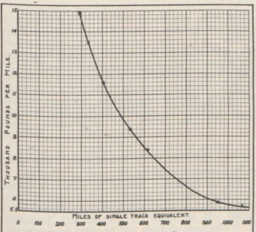


COST OF ELECTRIFICATION.

INCLUDING OVERHEAD EQUIPMENT, TRANSMISSION LINES & SUB-STATIONS.

W.J.

FIG. A.



CAPITAL EXPENDITURE PER MILE FOR ELECTRIFICATION

IN RESPECT OF MILEAGE EQUIPPED.

W.J.

FIG. B.

A brief reference to the Reef Electrification scheme is necessary. The Administration decided early last year to electrify the Suburban Services of the Reef and the sections authorised for electrification are Randfontein to Springs, the Pretoria Line, the small off-shoots to Orlando, New Eloff St. Station and Wattles. The total cost of the scheme, including overhead equipment, substations and motor coaches, etc., will be £1,124,396. The Administration in this instance does not expect immediate savings as a result of electrification, but the scheme is being undertaken because experience has indicated that the rapidly increasing suburban traffic of the Reef can be more economically handled in the near future by electrification. Passenger traffic on the Reef is increasing and will continue to do so, and it is a well-established fact that the more intensive the traffic the greater are the operating advantages of electrification. The benefits to be derived, therefore, must be viewed from the operating aspect rather than from a mere comparison with present steam costs.

Before the end of 1937 over 1,000 miles of line will be electrified in the Union and over 20% of the Union's rail traffic will be carried over electrified sections, as compared with U.S.A. with its enormous Railway System of 244,838 open miles, where 6,441 track and 2,760 route miles are electrified. Approximately 257,000,000 units will be purchased for traction purposes and over £587,000 will be paid per annum for electric power, and electric rolling stock will be represented by 323 units, comprising 135 locos. and 193 motor coaches.

COMPARATIVE RESULTS WITH STEAM :

We have no true economic comparison giving exact statistics of steam operation as against electric operation. During the last eight years certain definite advantages have, however, become apparent, the biggest of which is the cheaper maintenance costs of the electric locomotive. The fourteenth class engine is the one largely displaced by electrification, and the cost per mile for all repairs to this class is approximately 12d. as against the cost of 2d. for the electric loco. The electric locomotive can be kept longer in traffic. The average engine hours per day in traffic for steam engines in Natal is 9.66, as against 15.06 hours per day for electric locomotives. The average ton mileage per day per engine in Natal is :— steam 18,118, electric 68,802. A comparison of the loads taken prior to electrification shows a schedule run under steam of 16¼ hours Glencoe-Maritzburg, with a load of 1,000 tons to Ladysmith. 720 tons Ladysmith to Mooi River, 820 tons Mooi River to Maritzburg, whereas the electric run on this section is 1,500 tons straight through, in 10¼ hours. Apart from the increased tonnage and the time saving indicated above, the electric locomotive can be depended upon to run to schedule. The density of traffic under steam conditions in 1923 was such that it was seldom possible for a steam engine to run to schedule, the excess in time often being up to 50%. With the completion of the electrified section Durban-Volksrust next year a saving of over 9 hours in the transit of goods traffic from the coast will be effected.

The question is often asked how many steam locomotives are replaced by an electric locomotive. It is difficult to answer this question accurately, but an indication is given by the fact that in Natal during 1926 there were 540 steam locos. employed in the handling of all traffic, whereas on the completion of the present electrification construction between Durban and Cato Ridge, and between Glencoe and Volksrust, there will be under 300 steam locomotives and 135 electric locomotives (the latter number including electric shunting units).

EXTENT OF PRESENT DAY CONSTRUCTION :

Construction in hand to-day, which it is anticipated will be completed within the next six months, comprises over 500 miles of 3,000 V.

equipment in Natal and on the Reef; 23 sub-stations, ranging from 2,000 to 6,000 KW. capacity; 150 miles of 88,000 V. transmission line. There are 93 motor coaches, 23 main line and 10 electric shunting locomotives on order from overseas or being built in this country. In all, the cost of the construction in hand is approximately £2,000 000. The substations and transmission lines are being constructed by the Railway Administration on behalf of the Electricity Supply Commission, with whom the closest collaboration exists and to whom much of the success of the work is due.

(2) ELECTRIC LIGHT AND POWER :

This section includes the Department's work in connection with power installations in workshops, harbours, loco. sheds, etc.; lighting installations in buildings, yards, and stations; power station installations; oil engines and numerous other applications of electric light and power incidental to the running of the Railways.

There is no town or village in the country of any size, which is a supplier of electricity where the Railways are not a consumer and in most cases the largest.

The following statistics indicate the support given by the Railway Administration, both as a purchaser and as a supplier, to the various bodies throughout the Union :—

AS A PURCHASER—1933-35.

	Sold: Total Units	Units Sold to Other Consumers:	Units Sold to Administration:	
Durban :	100,362,297	92,369,889	7,992,410	7.97%
	105,767,577	97,701,588	8,065,979	7.65%
	112,900,716	102,549,702	10,351,014	9.15%
East London :	9,953,229	8,481,896	1,471,333	14.78%
	11,276,926	9,217,424	2,059,502	18.25%
	13,309,533	11,426,143	1,883,390	14.15%
Port Elizabeth :	24,185,075	22,512,584	1,672,491	6.92%
	30,895,536	28,956,977	1,938,559	6.28%
	35,844,625	33,675,831	2,168,794	6.06%

Bloemfontein :	14,329,760	11,443,210	2,886,550	20.15%
	15,301,240	11,505,742	3,795,498	24.83%
	16,431,439	11,558,712	4,872,727	29.65%
Pretoria :	37,947,329	34,459,949	3,487,380	9.2%
	38,863,010	34,450,066	4,413,944	11.35%
	44,613,315	39,834,338	4,778,977	10.73%
Kroonstad :	1,653,735	1,233,440	420,295	25.4%
	1,585,791	1,239,936	345,855	21.7%
	1,519,539	1,159,205	360,334	23.7%
Bethlehem :	954,003	693,216	256,787	26.8%
	933,033	687,008	246,025	26.4%
	892,780	599,664	293,116	32.9%
Vryheid :	448,573	376,684	71,889	16.0%
	494,465	426,045	68,420	13.85%
	589,042	482,184	106,858	18.14%
Mafeking :	354,331	153,973	200,358	56.6%
	480,779	208,804	271,975	55.4%
	575,689	238,888	336,801	57.4%

AS A SUPPLIER—1934-35.

	Units Generated: 1934.	1935.	S.A.R. Consumption: 1934.	1935.	Sold: 1934.	1935.
Vryburg :	186,933	227,535	15,845	31,825	171,088	195,700
Waterval Boven :	388,785	409,014	319,749	337,438	69,036	71,576
De Aar :	832,856	916,531	636,588	656,710	196,268	259,821
Warmbad :	99,324	138,608	8,183	22,855	91,141	115,753

The work at Headquarters includes :—

(a) The testing of all plant and materials. The test laboratory in Johannesburg has equipment to the value of £15,000.

(b) All specifications and new electrical engineering projects.

(c) Train lighting, piecework and shop organisation.

(d) All Electric Light and Power Agreements.

The following statistics will give some indication of the work involved at Headquarters in the control of the various electrical activities :—

Annual Staff Wages, including System and Head Office .. .. .. £198,000.

Annual purchase of electric light and power material .. .. £124,000.

The maintenance of 5,500 motors aggregating 80,000 h.p.

The annual purchase for light and power of over 51,000,000 units (excluding traction) at a cost of £205,000, and the sale during the same period of over 1,500,000 units.

TEST LABORATORY :

The equipment in the test laboratory consists of apparatus suitable for calibrating most of the electrical meters in use and apparatus for testing pressures up to 50,000 V. A photo-electric type photometer and a 6 element oscillograph costing well over £1,200 are part of the equipment. Almost any practical range of D.C. or A.C. voltages are available in the Laboratory.

Apart from the special testing of various items of plant and apparatus, a large amount of routine work is carried out, particularly in connection with the repair and calibration of energy meters, indicating instruments and thermo-electric pyrometers which are used in the mechanical works for temperature control on various types of furnaces. Approximately 1,400 energy meters are tested annually, and a complete record of all tests are kept and certificates issued.

The Administration purchases something like 210,000 lamps annually, and not the least important of the work undertaken is the testing of batches of such lamps selected at random in order to ensure that the quality does not fall below the required standard. Items such as train lighting belting, batteries, V.I.R. and paper cables, H.D. copper conductors, insulating varnishes and oils, etc., are also subjected to rigorous tests in the Laboratory, to ensure that the Administration's requirements are met with. It will be of interest to note that the Administration purchases some 45,000 feet of train lighting belting per annum.

Another important phase of the work carried out is the inspection and testing of all oil engines, and for this purpose the necessary staff is stationed at Headquarters. The Administration has over 350 oil engines in service, ranging from

$1\frac{1}{2}$ h.p. petrol-paraffin type to 330 h.p. crude oil type, used for driving pumping plants, compressors, welding machines and generators.

During the past three years very important tests have been carried out on the mercury-arc rectifier substations in Natal. Compounding characteristic curves on inversion and rectification have been determined. As the successful operation of mercury arc rectifiers, particularly on inversion, depends to a large extent on the grid control equipment, it was essential that this portion of the plant should be subjected to extensive tests under various service conditions. The severity of faults under back-fire or short circuit conditions necessitated very careful checking and setting of the protective gear in order to ensure that faults would be localised and not affect the transmission system as a whole.

TRAIN LIGHTING :

Train lighting deserves special mention as few amongst the travelling public realise that South Africa possesses the most up-to-date train lighting equipment in the world. There are approximately 3 200 coaches each equipped with its own generator and battery of alkaline cells and 850 coaches equipped for lighting on electrified systems. The capital invested in train lighting is over £750,000.

The S.A. Railways have standardized on the "Stones" slipping belt system. This system comprises a dynamo capable of delivering 40 amps. at 24 volts belt driven from the coach axle, a "Pegoud" change-over switch, an auto-cut in and out switch, and two banks of 150 A.H. cells. The dynamo is suspended in such a manner that the output remains constant irrespective of the speed of the train. This is achieved by a "slipping belt" principle. This method of governing the dynamo output may not be perfect but it has the great advantage of simplicity. The "Pegoud" switch is a device designed to charge each battery alternatively, the change-over from one battery to the other being made at each train stop. The alternate charge and discharge of the two batteries is very desirable where Alkaline cells are in use. The "auto-cut in and out" switch is merely an automatic switch to cut in the batteries when the dynamo voltage has reached a suitable value and to cut out the batteries when the dynamo voltage falls below that of the cells. As the S.A.R. spend £3,000 per annum for train lighting lamps it will be appreciated that voltage regulation is an important point.

Recently dynamos have been developed which are inherently regulated and so do not require to use the slipping belt. The S.A.R. has a number of "Mather & Platt" and "Stones" dynamos of this type.

The cells in use are all of the alkaline type, principally of American Edison manufacture. Alkaline cells have been standardized for this service as their life is approximately 14 years, as compared with that of 7 years in the case of lead cells formerly in use.

The maintenance of train lighting equipment has reached a high standard and the cost is £12 per annum per coach. There are approximately 1,500 engines equipped with small turbo generators of a capacity of 500 watts at 32 volts; these sets are used exclusively for engine head and cab lighting.

(3) COMMUNICATIONS :

Communications play a very important part in Railway activities, safe trains working largely depending on the effeciency of communications and trains working apparatus. It may not be generally known that the Railways own and operate their own telegraph and telephone system throughout the Union. Close co-operation, however, is maintained with the postal authorities and there is a liaison committee of Postal and Railway representatives, who discuss any matters of maintenance and construction affecting the two Administrations. This co-ordination between the two departments avoids unnecessary Capital Expenditure in many instances and has for many years worked very satisfactorily.

The Administration's telephone facilities throughout the Union can be divided into—

(1) Trunk Telephone Lines (including Telegraphs).
(2) Selector and Station to Station Lines.
(3) Train Control Apparatus.
(4) Marine Wireless.

Trunk lines radiate from Johannesburg to every system, including Durban, Port Elizabeth, East London, Cape Town, Bloemfontein and even Windhoek.

Within the last 18 months, imposed on the physical circuits, carrier wave communication has been established to all systems except South West Africa. These trunk facilities link up with the local railway exchanges.

Automatic exchanges exist at Johannesburg, Pretoria, Durban, Cape Town and East London. Johannesburg alone has an 800 line automatic exchange

Trunk connections are primarily for the use of the Head Office Rolling Stock Control (engines, coaches and trucks). This control in Johannesburg receives returns by telephone of the rolling stock position every morning, and is in communication throughout the day with the system offices. Good use is also made of these trunk facilities by other railway departments.

SELECTOR AND STATION TO STATION TELEPHONE LINES :

Every System has it system telephone circuits. In order to direct the movement of rolling stock in the system, stations and depots are connected directly to a system rolling stock control office, as distinct from central control. Selector telephones are in general use. This system consists of a common pair of wires (say for example from Durban to Ladysmith) connected at each station. The controlling officer, situated at Durban, has sole control of these selector lines. Through his control cabinet, he can ring any individual station. between the stations and connected up to the system office there are also station to station telephones, used mainly in inter-station communication. In all, the Administration has over 5,000 miles of selector lines.

TELEGRAPHS :

Generally speaking, all telegraph systems are super-imposed on the telephones. Telegraph offices exist at almost every station.

SAFE WORKING APPARATUS :

Linked up with the Station to Station Telephones is the safe working apparatus. On every section of line the movement of a train must be governed by a proceeding authority in the shape of a signal or by token handed to the driver of the train. On main line sections, and on more important and busy branch lines, where single line working is in force, each section between two adjacent stations is governed by a token proceeding authority. The token appartus is electrically operated.

The maintenance of this apparatus, together with the inter-communication lines, is part of the department's work. In all, the Administration has some 1,100 token instruments and the Capital invested in this section alone is £170,000.

MARINE WIRELESS :

An important section of the communication activities is marine wireless. This, although not a large section, is a very modern development. Most of the tugs at Durban, East London, Port Elizabeth and Cape Town are equipped with receiving and transmitting apparatus for communication with the Port Captain's Office and in some cases lighthouses are also fitted. A recent development is the installation of a radio beacon at Cape Columbine lighthouse.

In connection with lighthouses, it is an interesting fact that at Cape Columbine lighthouse, recently built, the oil engines and electrical apparatus installed cost some £10,500. Over 80 Kws. of plant are installed for working the various apparatus, such as the fog signal, the light and the radio beacon.

Mention must be made of the reaction of electrification on Communications. The introduction of rectifier substations caused considerable interference due to the harmonics in the traction system and their elimination from the telephone circuits required a great deal of research work. It is pleasing to record that telephone interference from this source is now almost entirely eliminated.

In conclusion, I would again reiterate that my object in submitting this paper is merely to give an outline of the activities in the Electrical Department of the South African Railways. The paper must of necessity be brief, as it will be appreciated that a detailed exposition of any one of these activities would more than occupy the time placed at my disposal. If however, my effort has impressed the delegates at this Conference with the magnitude and diversity of activity in the Electrical Department of the Railways, my purpose in presenting the paper will have been fully realized.

The President : Gentlemen, the technical and economic success of railway electrification throughout the world has been remarkable; electrical traction has shown iself to possess superiority over steam traction, and extensions are taking place wherever it has been adopted. It places the transport management in a position to offer the public an attractive form of transport, and also much better and smoother service. It has special characteristics which are capable of development on a large and extensive scale.

The enormous ramifications of the South African Railway have been very lucidly described by Mr. Liebbrandt in his address; and I am sure you have shown by your applause how much you appreciate that address. The Paper shows that South Africa is in the forefront of this modern transport; and we all congratulate the author and his assistants on this very very comprehensive paper. I will defer discussion on this paper, as announced at the early part of this meeting, owing to the necessity to have the other paper read this morning.

With your permission, however I will call upon Mr. Dawson to reply to the discussion on his paper given yesterday afternoon.

A Survey of Municipal Peak Loads.
by Colin Dawson (Durban).

REPLY TO DISCUSSION.

I would like to thank Mr. Swingler for his remarks and, in view of his mature experience, it is gratifying to me to know that he endorses several of the opinions I have expressed in my paper.

Mr. Swingler is surprised to find that his peak problem is almost the same as ours, and I may add that it is also surprising to me, owing to the forty odd minutes difference in the daylight. I may say that in preparing this paper I tried to evaluate the effect of daylight saving on the peak, but for want of sufficient data could not bring it forward, but I would suggest that this is a subject which this Association may find would repay investigation.

With regard to the overload capacity of plant, this seems to be a reversion to the old method of requiring a 25% overload for two hours.

Mr. Swingler favours the two part tariff and instanced an off peak supply in Capetown. As I mentioned in the paper this type of load is being encouraged in Durban and several manufacturers have taken advantage of it. In two cases, for example, a load of 2,000 k.W. is taken during the day and 250 k.W. on peak, another 1,500 k.W. and 50 k.W.

In reply to Mr. Muller, I fully endorse his motto of "Do not worry the consumer with any restrictions" and this is one of my main objections to most of the schemes which have been put forward to reduce the domestic peaks and where the operation of the Power Station has been given preference to the convenience of the consumer. Mr. Muller is apparantly one of the fortunate ones whose peak is little more than this day load and as I stated in the paper the off peak tariff has, like all other things, its limitations and his is a case where it seems to be unnecessary.

Mr. Roberts mentioned the fact that the domestic appliances while adding to the peak also added considerably to the unit consumption during the remainder of the day. This is outside the scope of the paper; but I quite agree with the soundness of this argument. The majority of domestic appliances however, do add to the peak, and as most minimum charges are irrespective of the actual demand, i.e., based on room area, valuations etc., the additional units on peak are actually at the low unit rate.

I want to make it quite clear, in saying this, that I am in no way opposed to the encouragement of the domestic demand, owing to the units consumed as mentioned above, but am only dealing with its effects on the peak which, we all know, is with us, and, so far as can be seen, will always be one of our problems.

With regard to the proposal put forward in the paper for obtaining a peak supply from the Waste Heat plant, this was put forward mainly as a feature of interest to the Conference on what may be expected from a waste heat plant, combined with thermal storage. If I interpret Mr. Roberts' remarks correctly, he agrees with the principle; but detailed at length points which were really inter-related with other local factors which would be of no interest to members generally to discuss. I can assure him, however, that none of them have been overlooked, and together with many other points would all be carefully considered before it was decided to put this scheme into practice.

Mr. Damant criticizes the cooking demand given in the paper and states that the figure of 12,000 k.W. should be 21,000 k.W. As stated in the paper the division of demands was somewhat arbitrary, but I cannot agree that the demands for lighting, water heating, wireless, radiators refrigerators, etc., would only be some 350 watts per consumer to make up the total domestic demand which is reasonably correct.

After the criticisms of other members with regard to their actual experience with storage stoves from other aspects than their effect on the peak, I do not think this point requires a detailed reply.

With regard to a question regarding the costs given in the paper for the peak plant I think is is clear that "additional" costs only are given, the balance of cost being debited to the normal pass out supply.

I am very pleased that the paper created the interest shown by the discussion, and agree with Mr. Roberts that a fully detailed investigation of all peaks would be of considerable usefulness and it was with this idea that I originally started the paper, but owing to the numerous variable factors and the meagre informations available, I was forced to confine it mainly to our own problem although I think that our particular features apply fairly generally to a number of other Municipalities, as instanced by Mr. Swingler.

I thank you gentlemen for giving me such a good hearing and for your contributions to the discussion.

The President : I will now ask Mr. Kane to read his paper.

Distribution Sub-Stations OF THE Johannesburg Municipal Electricity Department

by R. W. Kane (Johannesburg).

Mr. President and Gentlemen,

I would like to express my appreciation of the honour which has been conferred on me in being requested to present a paper before this Convention, and I trust that members will find some items of interest covering equipment familiar to us all. It was originally intended that the Distribution Engineer should read a paper on distribution generally, but owing to an unfortunate indisposition this arrangement was regretfully cancelled, and I hope that my effort will prove a satisfactory substitute.

Briefly, sub-stations on the distribution network come under six headings, and it is the author's intention to describe the various types and respective equipment, with the gradual development experienced during the last ten years.

It will be understood that in a paper of this nature the descriptions must of necessity be brief, in view of the various types under consideration, but the author trusts that the brevity will be excused and partly compensated for by the field covered.

SUB-STATION BRANCH :

It will be interesting at this juncture to give a short resumé of the Distribution Branch and sub-branches as a whole, to enable a clear view of the relation between the Sub-Stations Branch and the sister branches to be appreciated. With this end in view the author has prepared a form of family tree covering the engineering side, and it will be seen from this that the Distribution Branch is roughly divided into four main groups under the Distribution Engineer viz., Sub-Stations, Underground Mains, Overhead Mains and Illumination Branches. The Sub-Station Branch is responsible for all converter and static sub-stations on the system, and, in addition, with the electrical workshops, manufactures sundry electrical equipment for the other three branches. The underground and overhead mains branches are self-explanatory and the Illumination branch covers the wiring and street lighting sections.

In brief, the Sub-Station Branch is responsible for all equipment between an incoming high tension cable end box and the outgoing high and low tension boxes.

High tension tests for all other Departments are carried out by this branch.

TYPES OF SUB-STATIONS : Converter Sub-Stations :

There are seven converter sub-stations in operation on the system, consisting of one motor converter sub-station, manually controlled, four manual rotary converter sub-stations and two automatic rotary converter sub-stations. The motor converter sub-station is situated in the central area and is principally utilized for the supply of direct current 3 wire distribution and direct current traction. High tension distribution is also effected from this sub-station, and at the present moment this is the only converted sub-station that is not also utilized for the distribution of low tension alternating current.

The converter plant consists of three 2,000 KW's and two 1,250 KW's Bruce Peeble Motor Converters giving a total capacity of 8,500 KW's, and each machine is suitable for either direct current lighting or traction duties. Extensive alterations are at present being carried out at this sub-station to cope with abnormal high tension distribution demands, and the existing high tension switchgear is being replaced by a larger quantity of higher rupturing capacity switchgear, the rupturing capacity selected being 500,000 kVA.

No further extensions are anticipated in the converter plant in view of the Department's policy to change over from direct to alternating current, but it is interesting to note that direct current peak demand on this system has remained fairly constant over the last few years, the demand increasing roughly in step with the change-over alterations.

The remaining four manual converter substations situated in the suburbs are utilized for the distribution of high and low tension alternating current the converter plant being used solely for traction purposes.

Each of the four sub-stations houses three rotary converters, the capacities of individual rotaries varying from 500 KW's to 1,000 KW's. These converters are of various makes and types and their lives range from 21 years to one month, the youngest member of the family being a recent addition to the Vrededorp Sub-Station of one 1,000 KW's.

The twelve rotaries combined give a total capacity of 8,250 KW's and the types cover tap starting, pony motor starting and pony motor starting with self synchronizing features, all with reactance voltage control.

The two automatic converter sub-stations are both of the same capacity, viz., 750 KW's, but the plants are of totally different design and present an interesting example of achieving similar results by totally different methods. The elder sub-station consists of one 750 KW. tap starting Metropolitan-Vickers Rotary Converter, the entire plant being automatic. Starting and stopping is effected by means of a master switch, the running period however being 15½ hours daily against the manual sub-stations 20¾ hours. During shut-down periods, the D.C. feeder board is supplied by means of an interconnector fed from the nearest manual sub-station, and the voltage regulation when running is such that normally the automatic sub-station feeds the manual sub-station with approximately 200 amperes. D.C. feeder circuit breakers automatically reclose twice when tripped after a short time delay, finally locking out when a fault is being experienced.

Owing to recent alterations in the Tramways Department's policy, this equipment is idle now, excepting for short periods of exceptional loading and low voltage.

The later automatic sub-station is pony motor started, the equipment being supplied by the British General Electric Company. The various controls and protective devices for this station are totally different from the earlier station. The starting and stopping in this case is also controlled by a master time switch, but owing to the increased traction demands another machine of the same capacity is being supplied and the converters will be controlled by load demand, the two machines on alternative weeks sharing the main and relief supplies. D.C. Feeder Breakers in this sub-station are of the high speed type with reclosing features and have given every satisfaction.

As in the earlier automatic station, a direct current interconnector is employed between this station and the nearest manual.

An interesting feature in both the automatic sub-stations is the later incorporation of large metal oxide rectifiers of 5 volt, 500 ampere capacity. These rectifiers are connected in the earthing bond cable between the station negative busbar and the water main, and are for the purpose of ensuring that return currents flowing along the water main may return to the sub-station. When the sub-station is idle, however, it was found that return currents from the various negative rail bonds entering the station tended to return to the manual sub-station by means of the water main. The rectifier prevented this, being in effect a form of one-way valve.

Considerable damage was caused in the earlier days to the D.C. equipment in all rotary sub-stations, by lightning, but this has been catered for to a certain extent by the installation of electrolytic lightning arrestors. This type of arrestor is connected direct between the positive busbar and earth and is controlled by a 30 ampere high rupturing capacity fuse. Experience has shown that it was rarely necessary to recharge the arrestor more than once a year, this taking place prior to the summer months with their usual lighting storms. With the advent of regenerative rolling stock, however, it has been found necessary to recharge the arrestors more often.

Before leaving the rotary sub-stations, it may be of interest to comment upon the staff arrangements. The full staff consists of 22 attendants, one attendant per shift in the rotary sub-stations and two attendants per shift in the motor converter sub-station. Each attendant works a six shift calendar week with one day off and three relief attendants are employed in relieving the attendants off duty. The twenty-second attendant is employed as a general relief for all sub-stations, relieving during annual leave and sick leave periods.

Various shift arrangements have been tried from time to time, but the present arrangement has been found to be one less liable to abuse, especially with a mixed staff of daily and monthly paid attendants.

Transformer Sub-Stations :

Transformer Sub-Stations on the system are of various types and designs, covering the necessary evolution with high tension supply alterations and increased loadings. The earlier type of house consists of one compartment divided in two by a metal screen with door, dividing the chamber into low and high tension compartments. The high tension section houses the incoming cables, isolating and paralleling links high tension switches and transformers. The low tension side is used for operating the high tension switches and also houses a vertical shop-built low tension board composed of main low tension knife switches and fuses and circuit fuses. The capacity of chambers of this type rarely exceeds 2—100 kVA transformers and are all used for single phase 3 wire distribution.

A later development consists of a slightly larger chamber again divided in two compartments by a metal framework, but in this case the screen is only the regulation 4′ 6″ from the wall and houses the high tension incoming and outgoing switches with isolating links on both sides of every switch. Operation of the switches is done from the low tension side. The low tension section houses the transformers and a shop-built low tension board similar to that of the previously described chamber, the main difference in this board being the back connections and the necessary spacing between board and rear wall. The capacity of these chambers rarely exceeds 2—150 kVA transformers.

The next development in chambers consists of a two section building housing transformers in one section and both high tension and low tension switchgear in the second section.

The high tension board consists of a bank of truck type draw-out cubicles, and the low tension board is built up of individual front access cubicles, each housing isolating links and a series operated oil switch. The capacity of this type of chamber is normally capable of housing up to 2—300 kVA transformers.

The latest type of transformer house consists of the two sections, as before, but is considerably larger; four transformer bays being provided and ample space in the switch chamber for extensions.

The size of the house permits of extensions to either switchboard and the ultimate installation of 4—300 kVA transformers, if required. A feature of this chamber is the added ventilation provided in the transformer section, each transformer standing above a ventilating duct and below a corresponding roof ventilator.

Drop down drawout high tension cubicles are now standard practice, allowing larger rupturing capacity for a minimum of floor space, with the low tension distribution being catered for by an ironclad oil circuit breaker switchboard. The low tension switchboards are principally all current transformer operated with current and pressure test terminals on each unit and individual breaker isolation. It has been found from experience that this type of board with C/T protection is the most suitable for conditions pertaining on the Council's system. All switch units are for 3 phase 4 wire distribution, although in certain cases these are only used for single phase distribution.

The chambers just described cover, of course, the normal standard types, but certain conditions pertaining to available building space and required equipment, etc., have necessitated alterations from standard to meet different conditions. One such case is where, of necessity, all equipment is housed in one compartment, and it is here that the totally enclosed high tension and low tension switchboards prove their worth in simplicity of layout in conjunction with the transformers.

Where overhead high tension lines are controlled from these sub-stations, the feeder switch is of the automatic reclosing type the reclosing supply being obtained from operating transformers of suitable capacity. Reclosures are limited to an adjustable number, the switch locking out on the occurrence of a fault. An operation indicator is fitted to the switch to supply information of trips, etc. the control gear being inspected and tested once a week.

It is interesting to note that alterations have recently been effected to these switch units in the form of bridging links, and thereby hangs a tale. Prior to the controlling of the Department's frequency, it was customary to trip these switches by means of the relays once a week, to check the reclosing sequence. No inconvenience was experienced by consumers, being mainly domestic, but with the advent of synchronous clocks and controlled frequency, a different situation was created and the consumers natural resentment to regular and systematic failures entailed the subsequent alterations. Thus, the most negligible power consuming apparatus on the system spoilt the Department's "little games" and demanded and received the respect due to a large bulk supply consumer.

Briefly, the reclosing switch is bridged by means of the links during test, which only occupies about two minutes.

Certain transformer houses are equipped with constant current high tension series lighting transformers, the protection being by means of one main high tension switch through a high tension time switch to the transformer primary. Bridging links are installed in parallel with the time switch for operation in the event of the time switch failure, etc.

TRANSFORMER KIOSKS.

In this type of transformer sub-station, as in the transformer houses or chambers just described, considerable alterations have taken place in sizes and types throughout the history of the department, but it will be sufficient, I think, to describe the types and equipment in use on the system at present.

The most ancient member of the family is a circular sheet iron housing containing transformer and switchboard, the protection on the high tension side consisting of a non-automatic oil switch and high tension fuses. There are only two kiosks of this type on the system, one of these being the subject of an interesting experience about 15 months ago. The transformer broke down early one evening and the branch was hard pressed to find a suitable transformer to fit the kiosk. By suitable transformer of course, I mean one of correct capacity and of such dimensions as would enter the kiosk. Fortunately, however, a larger transformer was found that would suit the kiosk's internal dimensions but not the kiosk door, so the kiosk was dismantled and rebuilt around the transformer, low tension supply being maintained throughout from an adjacent chamber. Normally, this is an operation not to be proud of, but considering the circumstances and the necessity for restoration of supply, a little pride is pardonable. Fortunately, ground has now been found, but at a fabulous cost, to replace this kiosk by a more modern type.

Another pattern, of which there is fortunately only a few, is what is known as a "double decker" iron kiosk, the lower deck containing the transformer and the upper deck the switchboard. This switchboard consists of a sheet of insulating material situated in the centre of the kiosk; mounted on one side of the panel is the high tension equipment consisting of one non-automatic oil switch and high tension fuses. On the other side of the panel is mounted a double pole knife switch, main low tension fuses and curcuit fuses. It is customary for this type of kiosk to have the street lighting controls and panels mounted in a cast iron pillar adjacent to the kiosk, owing to lack of space in the kiosk, and a similar pillar contains the necessary high tension isolating links. This type of kiosk is only single phase and is limited to a capacity of 100 kVA. The next step in kiosk construction was a larger kiosk of similar pattern but an automatic oil switch with current transformer protection is provided, and with careful selection of transformer, it is possible to instal a 150 kVA transformer. Pillar boxes house the main isolating links and street lighting panels for this type of kiosk, with the exception of a few cases where the space has been found in the kiosk for the street lighting equipment. In this type of kiosk the first 3 phase low tension board was installed, it then becoming standard practice to equip all kiosks with 3 phase low tension equipment for both single phase and 3 phase use, thereby eliminating later costly alterations when three phase high tension became available.

Our next departure in the matter of kiosk types was a decided change from the previous types and was necessitated by the need for greater transformer capacity, better protection and safer operation. This design is known as the 3 compartment kiosk and is constructed of sheet steel, making a small compact chamber of 3 sections with four doors. This type of kiosk embodies high tension isolating links, high tension automatic oil switch, with ammeter and current transformers, power transformer up to 150 kVA, low tension distribution board built up of cool handle fuses and sindanyo panel, and, in addition, houses the street lighting time switch and distribution circuits. In short, this kiosk takes the place of the older type with its two adjacent pillars and it is decidedly easier to handle from the operation and maintenance point of view. The original kiosks of this type allowed for 4—3 phase, 100 ampere circuits, but of late low tension equipments were increased to 200 ampere per circuit, giving a total carrying capacity of 800 amperes per phase. This of course is far in excess of the transformer capacity but permits greater flexibility in loading arrangements. 60 ampere circuits would normally be ample if conditions permitted balancing on each outgoing circuit, but in the absence of such ideal conditions, balancing of the transformer load is aimed at. With ample carrying capacity provided, very little trouble is experienced with overheated and denatured contacts, such cases being principally caused by dust and bad contact and seldom caused by overload.

Within the last two years these kiosks have been slightly altered in dimensions, permitting the installation of a 200 kVA transformer. This latter type is reputed to be of a more pleasing appearance and is of welded construction in contradistinction to the earlier type with riveted structures. It remains to be seen, however whether these newer structures will permit of structural repairs on site as readily as the earlier type, it being rather a habit of local motorists to use any electrical structure as an emergency brake.

BRICK KIOSKS :

With the advent of the Town Planning Committee, iron kiosks on or adjacent to pavements are now viewed with disfavour, and from this with increased load demands the later type of kiosk has evolved, consisting of a brick and concrete structure. The three compartment feature has been retained but considerable improvements have been incorporated in the type and layout of equipment. The high tension section permits of the installation of 4 sets of 3 phase isolating links, current transformers and oil switch of larger rupturing capacity. A further improvement with the space available permits of the installation of the current transformers on the dead or load side of the oil swith, experience showing that fewer current transformer failures are experienced when so connected, particularly in an area subject to atmospheric disturbances. In the power transformer section more space is provided, permitting the installation of a 300 kVA unit, and a ventilating cowl is built into the roof immediately above the transformer. Owing to the nature of the structure the ventilation is hidden and does not detract from the appearance of the building.

The low tension section is also the subject of considerable alterations and improvements, and the standard board in these kiosks is worthy of a detailed description. The board consists of two sections which form the wall between the transformer and low tension compartments; one section is composed of a panel of insulating material on which is mounted the triple pole main knife switch, low tension current transformer, maximum demand indicators, street lighting clock and street lighting circuits. All connections are behind the panel and further covered by a thinner sheet of insulating material. The second section of the board consists of five 3 phase box type fuse units with self aligning contacts. If necessary, two additional sets may be added. Above these units is a panel on which is mounted three, or, alternatively, one ammeter. In the latter case a small compact ammeter switch is provided to supply readings from all phases. Each circuit fuse of the units is provided with an ammeter socket on the load side and a similar socket is provided on the corresponding bus bar. When individual circuit tests are taken, a series type ammeter, or alternatively, an insulated conductor is inserted in parallel with the fuse and the fuse then withdrawn, permitting reading then to be taken. When the insulated conductor is used, as is mostly the case, a "tong test" type of ammeter is used.

The installation of maximum demand indicators is a comparatively new departure and has proved an unqualified success. These are of the indicating thermal operated type with a 20 minute characteristic, and are provided with two pointers, one indicating the varying or prevailing demand and the other the peak. This latter pointer is sealed to prevent resetting, except by the responsible official, and has enabled the Test Branch to conduct a greater number of tests per day during the annual winter load tests than has hitherto been possible, this step being necessary in view of the increasing number of load centres. Three single phase units, of course, are used to enable a check to be kept on the nature of the balancing at peak.

BULK SUPPLY CONSUMERS :

A feature of the distribution system of recent years has been the rapid increase of this type of consumer. The department's policy compels all consumers contemplating a demand of more than 30 KW's to take a high tension bulk supply, and it is interesting to note that four years ago an exceptionally busy year saw the connecting to the system of 24 such consumers which was then a record for one year. Last year, that is, July 1935 to June 1936, saw the connection of 119 consumers of this type, and there appears to be no abatement of demand to date. September of this year provided the first application from a private domestic consumer for high tension bulk supply, this step being necessitated by the proposed installation of an ambitious heating scheme. The normal applicant for this type of supply bears the cost of the service cable, which terminates at a switch cubicle provided free of cost by the Council. From this cubicle the balance of the equipment with the exception of the transformer, is provided and installed by the consumer, to the Council's and Government regulations, the whole being housed in a suitable chamber provided by the consumer. In a few cases the transformer equipment is provided by the consumer, but normally this is hired from the Electricity Department, at a monthly rental of £1 per 100 kVA. Stringent tests and inspections are carried out by the Sub-Station Branch prior to putting a consumer into commission, followed by an inspection by the Government Factory Inspectors. Half-yearly inspections take place with maintenance of the Council's equipment, and consumers are notified if necessary of any alteration or replacement required on their equipment or chamber. It is the custom to so arrange the position and approach to the chamber to permit of 24 hour access for the Council's officials, who are provided with the necessary keys by the consumer.

I would like to mention here that there is one consumer in town for which the Department does not possess all the necessary keys for 24 hour access, but the latter is assured to all citizens, the main difficulty being free exit. To date, however, I am pleased to say that no official of this branch has had much difficulty in leaving the Fort.

This department decides on the size of transformer necessary when on hire and controls the layout of equipment for which a layout plan is submitted for approval; the consumer's protection is initially set by the department. The Council's high tension switch with overload protection coupled with systematic inspections prevent unauthorised overloading of transformers, and the switch is sealed in such a manner as to prevent operation unknown to the Department by the consumer or his employees.

Naturally, types of chambers vary considerably, although complying with the Council's building and electricity regulations.

Installations vary in installed capacity from 30 kVA to 3,000 kVA, the largest consumer, that is, rated on the installed capacity, being the Carlton Hotel.

An exception at present is the Empire Exhibition which is our largest consumer, the installed capacity being 4,700 kVA on hire from this department.

The department stocks transformers up to only 500 kVA for consumer's use, the limit being imposed principally by the transportable bulk and desire to standardize Any number of transformers can be installed, however, to permit of the necessary capacity. The majority of bulk supply consumers operate at a low tension voltage of 380/220 volts, 3 phase, 4 wire, but a few take high tension supply for direct use on suitable high tension plant.

MUTUAL SERVICE CHAMBERS :

Of late years it has been the policy of the Department to accept from a proposed bulk supply consumer where necessary the use in perpetuity of a suitable chamber, which is then equipped entirely as a transformer sub-station by and for the use of the department. The consumer is supplied with a low tension service at the required point of distribution, free of cost.

The equipment in this type of chamber is similar to that used in the standard chambers, except in the provision of switchgear of higher rupturing capacity, the majority of these chambers being in the central area. A feature, however, is the installation of fire extinguishing plant, which is entirely automatic, being controlled by temperature rate of rise actuators. The extinguishing medium used is carbon dioxide, which is stored in liquid form in cylinders. Manual operation is provided for, and, in addition, all door openings etc. are suitably screened by specially designed nozzles.

SERIES TRANSFORMER KIOSKS :

During the last twelve months all arterial roads leading from the city have been adequately illuminated by high tension series lamps. This necessitated the installation of a number of specially equipped kiosks, which house the necessary equipment. The kiosk is divided into two sections, one section containing the high tension automatic oil circuit breaker with the incoming links and clock short circuiting links.

The second compartment contains the transformer and time switch, operation of the main high tension switch being also carried out from here.

Throughout the system the constant current transformers used vary from 5 kVA to 20 kVA, the current being kept constant at 6.6 amperes.

COST OF EQUIPMENT:

It may be of interest to give a few particulars of installation costs of the transformer substation, and in this connection I will only deal with the modern types equipped.

Large transformer sub-stations cost in the region of £1,475 0s. 0d., £420 0s. 0d. being expended for the building, £450 for the low tension switchgear, £95 on the average for each high tension cubicle, this cost varying with the rupturing capacity, £30 for the complete street lighting panel and approximately £100 for labour and miscellaneous costs.

Brick kiosks cost £150 to build and approximately £120 to equip, giving a total cost of £270 0s. 0d.

The body of a steel kiosk costs £75, with a further sum of approximately £90 to equip.

The above costs, however, do not include the cost of the necessary transformers, which, of course, vary with the size installed.

The initial cost to the Department for a bulk supply consumer varies from £100 to £220, some cubicles alone costing practically £200 landed in view of the large rupturing capacity.

CONSTRUCTION AND MAINTENANCE :

The construction and installation of all equipment is carried out by the sub-station staff, and a systematic inspection of all municipal load centres is maintained, special reports being completed for each sub-station. This ensures full time employment for two employees, all sub-stations being inspected and cleaned roughly once every eight weeks. Plant requiring attention is repaired at the first available opportunity, depending on the urgency of the matter, but it is rarely necessary to isolate any low tension section for a period of more than a few minutes owing to the system of interconnections between load centres.

It is a condition of supply that the two hours between 5 a.m. and 7 a.m. on the first Sunday of every month be reserved for maintenance, and it is only a matter of seven years since the whole city shut down at this time. This is impossible nowadays and only sections experience this 'blackout' as required.

It is necessary, of course, under certain circumstances to arrange for isolations at periods other than the above, and in such cases the Department's intention is advertised in the local press. It will be appreciated, however, that there are a few isolated cases where blackouts occur at most unexpected times, automatic oil circuit breakers exercising their ancient prerogative, but, considering the extent of the system covering over 65 square miles and the periodical atmospheric storms, remarkably few major faults occur.

When dealing with bulk supply consumers, I mentioned that half-yearly inspections are customary, and it has been found necessary to group these consumers under four headings for this purpose. Firstly, we have the small or suburban domestic consumer certain colleges and theatres, where is is possible to arrange isolation for approximately two hours during normal working hours; secondly, we have the industrial and business consumer permitting isolation outside of normal working hours, say on Saturday afternoon or Sunday; thirdly, we have the large domestic consumers with elevators or buildings with combined domestic and business loads that only permit of isolation in the early hours of a morning. Even then the staff must be careful and not isolate belated revellers in a draughty lift shaft or, with the prospect of a ten or more storeys weary climb; the fourth or final group consists of hospitals, kindred institutions, cold storages, hotels, etc., where periods of isolation can only be arranged when the respective activities permit.

It will be noted from the above that the minimum of interference to a consumer is the object in view, and with the above conditions it will be appreciated that the staff's activities are fairly onerous in arranging, maintaining and reporting twice yearly on nearly 500 bulk supply consumers.

Returning to the Department's sub-stations proper, all main sub-stations and those containing reclosing switches, etc., with direct current operated trip gear, are inspected weekly, relays and batteries being checked for operation and condition. The bulk of the D.C. tripping equipment in the suburbs ranges from 6 to 24 volts, and until November last year the standard 6 volt lead cells familiar to motorists were used. These have been replaced by 37½ ampere hour nickel iron cells, which have proved entirely satisfactory, a decided advantage being the longer life and periods between charging under the conditions pertaining. Another advantage of interest is the fact that these cells cannot be used in motor cars. It happened occasionally in a transformer sub-station that a battery in good condition would be replaced by one of ancient and doubtful origin, and naturally, no one knew how.

GENERAL :

A comparison of load centres giving the number on the system in 1936 compared with the connected centres of 1926 and 1931 will illustrate the vast expansion experienced during the last decade. In particular, an outstanding feature has been the increased number of bulk supply consumers of late years, and it is sufficient to remind you of the year's connections of four years ago with that of the present year, viz., an increase of 495%.

Converter Sub-Stations in 1926 numbered 6 with an installed capacity of 14,500 KW's. In 1931 the total number was 7, with an installed capacity of 17,250 KW's. There has been no increase in the number of sub-stations but the installed capacity is now 18,250, with a further 750 KW's on order.

The Department's static sub-stations of all types in 1926 numbered 81; in 1931, 136 and in 1936, 255.

Bulk supply consumers for the same years were 63, 163 and 454, respectively.

Dealing in total high tension load centres, we have, therefore, 150 in 1926, 306 in 1931 and 716 in 1936, all the above figures being based on June of the respective year.

Transformer statistics give very interesting information, there being in June of this year on the distribution system 1,019 transformers with a total capacity of 130,880 kVA, 151 of these of a total capacity of 17,740 kVA being privately owned, compared with a total connected number in 1926 of 210 units of approximately 17,000 kVA.

It will be seen from the above transformer figures that this section of the branches' activities in itself is the source of a considerable amount of labour in maintaining, repairing, testing, transporting and recording alterations of necessary units, in addition to which the major repairs required by the generating stations are also handled.

Apart from new load centres and maintenance, considerable work is done in changing over existing load centres of all types from 3,300 volts single and two phase to 6,600 volt, 3 phase, and changing over from single phase, low tension, to 3 phase, low tension.

Throughout the system, two standard Yale locks are used, one for high tension and the other for low tension, keys for the latter being issued to all skilled artisans and high tension keys issued to responsible officials.

Each load centre is complete with danger notices, fire extinguishers log books, etc., and switch cards are fixed to all units for recording overhauls and details of equipment.

Detailed records are supplied by the Sub-Stations Branch, in common with the other branches, to the Distribution Assistant, an official who is in charge of all distribution records, line diagrams, etc., and who also controls all load and pressure tests, load tests in particular being taken at each municipal load centre during the winter months. From the tabulated results transformer capacities are increased as required and reasonable balancing is effected.

A vast amount of time has been expended lately in attempting to obtain sites for additional load centres, but it will be appreciated that this is by no means an easy task, particularly when the prevailing property boom is considered.

In conclusion, Gentlemen, I desire to place on record my grateful thanks to the management of the Johannesburg Electricity Department for the opportunity to present this paper, together with my appreciation of the labour expended by fellow officials of the Department in preparing illustration and statistics for inclusion in the paper.

The President: Gentlemen, your hearty appreciation shows your interest in this paper. In this connection, it will be noticed that no visit has been arranged to the Electricity Department's distribution system, but Mr. Kane or his assistants will be very pleased to take any of you to any portion of the system that you would care to inspect or in connection with this descriptive matter. Our thanks are due to Mr. Kane for his interesting paper. It shows the method of development in this city, and it may be of some use to some of the smaller municipalities.

I understand that Mr. Roberts has put in a written contribution in connection with Mr. Liebbrandt's paper, and I would ask the Secretary to read it now.

DISCUSSION :

The Elec. Dept. of the S.A.R. & H.

Mr. John Roberts (Durban): It gives me great pleasure to pay my small tribute to the excellent work which Mr. Liebbrandt has carried out during the past few years in the extension of electric traction in this country. He has thoroughly appreciated the importance in a territory like this, the Union of South Africa with its abnormally sparse population of cutting down the cost of transmitting electric power from the place of generation to the point of use. It is a matter of importance of course, not only to those who have to distribute current for hundreds of thousands of miles but to the Municipal Electrical Engineer serving a comparatively small area but with much lower density of population than prevails in areas in other countries. The population for instance, of a town of the size of Durban, if located in England or America would in many cases exceed a million or more people instead of say, 200,000, and it is just as important for a Municipal Electrical Engineer to explore the cheapest method of transmitting and distributing electric power particularly if he wishes to meet the electric requirements of every domestic consumer.

I think I appreciated the importance of this matter very many years ago and for this reason refused to have anything whatsoever to do with direct current except for tramway work.

Mr. Swingler once told us at a Convention Meeting that it was costing Capetown over a million pounds to change from Direct Current supply to 3 phase service. The total net debt of the Durban Town Council's Electrical Department is well below that figure. Mr. Leibbrandt's work has, I believe, been criticised because it is not likely to give that complete security against break-down that more substantial and costly construction would have provided but he has realised that it is better to give a service of say 98% efficiency than no service at all.

Dr. J. H. Dobson, D.S.O. (Past President) : The present unprecendented prosperity of the Witwatersrand Gold Mining Industry is extending its influence to most of the principal Towns and Cities in South Africa; and the consequent increases in railway traffic have led the S.A.R. Administration to embark on a policy of appreciably extending Railway Electrification. It is therefore appropriate that Mr. Liebbrandt has been good enough to present to this Association of Municipal Electrical Engineers an outline of the Electrical Department of the S.A. Railways and Harbours—your applause and the hearty vote of thanks accorded to him is an indication of our high regard for him personally and our appreciation of the trouble he has taken to give us a mass of technical information and statistics of intense value not alone to Municipal Electrical Engineers, but I think you will agree with me that his paper is of national interest.

There are three sections of this Department described in his paper, namely :—

(1) Electric light and Power for its own numerous Power Stations, Engineering Workshops, Cranes, Elevators, Harbours, etc.

(2) Communications including telephone and telegraph installations, train control apparatus and signalling and Marine Wireless, etc., etc.

(3) Railway Electrification which, as Mr. Liebbrandt states, is now the principal activity of the Department and therefore occupies a very prominent part of his interesting and valuable paper.

The late Sir W. H. Hoy deserves great credit for persuading the Government to embark on Railway Electrification on the Main line in Natal and the suburban traffic in greater Capetown. It is a matter of regret to many of his friends that he did not live to see the satisfacory developments that have been presented to us to-day. It might be of some little interest to remark that the S.A.I.E.E. played some part in the embryonic stages. Early in 1914 it appointed a special Committee styled the "Development of Resources Committee" consisting of Messrs. Buchanan, Dobson, Ewing, Elsdon Dew, Kirkland and Bernard Price—this was the result of the then trade depression and the Special Committee was appointed ostensibly to try and find outlets for greater scope and greater employment in the electrical engineering profession. Railway electrification was one of the sections upon which we were specially interested. The great War intervened but propaganda on Railway Electrification continued. Several of us on this Committee entertained Sir William Hoy to a luncheon party in the Carlton Hotel and most of the afternoon was occupied on the subject of Railway Electrification.

In my Presidential Address to the S.A.I.E.E. in February 1918 I referred with pleasure to the paper that had been read during 1917 by our old friend John Kirkland in which he showed that the engineering aspect of the Electrification of Railways for main line traffic was established beyond all doubt as illustrated by Mr. Kirkland's excellent description and working of the Chicago Milwaukee and St. Paul Railway in America. In my address, I then expressed the hope that this example would prove both a powerful incentive and inducement to apply these methods to the S. A. Railways.

Merz and McLellan's first report to Sir William Hoy on "The introduction of Electric Traction" followed later and was dated June, 1919, and as Mr. Liebbrandt has pointed out, construction work on the Electrification of the Pietermaritzburg—Glencoe and Cape Suburban sections was started in 1925-26 and both were in final full operation during 1928.

Pioneers in any section of Engineering have to face the possibility of having a rough time in the early stages of any enterprise and Mr. Liebbrandt mentions in his paper "it is no exaggeration to say that the outlook both in Natal and in the Cape during the early years of electrification was black and that this state of affairs continued until 1931."

Several years had elapsed since the original estimates were framed and the completion of these two Railway Electrification schemes. Industrial conditions had changed appreciably, costs of plant and materials had varied, copper was at very high prices and many items of work were debited which were never originally forecast would be charged to railway electrification. Consequently original estimates were exceeded and Capital Costs and Power Costs were higher than anticipated. Unfortunately as Mr. Liebbrandt has pointed out, this state of affairs coincided with an appreciable fall of traffic on the two electrified sections, due to World Trade Depression which particularly affected the Natal Main line and decreased traffic on the Cape Suburban line due to virulent competition from Motor Buses and private ownership of motor cars, etc. These were the burdens which fell heavily on those responsible for the inauguration of railway electrification in South Africa, these being in addition to the usual preliminary teething troubles, the principal of which were due to lightning troubles, electrolysis; which had to be contended with for some time.

It is all the more refreshing to read in Mr. Liebbrandt's paper of the turn of events subsequent to 1931. The preliminary troubles have been satisfactorily overcome, Capital Charges appreciably reduced and Power Costs brought down by some 26% to 28%. Extensions of the existing Railway Electrification have been carried out wherever possible to improve load factor and reduce overheads. The results of all these efforts have converted S.A.R. railway electrification from what was, during the first years "considered to be an economic failure to what is now an outstanding success."

The S.A.R. Administration has been thereby encouraged to make still further extensions and has decided to electrify the Randfontein—Springs section, and the section between Germiston and Pretoria together with certain off-shoots to same at Orlando and Wattles—it is expected they will be in operation during 1937.

As Electrical Engineers, I am sure we are all glad to know that the S. A. Railway Electrification has justified the broad outlook and courage of those who pioneered the scheme, and the reading of this paper affords us an appropriate opportunity of congratulating our brother electrical engineers in the S.A.R. Administration for the very important part they have played in bringing maters to the present stage of general technical economic and operation satisfaction.

I am very glad to have had the opportunity of listening to the reading of Mr. Liebbrandt's paper and heartily congratulate him particularly(as well as generally to those of his staff who assisted him) on the outstanding achievements with which some of us might have been generally acquainted.

Mr. Liebbrandt has explained how difficult it is to secure definite comparisons between the overall costs of steam and electric locos, but some of the statistics he gives are very impressive :

Taking his comparison of the 14th Class steam loco which is chiefly displaced by the electric loco :—

1. Repairs cost per mile, steam 12d. and electric 2d. (Electric about 1/6th the cost of steam loco.)
2. Actual Engine running :
   Hours per day : steam 9.66; electric 15.06
   (Electric runs about twice the number of hours of the steam loco.)
3. Average ton—mileage per day :
   Steam 18,118; Electric 68,802.
4. Time required for journey and loads between Glencoe and Pietermaritzburg :—

   Steam 16½ hours, loads 720 to 1,000 tons.
   Electric 10½ hours, loads 1,500 tons straight through.
5. When Durban to Volksrust electrification is completed, there will be a saving of about 9 hours in transit of goods traffic.

These are salient point that members of the Association will be glad to have on its records in the publication of its proceedings and will also be of public interest generally.

I have much pleasure in supporting the vote of thanks which has been proposed by our President to Mr. Liebbrandt for his paper.

After a few general announcements by the President, the Convention adjourned at 12.50 p.m.

WEDNESDAY, November 18th, 1936.

The Convention resumed at 10.5 a.m. at the Conference Hall, Empire Exhibition, with the President in the Chair.

DISCUSSION :
"Distribution Sub-Stations"

The President : Before calling on Mr. Le Mare to give his paper I think it well to invite discussion on Mr. Kane's paper of yesterday morning.

Mr. Geo. H. Swingler (Capetown) : I would like to propose a vote of thanks to Mr. Kane for his paper describing the substation arrangements of the Johannesburg Electricity Undertaking, a number of the features of which differ from corresponding details in Capetown. For example, whereas in Johannesburg the substation high tension switchgear is all of the cubicle type, in Capetown we have standardised upon metal-clad high tension switchgear. My personal opinion, to which I have been forced more or less against my will by practical experience, is that the metal-clad type of gear in general has advantages over the cubicle type which outweigh the extra cost involved. The advantages to which I refer are greater robustness, greater freedom from external causes of interference with the correct functioning of the gear and the greater convenience of metal-clad gear in dismantling and reusing it in another location should occasion so demand. This latter point is of importance when, as has been our experience in Capetown, it has been found necessary because of increase in the substation capacity to move switchgear from one location where the rupturing capacity required was greater than that of the gear to another substation perhaps even more miles away where in this respect it could be used with safety.

While on this point I would put forward the suggestion that when ordering switchgear a bold line be taken on the question of installing in the first place switchgear of rupturing capacity adequate to deal with the probable requirements for a considerable time to come notwithstanding the extra cost involved in the larger gear.

As is now the case in Johannesburg, iron kiosks of the type described in the paper would not be permitted in Capetown, and indeed considerable objection is frequently raised from time to time even to the very much smaller and therefore less conspicuous low tension distribution pillar boxes.

A certain amount of difficulty is experienced in Capetown in obtaining sites for substation purposes, so that it is not unusual for the Council to have to pay considerably more for such sites located in the desired position than at first appearances the area of the ground concerned warrants. Against this, however, must be placed the saving in the cost of cables and losses therein brought about by the shorter lengths of cable runs to the position considered most favourable through technical considerations as a substation site which will more often than not counterbalance the lower price at which a site in a less favourable position could be obtained.

The paper is of special interest in illustrating how widely different practice in respect of the distribution system may be in different centres in achieving the same result, and while a paper of this nature serves an extremely useful purpose in disseminating information on these matters, it brings to my mind again what I have often thought to be a very valuable means of making for the more economical and efficient operation of this division of the Electricity Department's activities, namely that supply authorities should allow their Distribution System Engineers opportunities of visiting other centres both in this country and overseas to become acquainted with methods in use there. Personally I would be very pleased to permit the Distribution System Engineer from any South African Municipal Undertaking to spend say, a fortnight with the Capetown Undertaking and to give him all information possible regarding our methods of transmission and distribution. I feel that an interchange of knowledge and experience obtained in that way would be of very great value both to the visitor and to the Undertaking visited, and I submit that this is a matter which our Association ought to encourage.

Mr. Horrell (Pretoria) : The author has provided us with an interesting resumé of substation layout practice in Johannesburg and his difficulty in enlarging on some portions of his description of the equipment in a paper which must necessarily be restricted in length can be appreciated.

There are one or two points which I think could be enlarged upon to the advantage of the paper. For instance we are informed that transformer kiosks are now in use which permit the installation of a 300 kVA unit. It would be appreciated if the author could provide dimensions of such a unit.

In Pretoria we have been considering kiosks to house 200 kVA units but find that its bulk is objectionable, for not only is it difficult to accommodate them on the sidewalks without inconvenience to pedestrians, but property owners would I think, be perfectly justified in objecting to their erection in front of their property.

This combined with the difficulty of purchasing suitable ground in the environs of the central area has led us to consider placing the transformers underground. Unfortunately we cannot follow Durban's example in providing drainage, so have had to fall back on a steel chamber with a diving bell type of hood, ventilation being provided by a fan in the adjacent switch cubicle.

So far as the central area is concerned, it has been our practice for years past to negotiate with the owners of suitably situated new buildings for the provision of accommodation for communal substations, the arrangements otherwise being very similar to those described by the author. In the majority of cases the owners have met the department in this matter, although until recently there was no by-law necessitating such consumers to take a supply at high tension.

Although the subject of mains and distribution generally does not come within the scope of the present paper and therefore cannot be dealt with in the author's reply, I would like to suggest that Mr. Rodwell might arrange for the reading of such a paper at our next Convention. I am certain that a description of the methods employed in Johannesburg for E.H.T. and L.T. distribution would be of great interest and value.

Mr. Harvey (Springs) : I notice the paper refers to their now installing 500,000 kVA rupturing switches. I would like to ask the author what led up to the adopting of these 500,000 kVA capacity switches — whether he had any trouble previously?

I notice in the paper, they are using series current transformers for street lighting; and I would like to know what protection is used against the breaking of a wire—a wire falling down.

With regard to their sub-stations, he states they have stringent tests by the Department, and also that the Inspector of Factories examines the sub-stations. I just wondered if that was a regular practice, because in our case, at Springs, we never have any factory inspectors going over our sub-stations.

With regard to the transformer sub-stations I would like to know the approximate distance between the transformer sub-stations, particularly in a new township. If they were to lay out a new township, how would they arrive at the distance between sub-stations in the layout?

Can the author tell me what sort of failures they have with transformer burn-outs and what percentage of failures they have?

Mr. J. S. Clinton (Salisbury) : I should like to ask the author whether he can justify the provision of high tension supplies to consumers with a maximum demand of only 30 kVA. Presumably the high tension switchgear in certain positions will require to have a rupturing capacity more or less in conformity with the station switchgear. It seems that the figure of 30 kVA is very much on the small side for economic installations.

The President : As there seems to be no further discussion on this paper, I will now ask Mr. Le Mare to present his paper.

National Propaganda.

A NOTE ON A CHANNEL FOR NATIONAL PROPAGANDA FOR ELECTRICITY IN SOUTH AFRICA.

By G. W. R. Le Mare,
Publicity Officer, Electricity Supply Commission.

In this brief survey it is not proposed to cover more than the wider aspects of the subject, nor is it my intention to do more than suggest a possible line of action, which it is hoped may lead to an expression of views by members of this Convention.

The first essentials before a national publicity campaign of any nature can be undertaken are the ability to supply the wares advertised in the area to be covered in the campaign, and the ability to supply at a rate inducive to general use. When writing recently in "Helios," a journal which is no doubt known to you all, the Rt. Hon. Herbert Morrison, leader of the London County Council and Minister of Transport of Great Britain from 1929 to 1931, discussed the problem in relation to the British Power Supply Industry and said:—

"I am all for publicity. I urged the industry to go in for adequate publicity when I was Minister of Transport, at the same time paying my tribute to the able publicity conducted by the great gas industry. I have no doubt that the publicity campaign will do good, but however well that campaign is conducted, I do not under-estimate its difficulties.........The publicity campaign can only deliver the goods in so far as the industry enables it to do so, but over other parts it either cannot, owing to physical or financial incapacity............"

All of these remarks are not applicable to South Africa but the basic argument is.

It seems necessary, therefore, to make a quick survey of conditions in South Africa at present. I may mention first the national body, the Electricity Supply Commission, with its extensive distribution systems over an area exceeding 1,100 square miles, supplying 15 towns with electricity in bulk, reticulating in 44 towns and villages as well as in rural areas. Last year the total energy supplied in bulk to municipalities and for domestic use direct to consumers was 186,348,40 units. Next is the Victoria Falls and Transvaal Power Company Ltd. which, besides supplying the great mining industry, supplies in bulk to some 8 towns as well as reticulating in certain areas. From that point the survey opens to the wide field of municipal supply, either with energy bought in bulk or with energy generated by their own enterprise. In all these areas there is a total of 202,503 consumers, who, in 1934 (that being the latest general figure available), consumed 276,806,029 units of electricity. Since then, of course, there has been a considerable increase in all areas, both of consumers and in consumption. These 202,000 consumers represent many more individuals and basing the figure on an assumption of an average family of four, the total number of persons now enjoying the benefits of electricity are in excess of 800,000. The population of the area in which electricity is available at favourable and nearly favourable rates now exceeds 1,071,000. With extensions carried out recently and planned, that number must increase very considerably. It may, therefore be argued that the first essential has been met.

Of equal importance, obviously, is the ability to supply the energy at rates which will encourage its use, or at any rate permits its use with moderate freedom. That figure must vary with localities to a degree. Rates from 10 major centres are set out in the following table :—

Town.	Domestic Charges after basic charges, which vary.	European population last census. (provisional).
Bloemfontein	¾d.	30,161
Cape Town	½d.	165,700
Cape Town Undertaking E. S. C.	¾d.	Figure not yet available.
Durban	½d. subject to 10% discount on total.	94,773
East London	¾d.	31,129
Johannesburg	½d.	252,926
Natal Central Undertaking E.S.C.	½d.	Figure not yet available.
Maritzburg	1d. subject to 10% discount on total.	22,218
Pretoria	⅝d.	76,229
Port Elizabeth	⅝d.	53,089

It will thus be seen that in our country in the areas of greatest population the rates for electricity are definitely attractive to the domestic user and the results are self-apparent. The same, of course, may be said of areas which are less populated but which have the geographical advantage of being in close proximity to major power stations or distribution systems. The field in which electricity is available at rates which perhaps are not entirely inducive to free use of the energy for domestic purposes does not bulk very large in this picture, but it would be very unwise to disregard the fact that there are areas where the unit charge is above that level at which electricity is the cheapest as well as the best servant. On the whole, however, it may be reasonably argued that the second essential also has been met and that, therefore, there do exist the primary conditions necessary before thought can be given to a national propaganda campaign.

If there were a need to debate the benefits which would follow intensive publicity, it would be possible to adduce detail in plenty. But it is perhaps most illuminating to quote figures of appliances installed under assisted purchase schemes fostered by the supply authorities. For the information in the following table I am indebted to the City Electrical Engineers in the towns set out :—

Town.	Appliances purchased under Hire-Purchase schemes.	Amount advanced.
Bloemfontein	R.— 214 Rf.— 15 W.H.— 13	£6,161 since 1928.
Cape Town	R.— 13,424 Rf.— 1,534 W.H.— 1,982 Was.— 443 Mis.— 1,431	£584,366 since 1930.
Cape Town Undertaking E. S. C.	R.— 478 Rf.— 19 W.H.— 7	£14,299 since 1932.
Durban	R.— 7,403 Rf.— 2,594 W.H.— 1,617	£337,390 since 1925.
East London	R.— 405 W.H.— 28	£12,877 up to Aug., 1936.
Johannesburg	R.— 2,100 Rf.— 190 W.H.— 150	£98,500 since 1930.
Maritzburg	R.— 369 Rf.— 235 W.H.— 43	£46,102 in last 5 yrs. only.
Natal Central Undertaking E.S.C.	R.— 75	£2,180 since 1932.
Pretoria	R.— 1,396 Rf.— 499 W.H.— 302	£69,723 since 1925.
Port Elizabeth	R.— 768 Rf.— 253 W.H. 86	£33,704 to Aug., 1936.

R.— Ranges; Rf.— Refrigerators; W.H.— Water Heaters; Was.— Washers; Mis.— Miscellaneous.

The value of such results as these from propaganda will readily be appreciated. An attempt to measure the value of wide use of domestic appliances to the power suppply authority was made in America, when the following figures were obtained. The "yard stick" is the annual revenue derived from the use of each appliance expressed as a percentage of the appliances' initial cost :—

Appliance.	Av. price per kilowatt hour (cents).	Av. annual use (Kilo-watt hours).	Consequent gross earnings produced per appliance (dollars).	Av. retail cost per appliance (dollars).	Annual gross revenue per cent. of appliance cost (cents).
Space Heaters	5.3	50	2.65	2.20	121
Hand Irons	5.3	50	2.65	3.60	74
Toasters	5.3	50	2.65	6.50	41
Water Heaters	2.0	3,000	60.00	150.00	40
Percolators	5.3	50	2.65	7.00	38
Ranges	2.5	1,750	43.75	130.20	34
Clocks	5.3	18	.95	6.23	15
Refrigerators	4.0	550	22.00	169.44	13
Ironing Machines	5.3	125	6.63	51.92	13
Vacuum Cleaners	5.3	36	1.91	54.96	4
Washing Machines	5.3	24	1.27	64.83	2

Average consumption per consumer in U.S.=1,025 units. (Quoted from Rural Electrification News Bulletin 5 & 6, issued by the Rural Electrification Administration of America).

The S.A. results given above have been achieved with a measure of propaganda and may be said to be typical of the beneficial results which flow from combined low tariffs and propaganda.

In Johannesburg the Electricity Department indulges in an effective use of many of the avenues of publicity—in newspapers, periodicals and showroom display. In Cape Town a very intensive campaign in many channels has been conducted by the City Electrical Department and by the Electricity Supply Commission's Cape Town Undertaking, again with undeniable results.

Durban, too, has lost no opportunity, and one excellent medium is a monthly bulletin issued with every account. In Maritzburg the returns pay tribute to the keen appreciation of the value of publicity and show the good use which has been made of it. In Pretoria a major use is made of cooking demostrations and a bulletin is also issued. The Electricity Supply Commision at its Natal Central Undertaking makes full use of the avenues provided for propaganda by cooking demonstrations and advertisements and at its Witbank Undertaking a measure of propaganda is also issued in several channels.

The efforts enumerated, however, are purely localised propaganda. At present the Electricity Supply Commission is making major use of only one channel for national propaganda—a monthly journal which is enjoying wide circulation in many areas of the Cape, Natal, Transvaal and Free State with the valuable co-operation of the municipalities. The industry as a whole however, cannot be said to be engaged in a national campaign.

It is opportune now to examine the channels which exist for the making of propaganda and the method of making that propaganda. Those channels are many— newspapers, periodicals, radio, the hoardings, lecture hall with the highly effective cooking demonstration, the cinema and the post. Any one of these or some of them might reasonably be used to carry either national propaganda or specific localised propaganda. National propaganda is the background — the basis—upon which it is held that all public utility propaganda should be grounded. The localised propaganda is that which has its basis on the national campaign but aims at carrying its message to persons resident in specified areas. Two excellent examples demonstrate the texture of national propaganda. One is the "Eat More Fruit" campaign, upon which tens of thousands of pounds were spent in Great Britain upon that one slogan alone. That slogan became the foundation of a very wide campaign of localised propaganda. When the slogan—the basic idea— had been driven home there followed the specific propaganda, directing public attention to one particular fruit or to particular shops which stocked particular brands of particular fruit. The campaign was a very successful one and we in South Africa benefited from it, since it helped to promote the sales of the products of our own orchards.

The second example was the Mustard Club—an ingenious brainwave which led to a vast national and, indeed, internationl campaign. The British Isles were placarded with circulars which exhorted the public to "Join the Mustard Club!" Nobody knew anything about the Mustard Club—where its headquarters were nor what its objects were. For a period of some weeks this mystery was maintained and even the major newspapers fell into the trap and mentioned the mysterious club in their news columns. At the psycological moment the club was unveiled, so to speak, and revealed as nothing but a piece of astute propaganda to induce the men, women and children of Great Britain to use more of a specific brand of mustard.

I mention these two simply as illustrations and I certainly have no wish to urge that we should sky-sign and placard the countryside with bald commands to the community to "Use more Electricity" and leave it at that. Nor do I propose the foundation of the "Unit Club," but those two campaigns do serve to show what "background propaganda" is and what its aims are. In brief, we might say that a national campaign endeavours to prepare the public for the detailed and localised campaign so that the "messages" of the latter will be more readily assimilated. In the field in which your endeavours lie there is no wish to sell the product for the profit of individuals but that is no reason why there should be an apathetic attitude towards sales-promotion from a national point of view.

We have seen what profits have followed localised propaganda aimed at the promotion of the domestic load in larger centres. I have quoted details only from the larger cities and though there are many others carring on excellent work, I would direct attention to those areas where either because of lack of finances or the lack of a sympathetic Council no efforts at sales-promotion are being made. In those areas the growth of domestic demand is engendered only by the inherent qualities and advantages of electricity itself. It is not enjoying that acceleration which propaganda could impart. I am certain that the members of this Convention regard as their concern the growth of the services of electricity to the whole community and that as professional men they do not limit their interest to those matters which are purely parochial as distinct from national, and which are their normal daily duties. A suggestion for a national campaign aimed at inducing a wide and appreciative knowledge of electricity's place in the modern home and in the factory may, therefore, be of interest to this Convention and I propose to outline in brief some of the methods which might be employed.

I have explained the difference between national and localised campaigns but it must be remembered that the cumulative effect of the more or less localised campaigns, especially in national journals, is one which builds, in effect, a skeleton national campaign. In the localised campaigns there are the contributions not only of the power supply authorities but also of the traders. Taking one issue of two Johannesburg daily papers, you find no less than 16 advertisements directing attention to particular brands of domestic electrical equipment. That cumulative effect is an advantage which electricity possesses and the task of those who would formulate a national propaganda campaign is, therefore, simplified to a considerable degree.

It might be well here to enumerate what should be regarded as those points upon which special endeavour could be directed. The wider use of :

(a) Electric stoves ;
(b) Refrigerators ;
(c) Water Heaters ;
(d) General heaters ;
(e) General household appliances—the vacuum cleaner, the washing machine, electric kettle, iron, sewing machine and a score of other mechanical aids which are offered to the modern housewife ; and
(f) Better house lighting.

All these, of course, are the subject of considerable local propaganda but that propaganda aims mainly at a sale of a particular brand of appliance. It is confined almost entirely to the advertisement columns of a newspaper and, therefore, is regarded by the readers as being perhaps a little extravagant in its claims. There is in my view very definite need for supporting propaganda aimed not at selling particular products but at imparting knowledge which promotes a keener apppreciation of the services electricity can perform.

Presuming an agreement upon the points set out above—even if it is an agreement arrived at simply to give a basis for argument—we can now return to consider the methods to be used in making national propaganda.

Firstly there are the avenues of paid advertisement in newspapers, periodicals, cinema slides and, if the new Radio Board of Governors gives effect to the hint thrown out by the Minister of Posts and Telegraphs, over the air. These channels are relatively expensive and the sustained campaign in national newspapers alone in both official languages would very easily run into five figures. I hasten to say that I am a firm believer in the value of newspaper advertisment and no campaign can be really successful without the use of newspaper advertising columns. The same may be said of paid-for-propaganda in periodicals and for cinema slides and the radio. But to investigate the

possibility of conducting such a paid-for campaign is beyond the scope of this paper and I feel that our discussion is likely to be more productive if I draw attention to a little-exploited channel which is offered in the editorial columns of newspapers and magazines. You are familiar, no doubt, with the weekly or fortnightly electricity pages which are features in some newspapers. They are, of course included because they attract considerable revenue for the firms suppplying appliances. But not infrequently the editorial matter falls below the standard one would like to see maintained. There are, of course, exceptions to this. I am aware that the monetary benefit to the newspapers is not the only reason for the appearance of these features—it is appreciated by Editors that they serve the public good and it is for this reason that I feel that most newspapers would be willing to co-operate with any body whose object it was to suppply good and readable articles upon electrical home-making and appliances .

That brings us to the point where we can consider whether or not the bodies primarily concerned with power supply could not meet this want for good articles. At present there is a fairly large amount of matter available in the larger centres but not means of its interchange. Good articles appear in the Cape pappers but are seldom seen in the Transvaal or Natal or Free State papers, and the opposite is also the case. If there were a central organisation for distribution of such propaganda articles that loss of good material would be obviated and the fulfilment of that ideal is one of the points which I would especially bring to the notice of this Convention. That does not mean the setting up immediately of an elaborate organisation such as the Electrical Development Association of Great Britain, but possibly of a central office under direction of a Committee through which newspapers could be supplied regularly with such matter as they can print without elaborate sub-editing and rewriting.

One source of suppply for such articles would as stated, be in the newspapers themselves. The articles now published are mainly written by staff members and there can be little doubt that the newspapers concerned would be willing to permit reproduction in other journals at different centres in return for a supply of other material. Certain of the newspapers do exchange articles at present but I have no doubt that generally an exchange agency would be welcomed. To be fully effective, however, the organisation would have to draw material from other sources as well. While I wish to make it clear that I do not suggest that the busy electrical engineer should sit down and produce propaganda articles, it is a fact that on the staff of many electrical undertakings are persons especially competent to undertake the supply of articles. There are, for instance, demonstrators and show-room attendants who, even if they have no journalistic ability, definitely have the necessary knowledge and articles drafted by them might be prepared for distribution by persons who are better skilled in writing. It is obvious that the costs of such a scheme would be infinitesimal when compared with that of a large national advertising campaign, while on the other hand it must be similarly clear that the eventual benefit flowing from such propaganda which appears. of course, in editorial columns, would be very considerable. There is no doubt that while the newspapers woold be willing to carry such propaganda, they would also expect some **quid pro quo** in the shape of paid advertisements. However, most of the power concerns do spend not inconsiderable sums already in paid advertising and it is reasonable to think that this advertising would itself be sufficient to induce the newspapers to accept the position.

Hitherto I have dealt only with the large newspapers, but it is clear to-day that the need for a national propaganda is even greater in the country districts, where small newspapers have an intimate circulation. It is a well-known fact that such newspapers do make readily use of such material as is supplied to them by national bodies seeking to make specific propaganda. One need but mention that the press service issued free by the British Empire Exhibition authorities was welcomed by the country editor, and the small news service conducted from the Publicity Office of the Electricity Supply Commission has been similarly welcomed. This news service, I may explain, contains articles of general women's interest on electrical topics and also a certain amount of propaganda for "ESCOM," the monthly journal which the Commission issues as an organ of national propaganda for electricity. Eight or ten items per month are sent out to 70 selected newspapers and such returns of cuttings as have been made show that the news service is achieving its object. It seems, therefore, to me that a very valuable field lies in the country newspapers. And the field should certainly not be ovelooked in any national propaganda campaign.

That, in brief, is an outline of the suggestion I put forward, and, backed by the knowledge that in the larger centres at any rate electricity is supplied at a cost which gives electricity no rival in the domestic field—there may be a gasometer explode with indignation at the expression of this sentiment—I feel certain that some considerable good would follow any efforts to give effect to the suggestion.

DISCUSSION :

The President : Gentlemen, Mr. Le Mare's interesting paper deals with the necessity for publicity and propaganda in the electrical field and urges National rather than localised effort in this direction. This is a subject which should lead to a great deal of discussion, and our thanks are due to Mr. Le Mare for his paper, which is now open for discussion. We will continue for a few moments only prior to taking refreshments.

Mr. W. H. Milton (Electricity Supply Commission): Mr. President and Gentlemen, I would like to thank Mr. Le Mare for his very excellent paper. There is one aspect of the subject which is mentioned in the paper and which, to my mind, has an important bearing on the problem, viz., the mention of the natural variation in prices for electricity which one must expect in this country.

The difficulties with which a centralised organisation would be faced in handing out articles for national use are to my mind, fairly obvious. It is extremely difficult for any central body to decide what prices are, as described by Mr. Le Mare, "reasonable," and therefore render electricity competitive for complete domestic application. The costs of electricity's competitive fuels vary so widely.

There is another aspect of the paper which requires careful thought—that is the question of water heating. With regard to the remark that "electricity can compete favourably with other means of obtaining the required object," in my own personal view, I think the project of electrical water heating is a most dangerous one when included in an advertising campaign for the more extensive use of electricity. Whilst I am personally satisfied that the use of electricity in this country in many places can very satisfactorily compete with other forms of energy supplied for general household purposes, I am not at all satisfied that the same applies to water heating; in fact, from the point of view of my own investigations, there are very few places where you can safely say that water heating can be introduced into the home economically in competition with other forms of water heating. After all, the extent of the use of electricity for water heating is probably of the order of 200 units per month in the average household. At ½d. per unit, the cost would not be very much less than 10/- per month, and in many households you will find the usual fuel will provide not only the water, but cooking for much the same figure. It is, of course, advantageous to suggest that with the introduction of the electric range, electric water heating should also be adopted, but on no account should the prospective users be mislead on the question of the cost of heating water electrically.

As regards water heating, there is, I think, another well-known disadvantage which I think might be very well aired at this convention—that is in most cases the householder adopting electrical water heating for the first time is frequently mislead into buying on price and price alone. The necessary capacity is apt to become a secondary consideration and where you do meet with dissatisfied consumers who have adopted water heating and who are not worried about the price, you will find in almost every case the trouble arises from the introduction into the home of too small a container. The normal draw off is as rapid that in a short time only cold water is obtained. The other trouble frequently experienced is due to scale on the insert tube. The scale acts as a cheap insulator and in extreme cases leads to the destruction of the elements.

I think these points should be kept well in mind when discussing this question of national propaganda, and I think the views of the general body of members on these aspects would be welcome to the author of the paper.

Mr. George H. Swingler (Capetown): As one who has been responsible for a good deal of propaganda and advertising in connection with the development of a demand for electrical appliances and the more extensive use of electricity, particularly for domestic purposes, I would draw attention to the need for exercising very great care in the style and wording adopted in these media, and also in the selection of the apparatus or service which is being "pushed." My advice in this matter is that on no account should Municipal Electrical Engineers associate themselves with any advertising or propaganda matter unless and until they are fully satisfied that the appliance or service concerned will fully fulfil all that is claimed for it, for the reason that the expense incurred in advertising can only too easily be completely wasted by the amount of harm which one disappointed consumer is in a position to do, and in this connection I would remind you that advertising undoubtedly is expensive. Because of this, and with all due respect to the smaller undertakings whose difficulties in the matter I appreciate, I would add that unless the energy charge for cooking purposes be brought to 1d. per unit or less and for water heating to ½d. per unit downwards and specially unless there is a potential opening for the use of electricity for those purposes it will be found more profitable to save money in whatever way may be possible in the course of normal development rather than to throw good money away in advertising the advantages of an "all-electric" house in an attempt to foster artificial development in a direction in which it is foredoomed to, say the least of it, lack of success.

That electricity is entirely satisfactory for heating and cooking purposes at a charge of ½d. per unit is,, I think, evidenced by the fact that in Capetown through our hire purchase scheme alone some 14,000 electric ranges as well as a large number of other domestic appliances have been sold by the Electricity Department in the course of six years and where the Council has spent through that scheme no less than £586,000 to date with local dealers in appliances and electrical wiring contractors. I am convinced, however, that this result would not have been obtained had not a programme of propaganda and advertising been inaugurated at the same time as the hire purchase scheme. Even so the difference between receipts for the sale of appliances under the scheme and the cost to the Department of the appliances installed amounted during the first year to 15/- per kW. installed. This figure has, however, been steadily reduced and during the past three years the balance has been the other way. The debit balance, however, was looked upon as a development expense, a view which is held also by other large undertakings who have embarked upon an intensive development scheme of this nature.

I do not think that the examples of advertising on a national scheme illustrated in Mr. Le Mare's paper are suitable for South African conditions where the distances between centres, the climatic conditions and the activities of the towns differ so widely. To my mind national "advertising" should so far as participation by Electricity Undertakings is concerned be more in the nature of national propaganda directed at increasing sales of electricity, for to my mind advertising in the sense of inducing persons to purchase particular types of appliances is essentially a matter for dealers themselves. If this can be arranged on a national basis, so much the better. The propaganda to which I refer is in the nature, for example, of contributing articles or advertisements relating to the use of electricity to papers which circulate throughout the country such as, for example, "The Ladies Pictorial," "Escom" and others,, although in addition to that there is no doubt but that in the larger centres similar steps would need to be taken in addition to create special local interest through the medium of advertisements and articles such as appear, for example, in the electrical page of the "Cape Times," "Cape Argus," and "Die Burger." This point is of particular importance in the larger centres through the competition which is met with from other sources of heat, light and power, so making it necessary to keep prominently before the minds of the local public the service in which we are particularly interested.

Councillor Allison (Pietermaritzburg): Mr. President and Gentlemen : At the outset, I would like to tender my congratulations to Mr. Le Mare on his very able and explicit paper. I am quite sure I am voicing the opinion of all present when I say the paper is a most interesting one and is appreciated by all.

I am extremely sorry to see that the Press, usually so much in evidence, especially at Political Meetings, are conspicuous by their absence. I sincerely hope that the proceedings of this meeting will be given full publicity in the Press.

I think I can safely say that in Pietermaritzburg, we have found that a splendid means of publicity is the giving of cooking demonstrations at intervals, both for Europeans and Natives. Mrs. Bush who is sent round the country by the Electricity Supply Commission has been of very great assistance to us in Pietermaritzburg in encouraging and making the use of electricity more popular. Cooking demonstrations in Pietermaritzburg have now become very opular. These demonstrations give the ladies the opportunity of meeting together, and a friendly spirit of competition is encouraged by the presenting of prizes. First of all our worthy Engineer offered prizes himself, and during my period of office as Mayor he induced me to offer prizes. Prizes are now being provided by the Corporation, and I can assure you the competitive spirit among the ladies is having a very beneficial effect from an advertising point of view. The ladies are very enthusiastic. Mrs. Bush demonstrated how to make scones in a certain way. A prize is then offered for competition at the next cooking demonstration for scones made according to the recipe given, and the resulting competition has been particularly keen. In most instances electrical goods are given as prizes and the winners have therefore to consume more electricity when using their covetted prize. The proof of the pudding is in the eating, and once electricity is used consumers continue to prove its undoubted benefit.

We have had Councillors in Pietermaritzburg, and I daresay there are Councillors in other places, who contend that as the Council has the monopoly in the sale of current, there is no necessity for a competitive price being charged. This view should not be taken. Although wood and coal cannot possibly be compared with the cleanliness and utility of electricity, it behoves all those whose duty it is to the public to distribute current to endeavour to meet consumers in every possible manner.

In Pietermaritzburg we found that, although we gave 10% discount off our accounts and 14 days in which to pay accounts there was a considerable amount of irritation caused on account of the meter readers having to go round continually throughout the month. Some of the meters were only read on the 14th or 15th of the month, making the period of grace expire on the 28th or 29th. This had the effect of preventing many people from taking advantage of obtaining discount by paying their accounts within 14 days of rendering, and effected mainly the poorer people of the community. This grievance has now been removed and customers are now given thirty days in which to pay their accounts. I agree with Mr. Swingler of Capetown that the secret of success is to have satisfied consumers.

I hope that other members will be able to put before us information which will assist all concerned to sell more current for the good of the community. (Applause).

Councillor McLean (Port Elizabeth): I totally disagree with Mr. Swingler in regard to our not advertising as much as possible. The large towns in the Union, particularly Cape Town, pride themselves on the fact that their advertising helps the smaller towns, as though they were doing it for that purpose (laughter). They talk that way, and the peculiar thing about the representatives of these big towns is, that they say, "We do the 'writes-up' etc." As a matter of fact, most of the information regarding these things come from America.

I, as Chairman of the Electricity Supply Department of Port Elizabeth, have not spent, as Mr. Swingler has spent, £2,300 on advertising and lost £8,000 in opening show-rooms—which in my opinion is a mistake from an advertising point of view. Show rooms in Port Elizabeth are left to private enterprise; and we ought to encourage private enterprise in connection with show-rooms. If we did, we would then get a lot of our advertisements free. But, in fact I would go further and state that this type of advertising shall be left entirely to private enterprise.

Mr. Swingler also wants us to believe that no good purpose can be served by advertising, and gives us a reason that we might make a mistake.

Now, the other commodity, gas, is advertised every day, and not by the gas people alone, but by electricity people at Conventions like this (laughter). We are being told, as a matter of fact, that gas will win the next war. So far as I know, it was gas has started all the previous wars. (loud laughter). So far as water heaters are concerned, in my experience, they are very useful things.

I feel that the bigger cities and any other Association available, mentioned by Mr. Le Mare should endeavour to assist the smaller towns in advertising electricity. After all is said and done, if there are dangers—and it is only you technical men who see the great dangers—the use of electrical appliances are comparatively safe where the householder is concerned. I feel certain, Mr. President that if the big cities dropped the idea that they must not advertise because it is helping the other cities, much more progress would be made. I do not think I am giving anything away but our Chairman tells me that Johannesburg helps Pretoria every time it advertises; I do not know what Pretoria has got to say about that. Be that as it may, I, along with the others wish to thank Mr. Le Mare for his paper. It has been a most illuminating paper, and one which at least the Councillor members can understand.

Councillor Spilken (Umtata) : I would like to say candidly, that this has been a most important and most interesting paper to me. Not having a technical mind I am not an Engineer, but from the point of view of publicity I want to say that Mr. Le Mare must be congratulated on his very fine effort. It has definitely inspired me with a lot of ideas, when I get back again, to put forward the selling of current through publicity, and I for one would welcome any ideas. I will certainly make a point, Mr. Le Mare, of utilising your services in future, to forward those important wares, and I do hope that other centres will take advantage of your services as well—if you give them gratis (laughter).

I would like to say, Mr. President and Gentlemen, that, on the question of water heating we have managed to work on a rate of $\frac{1}{4}$d.; and, if bigger centres find it very inconvenient they can always come down to Umtata and get free current for their baths; we will always accommodate them and show them how it is done.

In conclusion, I have not very much to say, because the speakers previous to me had a lot of wit; I am afraid I have not got to that stage yet; but I must say this has been a most interesting paper as far as I am concerned and I will take back with me a lot of new ideas; and I do hope that on the next occasion, I attend a Convention at Durban, I shall be able to suggest something to the members of this Convention in connection with propositions which I have already proved, and which will probably help them as well.

Mr. Horrell (Pretoria) : I would like to congratulate Mr. Le Mare on his valuable paper. It is undoubtedly a most interesting one. There is no doubt about it we should advertise more on the basis that he suggests, but whether that should be on a national basis in South Africa is problematical.

I feel, however, there might be a possibility of say the Reef towns and Pretoria joining in with Johannesburg and advertising in the Johannesburg papers. It could be done on a large scale and provided it was done well, I feel we should all benefit.

I quite agree with Mr. Swingler with regard to water heating, if you conscientiously cannot tell a prospective consumer it will be successful, it is far better to let it alone. Unfortunately we cannot say water heating is successful in Pretoria. This may be due to the hardness of the water which causes the elements to become coated with lime and become inefficient or to the initial cost of the installation.

Mr. Harvey (Springs) : The paper we have had on publicity by Mr. Le Mare, I think is an excellent one, and we must all agree that publicity is bound to bring results. What we have got to take care of is, we have to supply the goods, as it were. Well, we have the goods. Some time ago, the Electricity Supply Commission was going to start a department for approving of electrical apparatus, appliances and so on; I think if the Electricity Supply Commission were to start this department and approve of certain appliances, and cut out the inefficient ones, we would be bound to have success.

It does not matter what you push, so far as water heaters are concerned I am glad to find everyone more or less finds them a success. We are pushing them at Springs, and they are proving a wonderful success. The only thing to look after is the cleaning, which, if the municipality could undertake, would be an excellent thing.

Councillor Morrell (Capetown): Mr. President and Gentlemen, I feel with others, that I must congratulate Mr. Le Mare on his paper. In the first place I think it is well conceived; but in my own instance, I disagree entirely with him. National advertising as such would hardly be beneficial to a City such as Capetown–at least, that is my opinion —since the greatest competition we have there comes from the gas companies, and when one realises these gas companies have show rooms and actively engage in propaganda, I am of opinion the best method in which we can advance the interest of the sale of electrical installations and electrical appliances is by entering into the arena and going out for the business whole heartedly. In this, I think Capetown has been very successful. We have had our trying times, but have also brought sales to a stage when our best efforts have been warranted. Capetown must concentrate, in my opinion, on its own area, recognising at the same time that its efforts in its own area are conductive to an expansion of sales in other areas of electrical appliances, and incidentally the greater use of electricity.

I can hardly see that a change in its policy at this stage would be warranted, because we have gone very thoroubhly into the question, and placing it upon a commercial basis, we find that concentrating on our own area, and realising that we cannot ask the outlying areas to support us, the method which we have adopted has proved very successful.

As far as Port Elizabeth is concerned, in supporting national propaganda, I have in mind that some few years back they were aproached at the same time that Capetown was approached on a national scheme of advertising similar to that which was introduced by the E.D.A. into Great

Britain. They did not embrace the idea very whole-heartedly, in fact, I think they turned it down. We in Capetown are willing to help and assist such schemes, since we realise that by helping them we are helping ourselves. We then supported the scheme put forward by a monetary contribution of £100; which was on a basis with other large cities.

I can only say this is a very important subject from the Councillor Members' point of view; and as well as heartily appreciating the many points which have been brought forward, and speaking broadly upon the paper, I feel that the subject matter should come before the electricity committees, of the various municipalities, and receive further consideration.

Councillor F. B. Allen (Roodepoort-Maraisburg) I wish to congratulate the author of the paper because he has introduced a subject into this Convention, in which the ordinary layman, may take part.

Publicity is in the forefront of industry in the world to-day, and if electricity is to serve its purpose throughout the Union of South Africa, it must also use this industry in promoting its own interest. As electricity is a national industry, publicity should, of course, be on national lines. The criticism that has been offered this morning, to my mind, has been chiefly concerned with detail and has not taken into account the main topic of this paper.

I find the main conception is that the principle should be decided that there should be some central body in South Africa which would co-ordinate the publicity interests and ensure that in regard to general principles, there should be a uniformity in connection with articles apearing in the Press of this country. It has no concern with details such as the price of electricity in a small municipality.

Now, sir, it will be appreciated that for small municipalities a paper of this kind is of great value—(hear,hear)—because it readily falls within the province of Municipal business. We provide, or we are the channel through which the electricity is provided. The people who are selling these various commodities will see to it that as the industry develops, the supply is met and they will advertise the articles required.

If we go into the question of sales of electricity say, on the Reef, we find various prices charged for electricity, and therefore all kinds of difficulties arise in connection with publicity. Some municipalities, with justification have to provide out of the revenue from electricity substantial amounts for the relief of rates. As regards the question of the Reef combining for the purpose of advertising electricity to my mind that may come, but it is subsidiary to the main purpose of this paper which is to ensure uniformity in propaganda work in this country. In order to get the best benefit out of the paper Mr. Le Mare has given us to-day, the Association should come to some general conclusion as to the advisability or otherwise of having a central bureau or authority responsible for communicating uniform propaganda through the Press of this country. And, sir, for that reason, I have great pleasure in commending this paper, and I do hope that something will be done by this Association which will enable the smaller municipalities to derive some practical advantage therefrom.

Mr. G. G. Ewer (Pietermaritzburg) : Mr. President and Gentlemen, I would like to thank the author for his excellent paper. I am a great believer in publicity. When I was in London a few years ago, I was in close contact with the British E.D.A. and I am still a keen supporter of its work, in fact, Pietermaritzburg is affiliated to the British E.D.A.

As far as South Africa is concerned, I look upon the "Escom" Magazine which has been circulated by the Electricity Supply Commission at a very small cost, as one of the finest Electrical publicity methods we have in this country to-day, and I would suggest that any small towns who have not yet had details of it, should get them as soon as possible.

I find publicity of great assistance to my Council's undertaking; and our cooking demonstrations are one of the best methods of getting additional domestic apparatus used. When we arrange these cooking demonstrations, which are held monthly throughout the year we get the local contractors to lend us stoves and other apparatus, and there is a general talk on these by the demonstrator. We also have regularly every year an electrical exhibition, which is also a very good means of propaganda. The electrical contractors of the town, co-operate with the department and put up a very good show on these occasions.

With regard to Eletric water heating; this has really nothing to do with publicity, excepting that people seem to decry it in some cases. I am a firm believer in electrical water heating, and I feel we should tackle it in the same way as many overseas towns—that is as an off peak load. There is no reason why current should not then be supplied at about ¼d. a unit. In such cases, we can compete with other methods. If we cannot beat them on cost, at any rate, we can beat them in convenience (hear, **hear**).

I find the Press generally in Natal very sympathetic. Although it may cost a good deal, I feel that Mr. Le Mare's idea of some central organisation to co-ordinate Electrical publicity work is a good one; I would like to support the last speaker and suggest that we ask Mr. Le Mare to meet the Council of the Association—perhaps tomorrow morning—to discuss ways and means and see whether we cannot make a start in a small way. If we do this, it does not mean that Capetown or Johannesburg, or any of the big towns need drop their efforts. We could start in a small way, co-ordinate things and get publicity matter going throughout the Union. It would help the small towns, and to a certain extent, the bigger towns. I, therefore, make a definite proposal that we ask Mr. Le Mare to meet the Council and discuss the matter further. (Hear, hear and Applause).

Mr. J. W. Phillips (Bulawayo) : I have always understood that this was the Association of Municipal Electricity Undertakings of South Africa and Rhodesia. I find here that Mr. Le Mare has put down ten major centres, but has forgotten a major centre—the major centre of Rhodesia. I know Mr. Le Mare has classified the towns according to population; and of course, we with a population of only 12,000 or so would be out of it; but there are at least one or two towns in that list whose annual sales do not come up to those of Bulawayo.

I mention that because we also sell after a certain quota, "juice" for domestic purposes, at ½d. a unit.

The main reason, however, for getting on my feet is that I have just received a contribution from my assistant, Mr. Sibson, who, you will remember attended the Convention last year representing Graaff Reinet and which he has asked me if I would be good enough to read.

Mr. A. R. Sibson (Bulawayo) : Mr. Le Mare is to be congratulated on introducing this very important subject to the Convention. As he points out, except for a few isolated instances in the larger towns, very little in the way of publicity work, with the object of advancing electrical development is done. At the same time, it is very difficult to see how anything in the nature of propaganda through the normal press-channels can be achieved, except in the larger towns where newspapers with ample space facilities exist, and where large scale advertising by Electrical Firms is present to give the necessary stimulus to Editorial inspiration.

It is true that there are large newspapers circulating in the country districts, but the electricity consumer is a parochial creature, and needs to be approached from the local angle.

As a result of lack of publicity in the small towns, Electricity Departments are usually bracketted mentally with sanitary schemes and slop-water removals. In this connection I should like to submit a suggestion, which where it can be carried out, will be shewn to be of considerable value.

The Durban Electricity Department have pioneered the Monthly Bulletin idea, and the benefits that have accrued from this system of publicity must be incalculable, but there is no reason why the same idea should not be adopted in smaller towns, particularly towns where lack of newspaper facilities render efficient press publicity out of the question. The material for such Bulletins could be circulated as Mr. le Mare suggests from some central publicity office, or contributed to from local sources according to the journalistic talent available, while the Bulletin could be made to pay for itself by the inclusion of advertisements from local dealers which need not necessarily be electrical. The advertising value of a publication which enters free to the home of every electricity consumer would not be lost on keen business men.

To lend force to the argument, a few copies of such a Bulletin which was published monthly in Graaff-Reinet are submitted: this has undoubtedly done much to foster the electrical development of that town. While admittedly adding one more load to the onerous tasks of the over-worked Electrical Engineer, it nevertheless goes to prove the ancient dictum that, the hardest worked man can always find time for something else to do.

Mr. A. E. Val-Davies (Visitor): Mr. President and Gentlemen, I would like to support the views expressed in the paper just read, and I would like to add a few remarks of my own.

It has struck me that the tone of the discussion has been somewhat pessimistic. One would think that development in South Africa has been discouraging; I see no cause for any pessimism; bearing in mind the time which has elapsed since the value of the domestic load was realised, the figures are quite remarkable, and they indicate that whatever the process of development may be the result is, I consider, satisfactory.

My own experience in the smaller towns has been rather interesting, I have found that it paid to develop the small demand and not to try to rush the public into a large expenditure. In the smaller towns, the proper method of developing the municipal domestic load is to start with the common iron, kettle and toaster. I find that the best advertisement for development is the satisfied housewife.

There is one means of securing publicity which can easily be extended. I have often recommended that on the monthly bills for electricity (which reached the consumer direct), a blank space should be left, about 4″ by 2″, on which a legend (changed month by month), can be imprinted by means of a rubber stamp. The definite impression of the rubber stamp immediately attracts the attention of the consumer. The legend can be changed periodically; it should not be printed, because the rubber stamp attracts more attention. It is a simple matter to stamp these forms each month, and they reach the heart of the demand—the consumer.

Councillor Middlebrook (Durban): My words, sir, will be very few. I do think we have been dealing with a great deal of detail. Some of it has been illuminating and helpful.

In our discussion on the position, from the national point of view, we have to take a broad view as to whether or not national propaganda is going to be of assistance to us—or, so it appears to me.

I think the author concentrates on which of the methods would be best in the interests of the sale of electricity for the whole of the Union; and I think, if we are to reap anything practical, I should like to support Mr. Ewer and suggest that the matter be referred to the Executive for consideration, and that they bring up some definite scheme at the next convention (Applause).

Mr. Dawson (Durban): Mr. Le Mare has set out in his paper a suggestion for the commencement of a campaign to increase the use of domestic appliances but has disregarded what is to my mind the far more important aspect, namely the industrial demand.

The rates given in the paper are definitely attractive to the domestic consumer, so much so in fact, that most of the undertakings are pressed to cope with new installations and demands due mainly to the low unit costs of ¾d. to less than ½d. and where the rates are not economical it is a bad policy to sell appliances as that will result in unsatisfied consumers.

The large amounts advanced by the municipalities on the hire purchase scheme do not, I think, represent all the appliances sold as they do not include appliances bought outright or through the agents. In the case of Durban, at any rate, approximately twice the number of stoves and a larger number of appliances are installed to those purchased through the hire purchase scheme and I think this should have been made clear in the paper.

The paper would have been considerably more valuable if the author had given some indication of what the probable results of this campaign were likely to be to the ten towns selected for his illustrations, over and above what they were now doing, as it seems to me that these towns would have to bear most of the costs of any such campaigning as suggested.

Referring to the table showing the percentage of current consumed to the cost of the appliance, it would have been more helpful had the table been adjusted to local standards of costs. The cost of current, for example, averages in the table about 2½d. per unit, whereas for the large consumption given in this table the average cost locally for minimum charges and ½d. per unit would average about ¾d. The cost of appliances on the other hand would probably be lower in America than locally so that the percentages given would not be anything like to favourable for local conditions.

To my mind the domestic demand, although a very valuable one, is well catered for in the towns selected in the paper and is rapidly increasing under the combined local propaganda and low rates, and the direction in which propaganda should be aimed is in increasing the power demand, and particularly that demand which is capable of regulation to be drastically reduced on peak. In this way will costs be reduced to the benefit of all consumers while the power load, particularly for new industries will automatically increase the domestic demand.

The President : The Johannesburg Electricity Department spends somewhere about £3,000 a year on advertising, and we are very pleased to advertise to the benefit of adjoining towns and all concerned.

For the benefit of those Councillors who have not been able to attend our Conventions previously, I would like to explain what has been done in the past in this connection.

Most of our members will remember that some two or three years ago, it was proposed that we should have an organisation in South Africa, somewhat similar to the Electrical Development Association of Great Britain. Dr. van der Byl of the Electricity Supply Commission started a project which was supported, I believe, by the whole of these large centres in the Union. Unfortunately after circularising most of the centres, it was found, I think I am right in saying, that practically no support was coming from the smaller towns and country districts and it had to be dropped for lack of financial support. The necessary organisation cannot be carried on without financial support. I think the feeling is that we should co-operate in this matter and have a national organisation similar to the Electrical Development Association of Great Britain, which is also assisted, of course, by the commercial community of Great Britain. I quite agree with this principle; I think it was Councillor Allen of Roodepoort-Maraisburg, who raised that aspect of the question, and personally I feel very strongly that it is a matter that should be supported very largely by the commercial community. Is there any further discussion on this matter ?

Councillor Fereday (Salisbury): I would just like to add my very humble quota of thanks to Mr. Le Mare for his paper. This subject is particularly interesting to us in Salisbury ; I say "particularly interesting" because we have tried there to do something along these lines. For a small municipality, we have spent rather a lot of money , I think, on advertising. Last year we spent £500 on advertising, in addition to holding an exhibition where there was a demonstration of cooking, which cost a further £400. So an amount of £900 was spent last year in Salisbury.

Perhaps it is a presumption on the part of a small municipality to express its views or give its experiences to an Assembly such as this, representing very many larger and more important centres; but I would like to give you a little experience we had in Salisbury. Through our Engineer, Mr. Clinton, who is an enthusiast not only in advertising, but in other directions—through his iniative we tried to evolve a scheme in Rhodesia, wherein all municipalities would participate. A scheme was put forward by him and sent to the other municipalities, but we found it difficult—in fact, impossible, to get the co-operation of all the municipalities, and the scheme has been shelved.

There are several things I would like to have referred to in this paper, but the time is late, and I will not attempt to go into them at length.

I was particularly favourably impressed with the remarks of Mr. Milton and Mr. Swingler as to the advisability of care being taken when you advertise; as a commercial man, I feel that one should be very careful in advertising any project or article unless you are satisfied it is really worthy.

All I wish to say, Mr. President, in conclusion, is that although we have failed in our efforts in Rhodesia to obtain the co-operation so far amongst the different municipalities with this advertising, I do say this, that, if a scheme is evolved through the suggestion made by Mr. Ewer or Mr. Middlebrook—covering a general scheme of advertising—I think you can look to Rhodesia with confidence to co-operate.

Councillor Allen (Roodepoort-Maraisburg): I would like to second the proposition put by Mr. Middlebrook, in order to bring this matter before the Executive as a concrete proposal. I therefore have pleasure in seconding the resolution proposed, that Mr. Le Mare be asked to meet the Council.

National Propaganda

by G. W. R. Le Mare (E.C.C.)

REPLY TO DISCUSSION.

In reply, I would like to make it clear that the suggestion I have made does not provide for the replacing of any existing advertising and publicity campaigns at present being carried out by any undertaking. The news service would be supplementary to those.

With regard to the cost of the service, it is a little difficult to give a precise estimate but it seems likely that for a start the service could be run at an annual cost of approximately £250. This will provide a number of photographs and a careful selection of articles. The articles would not be broadcast but would be directed to areas where particular conditions apply.

The point was raised by Mr. Swingler and Mr. Dawson that they could see very little benefit flowing to their undertakings from such national propaganda. The fact remains that if good propaganda is made it can only have a beneficial effect. With the continuance of the excellent campaigns now conducted in Durban, and the addition of any national propaganda, there can be little doubt that further benefits would follow, and at a very small cost.

I agree that there is a need for industrial propaganda and this could quite easily be embodied in the news services sent out.

Some difference of technical opinion on the question of water heating was revealed in the discussion. While I wish to make no comment on that, it does raise the important point that there is a need for complete honesty in propaganda. Any false claims would have a boomerang effect. It is obvious, therefore, for example, that it would be very unwise to urge consumers to heat water electrically in areas where the unit rate was high.

Finally, in response to Mr. Harvey's (Springs) question about ESCOM Magazine, may I briefly explain its objects. The magazine is published by the Electricity Supply Commission in the national interests of electricity. Its aim is to promote a better knowledge of the services electricity can render to the domestic and industrial user. It is published on a good paper and contains, besides articles of strong propagandic value on such subjects as electrical cooking, refrigerators, electric washing machines, vacuum cleaners, etc., a fair amount of fiction by wellknown authors and two or three articles of general interest.

Its circulation for the main part is with the co-operation of municipalities in either one of two ways—the first is that the local power supply authority should agree to collect the subscription of 4d. a month by adding that sum to the monthly account of the consumer who voluntarily becomes a subscriber. That debit continues until it is cancelled either by my Department or by the consumer himself. The other scheme is for the consumer who wishes to subscribe asking that the sum of 4/-, which is the annual subscription, be added to his account on a month he nominates.

The Convention then adjourned at 12.15 p.m.

The Convention resumed at 9.30 a.m. at the Conference Hall, Empire Exhibition, with the President in the Chair.

The President : The first item on the Agenda this morning is a paper by Mr. Milton entitled "The Engineering Aspect of Small Municipal Electricity Undertakings." I will now call upon Mr. Milton to present to us his paper.

The Engineering Aspect of Small Municipal Electricity Undertakings.

by W. H. Milton, B.Sc. (Eng.), A.M. (S.A.), I.E.E:

Before proceeding to read this paper, I wish to make it clear that although the author is a member of the staff of the Electricity Supply Commission, the contents do not necessarily represent the opinions of that body but only the personal opinions of the author.

The engineering or design of the electricity supply undertakings of the smaller Municipalities within the Union of South Africa presents a different problem from that met with in the more densely populated countries of the world and in many instances the problem is one which is peculiar to the particular neighbourhood. To appreciate this, one need only have regard to the distance of many towns from the sea ports with the attendant variation in the delivered cost of imported fuel and also to the fact that the coal in this country is located principally in the Witbank area and in Northern Natal. The price of coal as compared with the cost of other fuels used in power production will vary with the relative distances from coalfields and sea ports and in this respect the railage rate though graded and limited to a maximum figure, nevertheless, in many instances, forms the principal portion of the cost of the fuel to the purchaser. Crude oil has to be railed from the several coastal ports of the Union via main distributing centres to the particular town concerned.

There is thus a composite cost in connection with these fuels which requires that the choice as between say steam and oil plant must have regard to locality.

The writer has not overlooked the existence of the local oil and other fuel industries of the Transvaal and Natal, but these sources could only provide at the moment for a very small proportion of fuel requirements for power purposes.

When setting about the design of an electricity undertaking for any given town, its type and situation relative to railway facilities, fuel, water and markets must be considered. The characteristics of the town are also very important, some towns are industrial; others are market towns and others almost entirely residential.

TYPE OF TOWN :

Some towns of the Union which until a few years ago showed marked signs of development are to-day altering their characteristics considerably. It will be found that these towns are of the market and shopping variety, and it seems that the change can be laid at the door of improved rail transport facilities and the motor car. Where the population in the neighbourhood of these small towns found it necessary to purchase normal requirements in the immediate vicinity with present systems of rapid transit, it is now possible for the population to visit large shopping centres, which in the past were too inaccessible and is there able to select from a wider range of alternatives and possibly at better prices whatever is required. As far as expense is concerned the gross cost may be greater than in the past, but if this aspect is put to the shopper the retort is usually— "Yes, but don't forget I have enjoyed the trip which offsets the difference in cost!"

Having first duly investigated and decided the classification to which a town belongs, the effect of the introduction of an electricity scheme must be assessed. It is firmly believed by many that the introduction of an electricity scheme immediately gives rise to an influx of industries and the conversion of a residential town to an industrial area. Whilst the availability of electricity is certainly an attraction, industries are business institutions and as such consider the source and quantity of raw materials available, the cost of converting them to the finished product in a given locality and the cost of transporting the finished product to its market in conjunction with the frequency at which deliveries can be effected. When regard is had to the source of the raw material and the position of the market for the finished product, some idea can be formed as to the industrial possibilities in any small town.

The type and nature of the town will serve as an indication as to the loading to be expected on the electricity undertaking and the probable form of the load curve can then be set down on paper. The form of the load curve will decide the number and size or sizes of sets which will most economically meet anticipated conditions, though the decision in this respect must have regard to the nature or type of the prime mover which has been decided upon. This aspect will be dealt with at greater length later in this paper.

RETICULATION :

The next feature which requires consideration is the extent of the reticulation and transmission network which will be required in order to serve the probable consumers of the undertaking. In Municipal schemes it is more or less incumbent upon the Municipality to supply all residents who can afford to purchase electricity. It is not possible to allocate the actual cost of that portion of a network required by each and every consumer and in consequence the cost of the network must be borne by probable consumers more or less in proportion to the use each user makes of electricity. In certain cases, of course, outlying sections of a town may be excluded from the initial scheme if, taken as a group, it is so uneconomical to include them that the scheme as a whole would be jeopardised. A decision in this last respect is, however, always difficult and can usually be taken when it is found that consumers in the particular area are unwilling to guarantee the minima required to make supply feasible.

The actual cost of a network per mile of reticulation will vary considerably with the nature of the town. Whilst the difference as between scattered and densely populated sections would appear to vary the cost per consumer considerably, the variation is in some cases offset by the quantity of copper required per consumer and the weight of poles required. This argument, however, cannot be applied in every case, as in some scattered areas the minimum size of both copper and poles is established by practical conditions and not by electrical and mechanical loading.

SYSTEM OF SUPPLY :

While on this subject, the question naturally arises as to whether the alternating current or direct current system should be adopted. In dealing with this aspect one must not lose sight of the fact that due to the economics of manufacture, it is generally possible to purchase alternating current apparatus at a lower price than direct current apparatus. This, of course, does not apply to the universal types of appliances such as for example kettles, irons, stoves, etc. One item which has come into considerable prominence and importance in recent years is the wireless set, and it is claimed that more satisfactory, cheaper and better equipment is obtainable for use as "alternating current main sets," than can be obtained for direct current systems. The author is not well-versed in the art of Wireless reception and cannot express a personal opinion on this subject. He has, however, heard claims that the direct current set supplied through a rotary converter will give greater satisfaction than the alternating current set plugged direct into alternating current mains. Be this as it may, however, there is no doubt that there is a strong prejudice amongst "listeners-in" in favour of the alternating current set.

As any electricity scheme which is being undertaken by an Urban Local Authority must receive the sanction of the Ratepayers, side issues of this description are apt to play a more important part in the decisions taken than much more vital considerations.

From an engineering point of view, the choice as between the alternating current and the direct current systems of supply is not simple. There are instances in the Union where the direct current system of supply has been adopted and developed quite satisfactorily, the most outstanding example at the moment being that of Worcester Municipality, where a 1,000 K.W. direct current generator was recently installed as being the most economical means of meeting the requirements of the rising load at the time.

The direct current system can be adopted with decided advantage to the undertaker providing the conditions are favourable and more particularly during the early years of development of an undertaking. The type of undertaking to which this remark applies is the one where little or no day load can be forseen, where household fuel is cheap and plentiful and where there is little likelihood of the development of an industry. In such places, the majority of the use of electricity occurs between the hours of dusk and 9 or 10 p.m.

and plant must be provided to meet the requirements during this period. From 10 p.m. until daylight the following morning little or no use is made of electricity and this is true of the majority of the non-industrial towns of the Union. Sometimes, one finds that the town's water supply load being made use of in this manner to improve the load factor on the electricity scheme. During the hours of daylight, only occasional use is made of electricity for an odd domestic appliance.

In a town such as that above described, it is clear that the direct current system making use of a battery, would enable the consumers on the undertaking to obtain greater facilities than is economically possible with the alternating current system of supply. If the alternating current system is adopted in such a case, either no supply could be given during the hours of daylight or the undertaker is faced with the salaries and wages paid during the daylight shift coupled with the cost and onerous conditions of operation (as regards plant) during this light load period.

With a direct current scheme using a battery, it is possible to achieve the complete charge of the battery during one or two shifts, leaving the battery to "stand a shift" without attendance.

In many cases where this system has proved a failure, the cause does not lie at the door of defective batteries and effective battery maintenance but may be ascribed to a battery of too small a capacity having been installed in the first place. It is realised that batteries are tricky things to handle, but advice obtained from the suppliers of batteries would, if followed by the engineer-in-charge, secure every satisfaction to the user.

When a direct current scheme is adopted, it is nevertheless certain that in later years a change-over to the alternating current system is inevitable if the town develops. This need be no cause for concern provided the change over is not delayed too long as during the period when there is only a negligible power load the cost of replacement of consumers' apparatus rendered useless by the change over will remain small. When the decision has been made with care in the first place the general excess cost arising from first adopting direct current and then changing to alternating current will be found to be more than offset by past savings on operation expenses and on the whole the Municipality will have benefitted.

The necessity of providing attendance during the period when small plants are running has been questioned from time to time. The "Salaries and Wages" bill often precludes the smaller Municipalities from inaugurating even a restricted hour service. Automatic plants are on the market which would obviate the employment of permanent staff and only involve a small remuneration for part time services. This subject is again referred to in the concluding stages of this paper.

Other than towns where automatic plants provide the only solution, cases of towns such as those above described are fortunately rare. In most instances the towns requiring an electricity service which can be shown to be a payable proposition have characteristics which lead to the selection of the alternating current system. The reticulation may be scattered or there may be a possibility that within a reasonable time the authority establishing the supply can visualise the necessity of supplying some small neighbouring community or some industrial load, both being features which demand that the alternating current system be available for the purpose. In these circumstances then, it is preferable that the alternating current system be installed initially in spite of the fact that three shift working cannot be adopted and that consumers will be left without supply during the day time. These disadvantages during the early stages can be weighed in the balance against the advantage of being in a position to supply neighbours or small industrial loads

at some later date and, in view of ultimate benefits, the scales are frequently tipped in favour of the alternating current system.

INAUGURATION :

Several references have so far been made to the possibility of a town inaugurating a supply; this means of course, the possibility of inaugurating a scheme which will be self-supporting. It is by no means easy to determine the actual extent of the revenue which is likely to accrue during the early years after the inauguration of a scheme. The approximate spending power of a locality must, however, be known to the designer. This knowledge is naturally only possessed by Councillors and local officials and even then it is somewhat difficult to obtain any definite statement as they are usually diffident to express forthright opinions probably because of the fear of giving offence to their constituencies. An experienced person, however, can in most cases form a very fair estimate of probabilities in this direction, using as a basis the general appearance of the locality.

It will be seen that these arguments presuppose a tariff for supply of electricity. This is not quite as anomalous as it would at first seem, because in most instances it will be found that if a scheme is to be adopted at all, the tariffs themselves must be reasonable. Therefore the assumption that a reasonable tariff will be applied will enable the engineer to prepare a scheme from the cost of which it is possible to confirm (or otherwise) whether the presupposed tariffs are economically practicable. If not, then ways and means must be investigated towards reducing the expenditure on the scheme possibly at the expense of reducing the extent of reticulation or hours of supply.

When dealing with the proposals both as regards the power station installation and the reticulation network, every regard must be had to the requirements for the extension of either or both sections of the scheme as time pases. In this way the danger of over-capitalising a scheme due to lack of foresight in its early stages can be avoided and the economical growth of an electricity undertaking can be safeguarded.

Having formed an approximate idea of the possibilities and the system of supply which is likely to be most advantageous, it is necessary to proceed with the detailed investigations.

CHOICE OF THE TYPE OF PRIME MOVER :

Steam, oil and gas engine driven plants are always available to intending undertakers in this country and in some instances water power is also available. The choice as between these several types of plant is only difficult at certain outputs where the conditions become critical as between the types.

HYDRO PLANT :

Dealing first with water power, the conditions of stream flow in this country usually lead to the necessity for the provision of expensive civil works to secure continuity of water supply. One usually also finds that the capital expenditure involved from and including the head box to the switchboard is extremely high and leads to a higher annual cost than is the case with other types of plant available. The cases where short pipe lines and relatively high heads are available within reasonable distance of the load to be supplied are unfortunately very rare. In some cases irrigation furrows exist which enable expenditure on civil works to be reduced to a bare minimum, but in these cases it is usually extremely difficult for the undertaker to secure his position as regards his water requirements as only the excess water is available and this excess may diminish with time due to increasing irrigation activity. In the circumstances, whilst the position may be secure at the outset, there is the ever-present fear that other requirements which have precedence may increase with time, until the waterpower project is in jeopardy. It is not always cheap or easy to consolidate the water rights for power purposes at the inception of a small scheme.

The writer would point out that it seems advisable to install hydro plant to the full capacity of water power available if this is at all possible, provided the plant so installed is not too much in excess of the immediate requirements visualised for the load to be supplied. For example, if say a 60 K.W. set would meet estimated requirements and the water available limits the maximum to 80 K.W., the latter size should be installed. This is recommended in view of the fact that the increase in the cost of hydro power plant with size falls very far short of a proportionate increase, and to install first one and then another small unit after a few years results in annual costs over a long period considerably greater than if a single large unit for the combined output of the two small sets had been installed at the outset. It is usually advisable that provision should be made for the installation of a quick starting type of standby unit or units when single hydro generators and/or pipe lines are employed.

The data available indicates that water turbine driven plant may be relied upon for continuous operation for very lengthy periods, in fact for years but there is always the ever-present fear of the type of breakdown which only occurs once in years occurring at any time during the period of operation of hydro plant. As the supply authority has a very definite obligation to his consumers to secure reasonable continuity of supply, the quick starting standby mentioned above may be regarded as an insurance towards security of supply.

Where water power is readily and economically available, there is no question but that it should be adopted.

In view of the specialised characted of hydro schemes and the dearth of suitable conditions for their installation in this country, the prospects of making use of such plant rarely occurs and must be dealt with in the light of the special circumstances as and when they arise.

OTHER PLANT :

Before dealing with the subject of the selection as between the various types of the remaining prime movers, namely, steam, oil and gas plant, one factor of considerable importance must be realised. The development of electricity undertakings in the Union is proceeding at a rapid rate and it is the general experience that generating plant usually becomes too small and therefore obsolete before the end of its normal economic life. This has led to the adoption of types of plant which have a relatively short life and low first cost. For example, the multi-cylinder high (rotary) speed oil engine is being installed more and more often in preference to the former slow speed unit which never wore out.

GAS ENGINES :

With this aspect in mind, the question of selection may be further considered. In the case of producer gas engine plant, it would appear that the fuel conditions in this country are not entirely suitable for gas engines required for continuous service. This country at present suffers from a deficiency of timber and warrants any conscientious undertaker avoiding denudation of what little timber does exist. This would rule out charcoal as a fuel. The relatively high sulphur content of the anthracite available in the Union leads to excessive maintenance costs on the producers and scrubbers. When an attempt is made to make use of bituminous fuel the tar difficulties are very real to the engineer in charge of such plant. Gas plants have been run quite satisfactorily in the Union, but there is no evidence to show that crude oil Diesel engines would not have produced quite as satisfactory results in the capable hands of the men who have made a success of operating gas plant. Gradually these gas plants are being displaced by crude oil plant or steam plant and this tendency may be taken as a sign of the times.

In this connection the author does not wish to infer that gas plant is not suitable for industrial purposes.

In industrial plants the need for providing for continuous growth of load does not arise in the manner met with on Municipal schemes. Extensions are usually in the form of blocks of power requiring their own prime movers. For this reason the plant does not usually become obsolete before it is worn out and/or uneconomical. The relatively low rotary speed units having few cylinders and which run intermittently throughout the week seem to produce conditions which suit gas producers and lead to very satisfactory results. Where the question of cyclic irregularity is of importance and where the tendency is towards high speed multi-cylinder units, the conditions which then arise do not appear to make for satisfactory operation of producers, and as these latter conditions usually apply where it is required to generate electricity for 24 hours per diem, it would seem that the nature of electrical loading for the supply of electricity for general Municipal purposes places gas engine at a disadvantage.

In the author's experience, it is many years since a case was made for the installation of suction gas plant in a power station of a Municipal undertaking.

OIL OR STEAM :

The choice then resolves into one between steam and oil plant.

Within the Union these two plants are only competitive over a relatively narrow margin of plant capacity except in special cases. This may seem to be at first sight a sweeping statement but when analysed its truth becomes apparent. For example, if the peak load to be provided for is of the order of 200 K.W. this loading inherently applies to a fairly well-developed town with consequent well-established load characteristics. A town requiring such plant will be found to have a load factor of from 30% to 40%, with facilities for establishing satisfactory loading during what, in smaller towns, would be a very light load period. Where such loading is likely to occur, it will be found that the annual operating costs of a steam installation will be considerably lower than the annual operating costs of an oil engine installation, due principally to the lesser fuel cost and incidentally to the comparable capital costs of the two types of plant of this size. For the larger sizes of plant, it may be considered axiomatic that the steam plant is undoubtedly preferable.

On the other hand, if an initial installation requiring sets no larger than 50 K.W. is to be selected then it will be found that once again anywhere within the Union oil engine driven plant will prove more economical. This choice is influenced by both the capital cost and consequential capital charges and also the operating costs. It follows that somewhere between these two sizes the choice as to which is preferable will depend upon the local conditions as regards loading and load characteristics, water supply, fuel and labour costs and the provision for capital charges and obsolescence.

FINANCES :

The question of "obsolescence" is one on which opinion is very much divided. This term is used to cover the problems of renewals, depreciation and actual displacement of plant within the period of its useful life. The author would prefer to use these terms with greater accuracy, and apart from this mention of obsolescence, the terms will be used hereafter with stricter regard to their meaning.

Very few oil stations in this country have outlasted the life of the oil engines installed, although in certain exceptional cases oil engine plant has been completely paid for by way of redemption of loans more or less concurrently with the plant becoming obsolete.

The usual accepted life of oil engine plant used for continual operation on electricity undertakings in this country is from 10 to 15 years.

As regards obsolescence, it is unusual to find that steam plant becomes obsolete within the period of loans raised to purchase it, although occasions of this nature have arisen. As far as steam plant is concerned, the usually accepted life is 25 years and for hydro electric plant a life of 30 to 35 years is not unusual. (This paper deals with small Municipal plants—in the case of large Municipalities the position may be very different).

With these different periods in mind it is not difficult to calculate a reasonable allowance for depreciation of plant. This allowance will naturally vary with the anticipated rate or growth of load, as the period within which the plant will become obsolete will vary. Estimates of this nature are, in general, guess work and no attempt can be made to establish the period within very narrow limits, and in any case considerable experience is necessary before an attempt can be made at a likely approximation.

Having settled the question of obsolescence, it becomes necessary to make some allowance for depreciation and renewals. Depreciation and obsolescence discount one another in that if the plant is to become obsolete within the period that the loan from which its purchase is financed then if due allowance is made for obsolescence there is no need for an allowance for depreciation. If, on the other hand it is anticipated that major items of the plant will not become obsolete but worn out, then it is necessary to provide for the depreciation of the plant to such an extent that the loan capital involved in the purchase of plant will not be inflated during the period of the loans raised to purchase the original plant and the items replaced. Cases in which it is advisable to provide for depreciation do not often occur with steam plant, but may occur where oil plant is installed.

As regards renewals, it is advisable to provide for the replacement of certain items of the plant's structure which have a known short life. For example, in the case of oil engines, it is necessary to replace cylinder linings from time to time and provision should be made in the costing system adopted for such schemes to enable this work to be financed from accumulated funds rather than that it should fall as a burden on any particular year's working costs. A similar item met with in steam stations is for certain portions of the furnace linings and arches, fan runners, etc.

The above indicates the theoretical aspect of the problem but it is desirable to establish another fund which may be termed a Reserve or Betterment Fund. Whilst it is possible to calculate with reasonable accuracy the amount to be set aside to compensate for obsolescence or depreciation and renewals, there is always the risk of an abnormal breakdown or accident to the plant. Unless a fund has been established from which to finance repairs, the cost of such work may fall as a heavy burden to be borne by the working costs of one year, possibly at the expense of a deficit.

In some Municipalities surpluses are carried forward each year and allowed to accumulate to the credit of the Electricity Department but unfortunately this is not the general rule. Where surpluses do not accumulate it is advisable that a reserve fund should be established before the balance of surplus is paid away to some other Municipal department from which it cannot be recovered in time of need. After making due allowance for all capital charges including the contribution to depreciation or similar funds, a reasonable allowance for reserve would be 1% of the total capital cost of the undertaking. When the total amount standing to the credit of the fund reaches, say, 15% of the total capital no further contribution to the reserve fund need be made, the extent of this fund, however, will naturally vary with the particular circumstances surrounding each installation and no fixed rule can be set down to fix the limitations of the fund.

Once the reserve fund has been established on a sound basis then further surpluses should be avoided by a suitable revision of the tariffs.

OIL ENGINE PLANT :

When considering the question of the installation of oil engine plant, the engineer is faced with the choice as between 4 cycle and 2 cycle engines, also as between what are termed slow speed and high speed plants.

This question is one which leads to endless argument. There is a very strong prejudice in this country against the use of 2 cycle engines. It seems to the author that this prejudice has arisen from the unsatisfactory results which have been obtained in the Union from certain early installations of this type of plant. The hot bulb ignition type has lead to very high costs in providing external heating of the bulb due to the fact that the sets are often run for lengthy periods at loads so low that insufficient heat is retained in the head for ignition unless an external supply of heat is maintained. The modern two stroke engine does not require the "hot bulb." Another argument put forward against the use of these sets is the extremely high lubricating oil bills involved, often reaching equality with the fuel oil bills. This influence which is reacting against the installation of 2 cycle sets is unfortunate. There is no doubt that manufacturers producing 2 cycle plants to-day have overcome many of the earlier difficulties and it is now possible to purchase plant of this type which, with reasonable care should give every satisfaction. The author understands that there is one set in use on a Municipal undertaking which has endeared itself to the engineer in charge and if the gentleman is present, he may have a word or two to say when this paper is thrown open to discussion. The advantages claimed for 2 cycle sets in comparison with 4 cycle sets are so well-known that the author does not intend reiterating them in this paper.

When dealing with the comparison of the cost of repairs and renewals of oil engine plant and steam plant, the author has found that engineers show considerable bias. The comparison is usually made between the two types of engines alone and the fact that a boiler and various ancillary appart-tus is required in connection with the steam plant is very often overlooked. Remarkable results have been achieved in regard to low maintenance costs of boiler plant and its auxiliaries, but on the other hand the cost of maintenance of this type of plant is by no means negliable and it serves no useful purpose to quote cases where no maintenance has been carried out, because such quotations only lead to similar quotations of special cases from the other side. On an average where reasonable attention is given to either type of plant, the author is of the opinion that the cost of mainten-ance of oil engine plant is somewhat higher than the cost of maintenance of steam plant, but the margin of difference in relation to the total annual cost of operating an undertaking is relatively small, where the sizes of sets installed have been wisely selected.

A point to be remembered when selecting the sizes of the units is that, whilst steam plant will operate satisfactorily at very low loads for long periods, oil engines cannot be operated below about ¼ load for any length of time satisfacorily. When comparing the merits of the two types of plant it will be found that the best unit sizes will differ as between oil and steam for the usual Municipal loading conditions at this stage.

STEAM PLANT :

When dealing with steam plant, the necessity for the installation of the several types of econom-ising devices must be given due and careful con-sideration. The selection as between condensing and non-condensing plant is not usually difficult. The modern methods of oil elimination are sufficiently satisfactory to enable the condensate being returned to the hot well and as the majority of the feed waters available require treatment in the interests of economic operation, this is a consideration. In view of the usual smallest size of steam plant installed, the efficiency value of a condenser usually outweighs the cost of providing it though in this respect claims are made for the thermal value of feed water heating by exhaust steam which compare very favourably with the thermal value of condensing. This problem, however, must be given very careful consideration only at critical conditions which occur where small sets are installed and where fuel is cheap say 10/- to 15/- per ton. For larger sized units and more costly coal the condenser will be found to be the best selection.

Where the coal bill is small due to low loading and cheap coal, the advantages of mechanical stoking are open to question. Further, the use of an economiser cannot be justified in view of the cost of its installation, and it is only when the coal bill reaches an appreciable magnitude that an economiser can be justified.

WATER TREATMENT :

Before proceeding, the author would again urge engineers to give very careful attention to the treatment of water used for boiler feed purposes and in some cases even for cooling water circulation. The majority, if not all of the trouble met with in steam plant and some of the troubles in the case of oil engine plant can be laid at the door of either boiler feed water or circulating water. Mr. Sibson delivered a very excellent paper on this subject at your last Convention and there is no need for the author to deal further with this aspect.

SIZE OF SETS :

Having settled the type of plant where the case is clear, or when desiring to make a close comparison it becomes necessary to select the best size or sizes of sets to install.

This only presents difficulties when the oil engine proposition is being evolved. It is usually deemed advisable that a single unit shall be capable of carrying the anticipated peak load for a period of approximately 5 years. At the same time, it is advisable that no unit should be operated below about ¼ of full load for any length of time. It is common practice to install two sets each of sufficient size to meet the peak load requirements, a third set being used for the light load period. The author is not satisfied that this is the most satisfactory arrangement. For example, if a plant is to be called upon to meet peak loads of 25 K.W., it will be found that the load curve on such a station will usually involve loading in excess of 13 K.W. for approximately 3 to 4 hours only each day, and for the remaining 20 to 21 hours the load probably does not exceed 7 to 8 K.W. If in such a case two 25 K.W. and a 10 K.W. sets are installed at the power station and the two large sets are run alternately it will be seen that each of the large sets operates for approximately $\frac{1}{12}$ of the total time in any given period. On the other hand the small set will be called upon to operate for $\frac{10}{12}$ of the time. If this is accepted, then it is clear at once that the small set will depreciate very rapidly while during an operating period of say 10 years, each of the large sets will have run for less than 8,700 hours and should still be in good condition. Actually it is usually found that during such a period of years the growth of load will have resulted in the installation of a further unit of 25 to 50 K.W. capacity and each of the 25 K.W. sets will have run for a longer period than 4 hours per diem. Most of the capital expenditure on the power station will have been made in respect of the two large sets which are thereafter, in effect, kept in glass cases. In the circumstances, it would appear that it is unnecessary to duplicate the large unit, the requirements of operation demanding rather that the small sets should be duplicated to prolong their life. To carry this to finality, the same load could be supplied by three 12½ K.W. sets, this arrangement providing for better allocation of running hours.

Before proceeding, it would be as well to analyse the requirements in greater detail.

A typical load curve of a small non-industrial town setting out upon an electricity scheme should be visualised. Such a curve would be illustrative of a town supplying say 70 to 80 consumers. Assume also that a water pumping demand of the order of 10 kW is involved and that the complete requirements of the town can be pumped within 8 hours. It will be seen that when water pumping is not required there is a peak load of 20 kW occurring between 6 and 7 p.m. and a smaller peak occurring in the early hours of the morning say from 6 to 7 a m. amounting to approximately 7 kW. During the day the load for a number of hours is only of the order of 2 to 3 kW. When water pumping is required, however, the day load would rise to 12—13 kW. and be maintained for approximately 8 hours.

Two 25 kW. sets and one 10 kW. set would probably meet requirements for a further 2 or 3 years, taking development at the rate of 10% per annum, which is an average figure.

The probable operating conditions may be analysed as follows :—

The 10 kW set would probably carry the entire load from 11 to 12 at night until about 5 in the afternoon when no water pumping is carried out i.e., it will operate for say 18 hours per diem. About 5 p.m. it would be necessary to start up one of the large sets and this set would be operated until at least 9 or 10 p m. depending upon the season of the year, but we can assume that it would be run until 11 p.m., i.e., the large set will run for 6 hours. To run the large set for a longer period would involve operating it at less than 20% load and such loading is not conductive either to economic or satisfactory operation of diesel units. The 10 kW set would be running at approximately 20% load at its lightest. If we assume that the fuel consumption may be expressed as 0.6 lbs. per K.W.H. generated plus an hourly consumption equal to approximately 15% of the full load consumption of the set, then for the two sizes of sets we would get the equations :—

(a) 25 K.W. set :

Total fuel used = 0.6 lbs. per K.W.H. plus 2.7 lbs. per hour run.

(b) 10 K.W. set :

Total fuel used = 0.6 lbs. per K.W.H. generated plus 1.25 lbs. per hour run.

As the average load factor of such a scheme would probably not exceed 15%, the average daily output from the plant would not exceed 78 units, thus making allowance for the daily and seasonal variations in the shape of the load curve.

The effect of introducing water pumping would be to increase this daily output of units to 156 per diem improving the load factor to 30%.

Now applying the above assumed data, we find that the quantity of fuel consumed daily would amount to :—

6 x 2.7	=	16.2 lbs.
18 x 1.25	=	22.5 lbs.
78 x 0.6	=	46.8 lbs.
		85.5 lbs.

The above amounts to approximately 1.1 lbs. per unit generated, which in such a case would not vary very far from actual practice.

When water pumping is involved, it will be necessary to operate one of the 25kW sets for an additional 8 hours per diem and the daily feed consumption would become :—

14 x 2.7	=	37.8 lbs.
10 x 1.25	=	12.5 lbs.
156 x 0.6	=	93.6 lbs.
		143.9 lbs.

The above amounts to approximately 0.92 lbs. per unit generated, which is not abnormal.

As stated earlier, the author is of the opinion that this arrangement of plant is not the most suitable in view of the unbalanced allocation of the running hours of the sets, and it is possible that three 12½/14 kW sets and a 5 kW set would better meet the requirements than the arrangement of two 25 kW and one 10 kW. set. The hours of running of the items of plant would then become:—

1—12½/14 kW set for 7 hours per diem.
2—12½/14 kW sets for 3 hours per diem (parallel).
1—5 kW set for 14 hours per diem.

Actually the period of operation of one 12½/14 kW set could be extended to relieve the hours of operation of the small set. During the periods of water pumping, a 12½/14 kW set would be run and not the 5 kW set.

By ringing the changes on the large sets, the hours of running of each large set would not be onerous during periods when water pumping is required, and better use would be made of the installed plant when water pumping was not required by extending the hours of operation of the individual large sets, each set being run for a matter of 6 hours per diem longer than would be the case of individual 25 kW sets.

The fuel consumption on the above basis for each of the sets would become :—

(a) 12½ kW set :

1.5 lbs. per hour plus 0.6 lbs. per K.W.H. generated.

(b) 5 kW set :

0.8 lbs. per hour plus 0.6 lbs. per K.W.H. generated.

The daily fuel bill without water pumping would become :—

13 x 1.5	=	19.5 lbs.
14 x 0.8	=	11.2 lbs.
78 x 0.6	=	46.8 lbs.
		77.5 lbs.

a saving of 8 lbs. per day or 9½% on the previous arrangement, while with water pumping—

21 x 1.5	=	31.5 lbs.
6 x 0.8	=	4.8 lbs.
156 x 0.6	=	93.8 lbs.
		129.9 lbs.

or a saving of 14lbs. per day or 10%.

From these remarks it will be seen that the saving in the fuel bill is appreciable in both cases. The author is of the opinion that there would be a considerable saving in the operating and maintenance costs over a period, which coupled with the saving in capital expenditure and the saving in fuel would amount to an appreciable sum within the useful life of the plant.

The above arrangement is usually objected to on the grounds of a multiplicity of sets and the general appearance of the engine room. It is frequently stated that it is difficult to operate diesel engine driven sets in parellel and when so operated the total capacity of the two units in parallel is less than the sum of their individual ratings. In the author's opinion these objections are not great as there are many instances of satisfactory operation on this basis, but the views of your members on these aspects would be very valuable.

When the question arises of the extension of generating plant, the arrangement put forward by the author will be found to have a wider range of possibilities than the more usual arrangement.

Having in mind that there are three 12½/14 kW sets and a 5 kW set in the above station, it follows that the next step can be a fourth 12½/14 kK set or a 25 kW set or 36/40 kK set, the existing plant working in very satisfactorily with any of these extensions from a point of view of standby and maintenance parts.

A very valuable discussion should be forthcoming on this general aspect of the problem of the small diesel engined station, and the author is looking forward with keen interest to hearing the views of your Members.

CRITICAL CONDITIONS :

The designing of the outright steam station presents very little difficulty except at the critical stages when it is difficult to decide whether or not economising devices should be installed. There is, however, considerable difficulty in arriving at a decision when the crucial stage of development is reached at which the choice as between oil engines and steam engines is being weighed in the balance.

The following practical illustration should serve to indicate the difficulty.

A plant is required to supply 250,000 units (sold) the maximum demand to be met being 100 kW. It is assumed that coal of about 12 000 B.Th. U/lb. would cost 24/- per short ton in power station bunkers and crude oil would cost £10 10s. 0d. per long ton in the power station storage tanks. To meet requirements two 150 kW steam sets would suffice and provide a satisfactory margin for development. The oil engine plant would comprise three 75 kW sets and 20 kW set for the light load period.

The following is the estimated capital expenditure on orthodox power station equipment (the cost of the network, being independent of the type of prime mover, will not effect the issue) :—

Items of Plant :	Steam:	Oil:
Power station buildings and foundations	£2,800	£1,500
Boilers and auxiliary apparatus ..	6,800	—
Cooling Pond	500	150
Engines and alternators	1,600	4,400
Condensing plant, etc.	1,300	—
Sprays and piping	—	120
Switchgear	500	750
Crane	300	300
Wiring and sundries	350	350
Fuel storage bins, etc., or tanks ..	250	150
Contingencies 3%	430	230
	£14,830	£7,950
say —	£14,800	£8,000

In order to provide for the sale of 250,000 units, allowance must be made for auxiliaries and losses and this allowance is estimated to be 60,000 units for the steam plant and 37,000 units for the oil plant.

Comparative estimates of running costs are as follows :—

Item:	Steam:	Oil:
Salaries and wages (allocated)	£1,110	£960
Interest and redemption	1,000	810
Coal for 310,000 units generated	1,100	—
Crude oil for 287,000 units generated ..	—	1,020
Lubricating oil	25	102
Water (nominal)	25	15
Maintenance (average)	250	250
Sundries, say	50	50
Renewals fund contribution	250	300
	£3,810	£3,507

A saving from the installation of oil plant amounting to £300 per annum is indicated by these figures (or approximately 25% of the coal bill). An examination of the details will show that the comparison has not been weighted in favour of the oil plant and the decision must be for the crude oil scheme on the basis of the data.

The maximum output of the plant without extension should, however, amount to 450,000 and 500,000 units sold on the basis of usual load factors. If the estimates are reviewed under these higher loading conditions an increase in the fuel water and lubricating oil charges would occur, the remaining items being unaffected to any material extent. Normal increases would be—

Steam — £596. Crude Oil — £796.

Thus under these conditions the difference would reduce to about £100 per annum still in favour of the crude oil plant.

When increased to this extent, however, the generating plant would become inadequate with the continued increase in sales and demand which may be reasonably anticipated. The extension would take the form of an additional 150 kW set at least. At this stage it will be found that the steam plant would result in lower annual generating cost. Were such a case to arise then on the lower output, the oil engine plant would be preferable but if the greater output is in sight within a reasonable period—say two to three years—then the steam plant would be preferable even though more costly to operate in the early stages. The above example is based on the use of the plant generally installed in this country. A steam installation may, however, be cheapened if fire tube boilers are installed. Once again I trust this alternative will form the subject of discussion.

It is necessary at this stage to mention an argument usually used against the installation of oil engine plant and in support of steam plant even in the face of avoidable deficits. The average variable cost per unit generated is greater with oil than with steam plant in the majority of cases. This fact is used as the basis of the argument that it is not possible to introduce as low a unit rate into the tariffs with an oil scheme as it is with a steam scheme. This argument is unsound and is dealt with later in the paper.

The difficult decision with which the engineer is faced at this stage introduces the possibility of a plant arrangement which has appealed to the author for some time as possessing distinct economic possibilities. It is admitted that for loadings in excess of ,say, 75 kW of peak to say 150 kW of peak (the critical condition depending on the comparative prices of crude oil and coal) steam units show a fuel cost considerably below that of oil engine units. The handicap to steam lies in the capital outlay.

It is admitted that the life of steam unit in continuous operation usually far outlasts its usefulness as an active item of a small station's generating plant. This is not the case with oil engines which are usually decrepit when the time arrives to displace them with larger units.

Whilst at first sight this appears to be an argument in favour of the steam unit, actually the reverse is the case because, in effect, it is not possible to make complete use of the asset purchased during its life. Though the plant may be still relied upon to operate it is no longer required and it is to be inferred that the plant was therefore overdesigned and more costly in consequence, in the first place.

In these circumstances a single boiler and steam unit can be called upon to operate for lengthy periods without shutdown provided a good water treatment plant is used to reduce the periods between descaling. At the same time the boiler should not be overloaded to avoid the attendant troubles of birdsnesting, etc. A satisfactory standby unit could be provided by oil engine plant totalling the rated capacity of the steam plant. The oil engine plant could then be called upon to run continuously when the steam plant is taken out of commission and should give no trouble till the steam plant goes back on the mains.

Such an arrangement would have the effect of averaging the capital expenditure and permitting fuel performance figures being achieved closely approximating complete steam plant figures, but is regarded unorthodox and has, so far, not been tried in this country. An objection to this arrangement of plant is that the engineer in charge would be required to be conversant with the operation of both steam and oil engine plant. This is no real difficulty as the majority of municipal engineers should be capable of undertaking the responsibility. Nevertheless it must be admitted that the operating programme would require to be very carefully arranged.

For the maximum benefit to be obtained it is essential that the steam plant should run for as long a period as possible between shutdowns. If such a period were extended to excess then considerable risk would be run of an extended shutdown as the boilers might become extremely dirty. As an oil engine is not suitable for continuous operation for very lengthy periods, operation of the steam plant for an excessively continuous period might then lead to a blackout due to failure of the oil engine towards the end of the period of boiler overhaul. On the other hand if the steam plant is shut down at too frequent intervals then due to the period which much elapse to allow t! boiler to cool, the oil engine plant would be required to run too frequently and therefore for too many hours each year; the cfficiency of the steam plant would also suffer considerably from the continual warming up and cooling off of the boiler plant; maintenance costs would probably become excessive, and taken on the whole, the advantages possible with this arrangement might be completely forfeited.

In consequence of these factors, it must be admitted that the programme of operation of the plant would require to be arranged with far greater care than is necessary in the case of either complete steam or oil engine plants and in such circumstances it would be advisable that the operating engineer should be prepared, and even desire, to control such a mixed station, if success is to be achieved. It is possible your members may have strong views on this subject and the author trusts they will not hesitate to air them.

The author does not intend to go into the question of detailed plant arrangements or details of the actual plant itself as this paper is already too lengthy.

LAYOUT :

Having decided on the type of plant to be installed, the engineer must turn to the question of transmission and distribution and the location of the generating equipment. In small schemes it is advisable that the power station should be located in the region of any large loads which may be offering. The power station should also be located near the railway station in order that siding facilities may be readily available as and when such facilities become desirable. The question of public nuisance must not be overlooked. In view of these three factors which control the selection of a site it is not possible to generalise but the most important factor in the author's view is that the situation should provide for siding facilities if it is anticipated that such facilities will be required at a time when it will not be economical to abandon a site chosen earlier on the basis of the other two chief factors mentioned above. The site itself should be such that it is accessible and that it can be readily used for plant installation and any cooling equipment required and provide for reasonable extensions of both buildings and ponds. In this respect the general building layout should be such that plant extensions are in no way obstructed by the original arrangement.

NETWORK :

The question of the distribution and transmission system is one which would require a lengthy paper if covered in any detail. In the circumstances it is only possible for the author to mention one or two factors of interest. When arranging for the necessary pole sizes, it must be borne in mind that these poles may be called upon to carry considerably heavier copper than that required to give satisfactory service at the outset, and it is not improbable that in some cases single circuit lines may become double circuit lines.

The use of high tension for transmission only becomes economical when loads of the order of 40 to 50 kW are to be transmitted distances of say, ¾ of a mile. In selecting high tension, the choice is necessarily influenced by the fact that in Municipal schemes the loads may never be regarded as stagnant and it is therefore as well to provide high tension transmission even in cases where low tension and heavier copper will fill the minimum bill. What would be ridiculous from the point of view of the design of a line to supply a fixed and established load becomes common sense when it is known that the load is increasing and will continue to increase at a relatively steady rate. It is further desirable to be in a position to provide frequent low tension feeding points where the use of electricity for domestic cooking is likely to be developed. For satisfactory service voltage variation on the supply to an electric stove should not be of any considerable magnitude. A voltage variation of 6% will produce over 12% variation in the temperature of hotplates apart from the much greater variation in the time taken to reach required temperatures. An unsatisfactory service to a few stoves will re-act very seriously on the development of this type of load amongst non-users.

The cost of a distribution network will vary considerably with the nature of the soils encountered and with the density of the population to be served and its spending powers.

REGULATIONS :

With the introduction of a scheme, it is essential that house wiring regulations be introduced to enable the Municipality to control the type and quality of the house wiring. Unsatisfactory work when connected to the mains may give rise to serious dissatisfaction from many unfortunate users who are continually affected by the shorts and trouble experienced by a nearby user whose wiring is defective.

The design of the network may be based on a maximum demand amounting to approximately ¼ of a kilowatt per consumer connected in small schemes. With the development of schemes, the engineer has, as a guide, the actual characteristics of his consumers to enable him to provide for suitable extensions. This development will be fostered if the Municipality introduces an assisted wiring and hire purchase scheme. In the author's opinion these two schemes should not be considered as a profit making trading department. If assisted wiring and hire purchase are carried out at or as near cost as possible, then a greater benefit will accrue to the Municipality as a result of increased sales of electricity than could be achieved from profits on advances.

TARIFFS :

The most important item influencing the successful inauguration of an electricity undertaking is the framing of the tariffs which are to be applied. The tariffs are necessarily a compromise as it is not possible to have completely scientific tariffs with any hope of such tariffs appealing to the general public requiring supply.

Much has been said in disfavour of the two part tariff in its various forms and there appears to be a strong feeling in favour of the sliding scale block rate tariffs. In my experience, however, once two part tariffs have been applied for a period the consumers appreciate their equity and the extensive use which can be practised without hardship.

A factor which is often lost sight of, is that whilst it is simple to introduce a sliding scale tariff, based on a definite number of units at a high rate and thereafter a supply to users at a low rate, this arrangement is only equitable to one size of consumer and it has the effect of permitting large users to ride on the shoulders of the small users and in many cases the majority suffer for the few. Once this form of tariff has been introduced and in operation for any length of time, it is usually found to be virtually impossible to introduce a two part tariff framed on the basis of a service charge per room plus a low unit rate because of the incidence of such a tariff on the larger and more influential users. While it is expedient to frame the tariffs on lines which appeal to the general public and Municipal Councils, it is preferable that every effort be made to introduce tariffs which may be modified as a result of operating experience without risking a storm of protest from the consumers.

For an undertaking to be successful, annual revenue should at least equal annual expenditure with due regard to reasonable allocations for all charges including depreciation, renewals and reserve or betterment. The annual revenue is a function of the tariffs and not (directly) the cost of production. For this reason revenue is not entirely dependent upon the type of plant used for generation.

In practice, it is frequently necessary to introduce tariffs which at the outset may result in small deficits but when these tariffs have been satisfactorily framed, the natural development of the undertaking should result in costs being met within the first two or three years and thereafter surplusses should accrue which may lead to a reduction in the charges being made. The reason for this process arises from the nature of the items which go to make up costs and the necessity that tariffs should be a compromise. The capital expenditure on an undertaking is incurred at intervals and therefore while the variable costs increase more or less steadily with the growth of load, the charges based on the capital expenditure occur well in advance of the development at fairly regular intervals. Thus the total annual fixed costs increase in steps while the total annual variable costs increase fairly steadily.

Well designed tariffs will result in a curve of increasong revenue which will represent a fair average of the stepped line representing the increasing costs.

Tariffs must therefore be designed to secure the maximum development and revenue possible within the capacity of the plant and must have regard to the two main types of cost making up annual expenditure. These types of cost are :—

(i) The standing costs which are approximately constant for the particular installation and only vary markedly with increases in the installed capacity. A proportion of the fuel bill should really be allocated to these costs as it must be admitted that a certain quantity of fuel would be required to energise the system whether or not the plant is used to generate electricity for sale to users and this quantity will be dependent to a certain extent on plant running hours only and not on units geerated; and

(ii) the variable costs which are a function of the number of units generated within the capacity of the plant, of which the maximum portion of the fuel bill usually represents the principle item.

The standing costs comprise the annual charges against capital expenditure, wages, etc., and a portion of the fuel cost mentioned above, while variable costs comprise items fairly readily picked out from annual cost accounts, e.g., fuel, water, oil waste and stores, etc.

If tariffs were designed in such a way that the fixed costs were recovered entirely through the medium of service charges or rentals and the variable costs were recovered solely by the charge for units supplied, it would be found in almost every case that the psychological effect would preclude any prospect of development due to an unwillingness on the part of potential users to become consumers though the type of tariff usually demanded by these same people may result in a higher average cost to the consumer. In the circumstances it is usually essential that general tariff design must effect a compromise. In the case of tariffs usually put forward in connection with proposed steam installations, it will be found that they generally take the form of a charge for so many units per room at say 1/– thereafter all units are supplied at say 1d. In support of such a tariff the engineer will usually advance the argument that whilst the scheme would not pay if only high rate units are sold, the low rate unit price will be sufficiently attractive to lead to a relatively extensive use of electricity by consumers and he will say that the average increment cost to supply additional units is only of the order of 0.6d. per unit thus ensuring a profit on the sale of these units amounting to say 0.4d. per unit.

In the case of oil engine installations it will be found that many engineers argue that owing to the high cost of fuel per unit generated it is not possible to inaugurate a scheme with the same tariffs which are possible with a steam scheme. Whilst the comparison which was given earlier in this paper showed that the cost of either type of fuel was approximately the same, with different purchase prices of coal and/or crude oil it is frequently found that the crude oil scheme shows a lower annual operating cost when compared with the steam scheme chiefly by reason of the lower capital charges, the annual fuel bill of the oil scheme being considerably greater than that for the steam scheme. In the circumstances, it is reasonable for the engineer to make the point that on the basis of the fuel costs alone it is not possible to advance the same low rate unit price as is possible with a steam scheme. On the other hand, the author would point out that whilst the tariffs formulated for a steam scheme budget for a loss on the sale of high rate units and a compensating profit on the sale of low rate units, there is no reason why, with care, the reverse should not be the case with an oil engined scheme in order that the development and ultimate introduction of steam plant may be hastened forward. After all, if the tariffs are designed to bring in such revenue that when the need for extension arises further development could be looked forward to either without an alteration to the tariffs or with a reduction in the tariffs, the engineer will have done his duty.

If profits are made in the early stages which are later offset to some extent by deficits, there is no reason for uneasoness provided the planning has been sound and the extensions will enable the scheme to proceed on a sound financial basis.

The author admits that the proposal advanced involves an element of risk as to establish a low rate unit charge which is less than additional cost, is merely courting trouble if this is done carelessly. Few engineers realise that it is equally dangerous if profits are anticipated on the sale of large quantities of units at a low rate and losses on the sale of the small quantities of high rate units as it is not impossible to visualise that the large quantities anticipated will not be sold in which case serious losses may arise from the unprofitable sale of high rate units.

If the compromise produces a total annual revenue which will result in the total annual cost being met and further if it is also possible to proceed with the installation of plant extensions when they become necessary still retaining the then existing tariffs with satisfactory results, it follows that irrespective of the actual average fuel costs the tariffs are sound and can be applied. It should be a further aim that with plant extensions there should be every prospect of a reduction in the high rate unit price and/or the low rate unit price. These factors should emphasize the desirability that the design of tariffs should be in the hands of an engineer with considerable experience in this direction.

From the above it should be clear that an electricity undertaking should carry forward its early deficits or surplusses as the case may be. In all cases where deficits are carried forward and allowed to accumulate, the accumulated deficits should, with time, be expunged by surpluses and in the case where surpluses accrue during the early stages and later deficits are anticipated, if the design of the tariffs is correct then before plant extensions are required only a small margin of accumulated surplus should remain. The transition from deficit to surplus or vice versa in these two cases should occur between two and three years after the initial plant is installed and each extension thereof, as the general experience is that under normal growth extensions of plant will occur at intervals of approximately five years. At all events the practice of carrying forward accumulated surpluses should be aimed at in order to offset possible future deficits resulting from, say, extensions or revisions of tariffs.

It is unfortunate that in so many cases, once the surplusses begin to accrue on an electricity undertaking they are earmarked for financing other Municipal activities, such as, for example, the making of roads, improvements to parks etc. In general this process is usually referred to as the utilisation of electricity surplusses towards the relief of rates. Once surplusses have been so used it is difficult for the other departments to do without the income and changes in the electricity surplus have serious repercussion. This subject led to rather a crimonious discussion at the last Convention and the author does not propose to argue the pros and cons of the matter in this paper.

If surplusses are allowed to accrue after having made adequate provision for renewals, depreciation and obsolescence, and it is found that an excessive fund is being built up, then the tariffs should be modified to reduce the cost of electricity to the users. It is found in practice that such reductions are accompanied by marked increases in the use of electricity with the result that the calculated decrease in revenue rarely occurs and in fact revenue continues to increase.

SPECIFICATIONS :

Having dealt briefly with all the principal points, the author desires to touch on two details of interest. In the first place the specifications which are issued from time to time in connection with the requirements of Municipal electricity undertakings, appear to include too much detail. It must be borne in mind that manufacturers will put forward their standard plant and equipment irrespective of the specified requirements of the purchaser as the work involved does not generally provide a sufficiently large return to the manufacturer to support a departure from his standard process. To merely ask for a plant, say of a given capacity, is admittedly insufficient, but there is a happy medium and if a specification only defines the major points to ensure that all tenders submitted in accordance with the specification are on a comparable basis it is probable that purchaser and supplier alike would be less likely to disagree as the result of misunderstandings. The stages at which manufacturers change from one type to another in the matter of design is variable as each manufacturer suits his particular process. To specify hard and fast types does not necessarily lead to the most economic purchase, though a preference for a given type, if any, should be expressed to give each manufacturer an opportunity to offer alternatives. These details are at the discretion of the engineer and if he has strong feelings no harm is done by their introduction in the specification but then only as preferences. On the other hand, to go to the length of detailing the internal constructiin of plant and equipment is, in the author's opinion, a waste of time. If the detailed construction of the given machine does not satisfy the purchaser he can reject it without having first specified complete details with which it is possible **no** tenderer can comply. Provided the specification is made sufficiently clear to avoid wide differences in the offers the engineer should be satisfied.

The author would recommend the reference in specifications to some standard such as a specification of the London B.S.I. and all supporting data required by the Standard Specification selected should be supplied by the intending purchaser. Engineers should also aim at permitting suppliers to put forward their nearest standard article. For example, if a set rated at 50 K.V.A. is specified to be supplied at an altitude, the purchaser will receive a set too large for his requirements because the standard is 50 K.V.A. at sea level and when rated down for normal altitudes the correction, though small, renders this size below specification and suppliers are required to put forward their next largest standard set rated down to specification. This may be uneconomical to the purchaser as the idle running costs and losses generally will be increased. In most cases a margin on the capacity of a set of –5% to –10% would not prejudice a scheme but it would probably effect a considerable reduction in cost. (The difference between a 47.5 K.W. and a 50 K.W. set from a Municipal operating point of view is not serious).

When dealing with oil engines the commercial rated output is the continuous 12 hour rate (B.S.I. specification 649/1935) and it is common practice to rate the sets down for 24 hours operation (= –10%). As the peak load is of such short duration and sets are lightly loaded for the remainder of the the 24 hours, the 12 hour rating would appear to be satisfactory. Discussion of this question should prove beneficial.

In connection with tenders it is common practice to call for guarantees of certain particulars. The worth of these guarantees is extremely doubtful as no monetary value is usually attached to them. It is all very well to state that the purchaser has the right to reject plant which does not comply with guarantees. The purchaser is rarely in a position to apply such a rejection clause as in most cases, by the time the plant is installed, it is essential that it should go into service. The rejection clause is certainly beneficial as it provides the purchaser with the ultimate big stick. To effect the compromise which is usually necessary, however, it would be preferable to demand monetary compensation from the tenderer for a specified extent of departure from the guarantees, and the author would urge all engineers to include some clause or clauses of this type in specifications. In framing such monetary compensation clauses (commonly called penalty clauses) the purchaser should bear in mind that during the period of service of the plant purchased the discrepancy from guarantees would be to his account, whereas once the plant is supplied, the seller is free of his obligations. In the circumstances the clause or clauses must have due regard to the value of the guarantees to the purchaser while not losing sight of the fact that the seller will at all times avoid contracting under conditions which may involve him in positive loss.

AUTOMATIC PLANT :

The second item of interest (dealt with briefly earlier in this paper) is the possibility of the introduction in some small schemes of completely automatic oil engine installations operating on the direct current system. It is held that under the Factories Act such plant could not be introduced without the permission of the Chief Inspector of Factories. There is no doubt that there is a very extensive field for the development of electricity supply on these lines amongst the very small Municipalities, Town Boards and Health Boards. It is possible that your members may be prepared

to express their views in this connection to the general benefit of many small towns who are at present without a supply and who must wait until such time as their development will enable them to support the usual minimum of staff required to operate an electricity undertaking.

Such a proposal would at first sight appear to be contra to the interests of employment but further consideration will bring to light the fact that an electricity scheme is self-developing and the demands of an electricity undertaking are ever increasing in spite of many an attempt to limit the demand. It is quite clear that when the undertaking reaches the stage of being able to support a permanent staff, that permanent staff is desirable and will therefore be employed. A permanent staff will have the interests of the further development of the undertaking at heart and can encourage such development with benefit to its employers. In these circumstances therefore the introduction of automatic plant should pave the way to increased employment and should meanwhile introduce the amenities of electricity supply to many people at present debarred from its benefits.

The author would be pleased to hear the views of your members, not only on the introduction of this plant from the aspect of employment but also from the point of view of the liklihood of its ultimate success.

Mr. President, Ladies and Gentlemen, I must thank you for the opportunity you have given me of presenting a general resumé of this subject and I trust that the several sections touched upon may be dealt with at greater length by forming individually, the subject of later papers (not necessarily by the present author).

I regret that I have been unable to go into details in support of many arguments put forward but in view of the time already taken you will appreciate the impossibility of such a step.

In conclusion, I wish to record my thanks to your Association for the opportunity afforded me of reading this paper, and to the Electricity Supply Commission for having given me permission to prepare and present it.

The President : Gentlemen, we thank Mr. Milton very much for presenting this paper, it will fill a long felt want in so far as the members of our smaller municipalities are concerned. When I suggested such a paper he pointed out how extremely busy he was; but in spite of that Mr. Milton has furnished a very interesting and informative paper.

This paper can be used almost as a text book by Engineers with small plants. It is obvious that a great deal of the matter is the result of very wide experience in dealing with a large number of plants; and in that respect, of course, it is not like the text book, because here you can take it for granted that the figures given and much of the data are taken from actual fact. I am afraid we Engineers could not take that from the average text book. Our thanks are due to Mr. Milton for his very instructive paper which you have shown by your appreciative applause.

Before proceeding with the discussion on this paper there is a matter of great interest to this Association, one which we have tried to deal with for a number of years past. It is the question of the—

LICENSING OF ELECTRICIANS.

We have proceeded a big stage forward, which is due to work by the Council, and to a large extent by the sound advice we have received from the Chief Inspector of Factories, Mr. Clutterbuck, to whom our thanks are due. We have received a letter from the Department of the Interior, which

I propose to read to you. It covers a lot of points which you have had in mind for a long time, and we hope that we shall reach some finality in the near future. The letter, addressed to the Association, reads as follows :—

Department of Interior,
Union Buildings, PRETORIA,
11/8/1936.

The Secretary,
Association Municipal Electricity Undertakings,
DURBAN.

Sir,

I am directed to inform you that at a recent meeting of the Provincial Consultative Committee, the question of the Licensing of Electricians was placed on the Agenda for discussion.

It is understood from the Department of Labour and Social Welfare at whose request the matter was discussed, that this subject has been under consideration for some considerable time by Municipal Electrical Engineers and that representations were recently made to that Department by the Transvaal Municipal Association and the United Municipal Executive of South Africa, requesting that steps be taken to enact suitable legislation to provide for the examination and licensing of electricians.

It is generally felt that such legislation is desirable and the Department of Labour and Social Welfare supports the view that control should be exercised over persons who undertake electrical wiring installations and alterations and additions therto.

It is further felt that a system of control under which licences would be granted only to persons who are able to satisfy an examining board that they possessed the necessary qualifications, would be welcomed by all electrical contractors of good standing and repute.

All machinery and electrical apparatus other than that used in connection with mining operations is subject to supervision under the Factories Act, No. 26 of 1931, and the regulations framed under the Act prescribe in a comprehensive manner the precautions which must be observed to ensure the safety of persons. This Act, however, contains no provision under which certificates or licenses may be granted to electricians.

The arrangements for the distribution of electrical power vary in different towns and Municipal By-Laws governing electrical installations are not uniform. The Department of Labour and Social Welfare is, therefore, of the opinion that this matter is essentially one to be dealt with by the local authorities and that it would not be properly placed either under the Electricity Act or the Factories Act.

Before the matter is given further consideration, by the Provincial Consultative Committee, I am directed to ascertain whether in the opinion of your Association :

(a) It is practicable to frame Regulations to provide for the licensing of electricians prescribing the qualifications required and subjects of examination, which can be applied uniformly throughout the Union.

(b) If such legislation is introduced, it should be administered by local authorities or by the Central Government under the Machinery Section of the Factories Act.

I shall be obliged to have the views of your Association as early as possible.

I have the honour to be, Sir,
Your obedient Servant,
P. J. HOOQURHART,
Secretary for the Interior.

The President : Those are the two questions we are asked, and you will remember that at a previous general meeting you gave power to act. Your Council has discussed the whole matter very carefully, and decided to recommend acceptance and we propose replying "Yes" to the first question and that the Central Government should be the body to administer the Act as is referred to in the second question. I am now asking this general meeting to unanimously support the proposal which on being put to the Meeting was declared unanimously agreed to.

The President : We tender our sincere thanks to Mr. Clutterbuck for his very valuable advice and assistance in this matter (Applause).

The Engineering Aspect of Small Municipal Electricity Undertakings

by W. M. Milton.

DISCUSSION :

The President : I now invite discussion on Mr. Milton's paper. I understand Mr. Muller would like to contribute.

Mr. H. M. S. Muller (Upington, C.P.) : Those of you who have not come in contact with the small Schemes can hardly realize the almost hopeless task of obtaining some measure of stability. From Mr. Milton's excellent paper you have in some measure gained an insight of the difficulties and problems confronting the Consultant who has to devise a small Scheme on a reasonably sound financial basis for some 200 or less Consumers with which to commence.

You will however, never realize the greater trials and difficulties which beset the Engineer in charge, who is subsequently required to make the Scheme self supporting.

To-day such modern blessings as household Refrigerators, etc., place the small Scheme on a far more favourable and secure footing than the small Scheme of five years ago, which may now only be emerging from an over capitalized position.

Very few of the small Schemes were self supporting from their inception and the principal cause has been the high cost of Distribution to reach the scattered consumers of a purely "Lighting" Scheme. Apart from the cost of copper, most of these Schemes could not even shew one consumer for each pole planted in the central portion of the Town. The position becomes more involved when outlying consumers also demand their right to participate in the services of such a Scheme, and although it is only fair, that such distant consumers should in some way contribute towards an extension which is not waranted or covered by the revenue therefrom, it is most difficult and undesirable to attempt any equitable adjustment. If there is a bare prospect of getting sufficient consumers on that section in time, it is wise to serve such consumers under the usual tariff and hope for the best.

It is my opinion that with present day progress, there is very little to recommend a Direct Current Station in favour of Alternating Current, even when the Station has to shut down from 12 a.m. to 8 a.m. for the first year or two.

In the past, a few storage batteries have given excellent service despite severe climatic conditions, but most have been a failure due to the inevitable abuse, and once installed, replating of the cells has merely been the line of least resistence.

If any good make of Battery is worked and maintained in accordance with makers' directions, then it will do all and more than is claimed for it, but usually the Engineer in charge of a small Municipal Station is his own Shiftsman, Linesman, etc. and has to train a local lad or two to assist him.

Under such conditions there must be some neglect and anything as delicate as a Battery never gets the attention it requires. If, under such conditions its Capital cost short life and Watt-hour efficiency is considered, it may well be that what is gained on the swings is lost on the roundabouts!

In the matter of prime movers, Mr. Milton has already stated the case of water power. As an instance, at the Augrabies Falls, there is the whole volume of the Orange River available with a sheer fall of over 400 feet, this is within a comparatively short distance of Kakamas Settlement, Keimoes and Upington, with a considerable rural population en route. At Kakamas there is at present a hydro station of 100 kVA. which obtains its water power from the irrigation canal and a steam station of 150 kW., and at Upington a steam station of 300 kVA. Yet, assuming sufficient load, it is doubtful if these Falls will ever be harnessed because it will require reserve storage which is prohibitive or "standby" plant which is equally prohibitive, considering the Capital outlay to harness the power of the Falls.

I make bold to state that the day of Suction Gas Engines as applied to a Municipal Electricity Supply Undertaking, is past. Suction Gas prime movers should not be overlooked for industrial purposes and it has put Upington and a few other Towns on a sound basis, when Steam was out of the question and Oil could not compete with Anthracite fuel, but due to the comparatively poor quality of South African Anthracite and the constant draught through the fires with vertical high speed Engines, the reliability for the purpose of Electric Lighting is exceedingly low. There is constant irregularity of voltage and few can realize the unhappy lot of the Engineer in Charge, who is expected to maintain a reliable service with such a Plant.

Nevertheless, as an example, three Suction Gas Sets aggregating 90 kW. has served Upington for over six years. The annual output always exceeded ¼ million units and from the commencement the average peak requirements were from 60 kW. rising to 74 kW. "Black-outs" were very rare and of short duration but after six months of Steam I still cannot realize that those disconcerting momentary 'fade aways' are past.

This annual output compared with kW. installed has no equal in South Africa and shews that under certain conditions Suction Gas is worthy of consideration.

It now virtually amounts to a consideration of Oil and 'Oil' and 'Steam' only. Mr. Milton has submitted a very fair comparison in his figures and I cannot submit further figures or examples in this, but I do state that (with a reasonably good load factor), a 100 kW. peak demand and an annual output of 300,000 units or more warrants very careful consideration in favour of Steam Plant. I further state that with a proportionate peak demand and an output of 500,000 units per annum and over it is a job for Steam only, irrespective of Locality.

It is doubtful if the rate of development in the small Towns will outpace the **economical** life of such steam Plant.

Having made these claims for 'Steam,' it must rightly be inferred that, otherwise, I am not making any claim against the undoubted superiority of 'Oil' for the smaller Schemes and for exceptional cases, especially where there is little reason to believe that future expansion will be rapid.

I again cannot go into details, but being one of those who has had the operation of small Stations for many years, when it comes to selecting the sizes of sets to be installed and referring to internal combustion Engines, I would install 3 Sets in preference to two, but certainly not four. That is, assuming the aggregate B.H.P. required is 275, then I would have two Engines of 100 B.H.P. each and one of 75 B.H.P. in preference to two 140 B.H.P. Engines, although my commencing peak load may require 100 B.H.P.

It should really be only one cylinder less for the smallest Engine and all parts must be interchangeable. If the usual load builds up to require parallel operation of the two larger sets during part of each day, then one large set and the smaller in parallel will always see you through, and there will be no reason why the smaller set should have excessive running hours against that of the larger sets. If, and when, additional Plant is required, the fourth Set will be double the capacity of the two largest Sets and that to all intents and purposes, will in due course see the end of that particular station.

Under just such conditions it may in time be economically sound to apply Mr. Milton's suggestion of a Steam Set in conjunction with the largest of the internal combustion Engines–having discarded the first three smaller Sets and with the view of discarding the last of the Oil Sets in time when a second Steam Set is installed.

The original suggestion of a Steam cum Oil Station as an initial installation does not seem sound. Apart from the objection given by Mr. Milton it is clear to me that the greatest objection lies in the fact that, in practice, the load will inevitably exceed the capacity of the Steam Plant when it will become necessary to operate the Oil Engine in parallel, thereby defeating the object in the first instance.

In good practice a 100% standby Plant should be provided, but not the least of the Engineers' troubles is to convince the Council that he has no reserve Plant. If, and when, his Council is convinced of this necessity, they in turn have to convince the Ratepayers and several years will elapse before the much needed Plant is installed. Therefore, if the position warrants Steam, it should be nothing but Steam initially, as Mr. Milton puts forward the suggestion on a **fuel saving** basis only.

The matter of Tariffs is a very difficult question. While it is imperative to have as few as possible, even those few become complicated when endeavouring to derive at an equitable charge to all types of consumers. I find that the "Room basis" or the equivalent in floor space, is most readily understood and generally acceptable to all. The minimum charge being sufficient to cover the "standing" or fixed operating costs, there is little risk involved in deriving at a secondary charge per unit as long as it is borne in mind that any further reductions in the charge per unit must at least fully cover fuel costs per unit generated. A Paper on this subject will be of utmost value to the majority of Municipal Engineers, unfortunately it is practically impossible to introduce a uniform Tariff for all in view of the widely divergent conditions.

A lot has already been said about the inroads that is made on surplus Revenue of the Electrical Departments and the time is ripe to insist on some form of correct financial control. Non-payment for such services as Street Lighting is tantamount to taking surplus Revenue from the Electrical Department for the use of General Rates. For instance a sum of £400 per annum which is an equitable charge for 125 Street Lamps will make a very favourable difference if applied to the reduction of Tariffs in an Undertaking having, say 300 consumers. The Local Authority should not only be guided by, but in the matter of correct financing should be subservient to certain requirements which are as vitally necessary when the Scheme is in operation as when the Scheme is submitted for approval.

Mr. H. Bahr (Klerksdorp) : It is needless for me to say I thank Mr. Milton for his excellent paper, because among those present I can pride myself to be one of the few who during frequent interviews, had ample opportunity to observe and appreciate Mr. Milton's work has really meant for the development of the Union's Municipal Electricity Undertakings and for Engineering Science in general.

Although I agree with 95 per cent of Mr. Milton's paper, the residual 5 per cent I would like to bring up for general discussion. These items have been noted in the sequence of the paper whilst it was read.

Mr. Milton has not discussed the matter of wireless interference and I would like to inform you, gentlemen that about a year ago I was instructed by my Council to draw up a by-law for the protection of wireless-owners and that I used as a model a short by-law accepted by the Provincial Administration of Natal.

This by-law was considerably amplified and made as comprehensive as possible; after due adoption by my Council, it was submitted for approval to the Provincial Administration of Transvaal, but, unfortunately it has been declared ultra vires.

The Post Master General is receiving large sums in the form of wireless apparatus licence fees; yet does not make any effort to protect the licencees. I have, however, instructed our Town Treasurer to send us copies, and I hope to have them ready by to-morrow.

Then we come to batteries, and suction gas plants. With regard to suction gas plants, I think Mr. Muller was in charge of the same plant that I was seven years ago. You can see the fuel consumption of internal combustion engines in any of the text books. It is very well phrased and all you have to do is to look up the curve and compare with your fuel consumption. Should any of you gentlemen be in charge of suction gas plants, you must see that you are using the suction gas to its full capacity, and naturally, use it intelligently. In that manner you will reduce your fuel consumption enormously.

Water Treatment : As Mr. Milton rightly pointed out there was a very good paper on water treatment read by Mr. Sibson. I would like to point out, however, that very often the importance of water treatment for internal combustion engines has been shamefully neglected, with the ultimate result that a large number of cylinder heads cracked. In a different way, water treatment is also very important to some boilers, and not sufficient care is taken. As you know, an accumulation of scale on your boiler tubes brings up your coal consumption enormously. Then again, you also have to consider the ultimate results of corrosion on your boiler plates.

Mr. Milton seems to favour the fire tube boiler. When it comes to a question of the efficiency of boilers and the cleaning of them, and the keeping down of maintenance cost then why not use the good old Lancashire Boiler?. But I consider in this country we are very often confronted with a sudden big demand for power, that we must make use of boilers which can respond very quickly. In my opinion, the straight tube boiler from the point of view of maintenance and cleaning cannot be beaten. You must not forget that we have had not very highly efficient labour at our disposal ,and also some of our tradesmen cannot be relied upon too much. The simpler the tube, and the more straightforward it is, the better.

Then with regard to the policy of maintenance; I have to come back to de-scaling : for instance, I have seen in many stations in South Africa, men trying to clean boiler tubes simply by pushing a brush through them, which is absolutely ridiculous. You have hard scale on the inside of your boiler tubes, and, to try to scrape it off by means of a brush is hopeless. The only way of removing it is, by means of a rotary mechanical boiler tube descaler. You will find, if you keep scale off your boiler tubes, down goes your fuel cost.

Rejection Clause : It should not be necessary to put in a rejection clause, because the manufacturers who undertake to supply the plant according to specification should be well known, and when anything goes wrong, they should rectify it in the speediest possible time. Naturally, we do not always know with what firms we are dealing; it might be a firm giving the cheapest tender and it would be just as well to put in a clause.

As regards revenue; Mr. Milton is quite correct about the revenue side. The Engineer is used and looked upon as the producer of revenue. To give you a concrete example, last year I proposed to my Council that it should supply river and domestic water to one of the mines in our district. The pump had to be boosted by a small boosting plant. When I put before my Council my estimate, and the tariff (I submitted a very cheap tariff) they said "Do not you think you are going to make a mistake; this thing is going to cost a lot of money?" I said, "No; your revenue will be much bigger." I erected two pumps which, together with the building cost £168, and I managed to show a clear profit every month of £75. Unfortunately, the extra revenue was not credited to my department; it was put to general revenue account. In my opinion, it is a disgrace. (Laughter). Why should a profit made by my department be credited to general revenue account?

Incidentally, it might interest Mr. Milton to know that our transactions of last year turned out to be very profitable.

The last point I would like to mention to you is that our municipality has in years gone by always made the mistake of not putting forward sufficient money for depreciation and renewals, with the result that when we had to renew or change over to a new station, we had no money in hand, because we had been made to knuckle down and accept most preposterous loan conditions some 27 years ago on account of lact of foresight on the part of our Town fathers.

When you gentlemen or Council members are confronted with any large capital expenditure, be very careful what you are doing; do not repeat the mistakes of your forefathers. Get money in the cheapest money market and do not bind yourself down for the next twenty or thirty years to buy or borrow money from the same firm. Put in a clause, that you only want to raise that money temporarily.

With regard to depreciation and renewals account; I proposed some years ago, and I discussed it with Mr. Milton, that it would be to the interests of any municipality to use part of annual renewals contributions for Machinery Insurance at a reasonable rate; you would then have complete insurance covering unforseen circumstances of any kind, or accidents due to inefficiency or incompetency. But, be very careful about item inefficiency. Some years ago I put in a claim for damage caused by an accident. They said, it was not an accident and they must put it down under something else. I said "All right; put it under somebody's incompetency" : the claim was paid. I think this matter of insurance is one well worth going into; it covers you against any contingency; it covers you against breakdown and so on.

Mr. L. L. Horrell (Pretoria) : The paper presented to us by Mr. Milton is one which will form a valuable contribution to the proceedings of our Association and the author is to be congratulated on his handling of the subject.

In offering him our thanks I would like to couple with it our appreciation of the Electricity Supply Commission's interest in the work of our Association.

The subject of the author's address will I am sure, prove extremely helpful not only to those of our members associated with the smaller undertakings but also to the consulting engineers whose privilege it is to prepare schemes for the inauguration of any additions to these undertakings.

Since its inception the Commission has been called upon to examine a very large number of these schemes and although the author has taken the precaution of warning us that the views expressed are not necessarily those of the Commission, I feel sure that it is this experience which has led the author to advance many of the suggestions which we are asked to consider. Many of these should be productive of both interesting and instructive discussion but as they deal more particularly with the small undertaking I do not propose to comment on them but to leave this to the members more closely associated with these matters.

I was pleased to note the author's reference to tariffs for I have often felt that the smaller undertakings could develop much more rapidly by adopting a two-part tariff instead of the block system or the practice of separate lighting and power metering on domestic premises.

Closer attention to this matter would I am sure, soon reap benefit sufficient to put the undertaking on its feet.

Councillor D. Nelson (Paarl): It has been very interesting to me to listen to the paper by Mr. Milton. I am not an engineer, but an ordinary Councillor, nevertheless I agree with Mr. Milton 100% on all his technical views, because I cannot critisize him. The only thing I would like to ask is with reference to his remarks and advice that he would like to see each Municipality install stoves, which he, Mr. Milton, considers would greatly benefit the Electricity Department of each Municipality.

I quite agree with Mr. Milton that a load added to a power station must be a benefit to the Department, and Municipalities, and especially to the Municipality which has its own generating station. Now let us take our case. We buy energy from the Electricity Supply Commission on a K.V.A. basis. Supposing we install say 100 stoves they must get their energy, as we all know at a very low price to compete with other stoves which are on the market like the "Aga" stove. The load of stoves usually comes on usually about 11 o'clock when all the factories are in full swing. It is estimated than an ordinary stove will use 4 Kilowatts and this at £5. per K.V.A. would cost us £2,000. per annum for the K.V.A. plus approximately £500 for units, a total cost of £2,500.

Assuming a stove consumes 300 units per month at ⅞d. per unit (that is the price we sell) that would give us an income of approximately £1. per month per stove, a total income of £1,200. per annum against the total cost of £2,500. for the K.V.A. and units; here it seems a big loss. I agree that one can never take that the full 400 K.V.A. for the 100 stoves will be added to the load, but in our case the stove load greatly effects our peak, as I said it is just the time when all our factories are on demand for energy. I also find that in the vicinity where stoves are added we immediately have to strengthen the line and instal bigger Transformers, and such extra expenditure is for a load which only draws energy for a few hours and at a time when our station is fully loaded.

Our Engineer also likes to increase our load, but we as Councillors, being greatly interested from the financial point of view, have to consider all the aspects.

I say again, the Municipality who has its own power station is quite different to those Municipalities which buy their energy and therefore I ask Mr. Milton what would his advice be to the Municipalities who fortunately or unfortunately have not their own power station, but buy their energy and once a peak is created for half an hour, they are immediately responsible for the whole month.

Councillor Allison (Pietermaritzburg): A lot has been said this morning on the question of profits from electricity supply. As a Councillor, I want to put another aspect, and that is, who brings the customers together which the Electrical Engineers have the benefit of supplying? It is the municipality which brings them together as a whole, and makes it a paying proposition; if it were not for that no municipal undertaking could possibly come out or make a profit.

In Pietermaritzburg, we have a European population of approximately 24,000, but of those there are roughly only 3,500 who are ratepayers. Therefore, a large number of people are getting the benefit of the amenities of the town which cost a considerable sum without contributing by way of rates. They get such privileges as health services, entertainments, swimming baths, parks, etc., all of which are run at a big loss. We also have our transport system which towns like those of Rhodesia do not undertake, and which means a loss from £8,000 to £10,000 a year. The electricity and transportation departments are run together in Pietermaritzburg. Where is that loss to be made up from, if you do not get it from some source? If you charge it to the rates, the rate is going to be so prohibitive that you will stop people coming to your city, and you will find services left undone which should be carried out. For 22 years there was a loss in the Electricity Department. Where did that loss come from? It came from the rates—the revenue fund. Well, if it came from the revenue fund on the one hand, now that we are making a profit, should not there be a redemption or balancing up account? It is only reasonable that the municipality which guarantees the loan debt of the Electricity Undertaking should benefit in some way from the profit derived, if any.

We know that a municipality as a municipality supplies numerous other services besides electricity. We cannot compare it as was done on a previous ocasion with the Electricity Supply Commission. If the Electricity Supply Commission make a profit, how on earth is it going to give it back to the benfit of the community? With a municipality, if we make a profit, we are able to divert that profit to help a very large number of Burgesses. That is why it is a very good thing that we are able to make a profit from electricity. There is a very large number of people who live in boarding houses; these people pay nothing towards the rate; the paltry room they occupy cannot be brought into the question; they can go to the swimming baths, or entertainments; they go to our Parks, and they can use our transport system, on which we make a big loss. This is just one of the services where the ratepayers who foot the bill, get a little relief, when profits are made on the Electricity Undertaking. In addition, 3,500 ratepayers out of a population of about 24,000 Europeans have to pay for all the relief works for unemployed. Is it right that a few people should bear the majority of the taxation of the city? I say it is wrong. If you do make a profit, is it not right that there should be a levelling up? I maintain it is so. I think there are two sides to every question. I am proud to say we have an Engineer in Pietermaritzburg who is anxious to make profits on the Electricity Department. He gets the credit for having made those profits, which, at the end of the year, may be transferred towards the reduction of rates. The progressive spirit and ability of an Engineer should not be stifled. I think other engineers in similar circumstances, should not look at it from the narrow point of view, the revenue should be available to be taken from one pocket and put into another. If the cost of the current is not prohibitive—that is the main point—and cheaper than you can get any other form of heat or power, then I say the position is satisfactory.

I understand from Engineers who are present, —I have personal experience on this matter—that in some municipalities, the consulting engineer is apt to give a very low figure in basing his estimate on inadequate and inferior plant, that is not sufficiently big enough to allow of expansion. It is a very costly practice, and owing to development, the plant soon becomes obsolete, and instead of costing less, in the long run it costs considerably more. It behoves Councillor members to take note of that fact, and see that they do not, under any circumstances choose the cheapest, or insist on the Engineer supporting a cheap scheme in the first instance.

We all know that the electricity undertakings are in their infancy, and with the very big development taking place, it is only right and proper that engineers as well as councillors should look ahead. If we could only have foresight and look ahead, and install plant which is big enough and of the correct quality, and be able to protect the interests of and cope with future development, I think it would be a saving of money in the long run. I hope I have expressed the opinion of engineers concerned, satisfactorily.

In conclusion, I would like to thank Mr. Milton for his very interesting paper. I, as a Councillor appreciate it very much, and I am sure the engineers all appreciate it all the more.

Mr. C. Runtzler (Port Shepstone): I wish to express my thanks to Mr. Milton for his very interesting and instructive paper.

I will leave the Hydro-Electric and Suction Gas Plants out of consideration. For the former, conditions in South Africa are suitable only at very rare occasions, as stated by the author, and of Gas Plants I have no experience.

I was practically brought up on steam, my experience of that commodity dating back some 44 years, and my experience of Diesel Oil Engines only about 6 years. But, if I had to choose, my choice would be an Oil Engine Plant if at all possible economically a small Plant, 200 K.W. I would give all due consideration to the fact that the money expended for the purchase of coal remains in the country, whereas that expended on Oil does not, but may be so in the not far distant future.

My reason for this attitude is mainly due to the ease and quickness with which one can cope with any sudden demand of current in a well arranged Oil Engine Plant. A draw-back of course is the fact that governing of the speed of Oil Engines is not as satisfactory as that of modern Steam Engines, but that difficulty can be overcome by good attention of the shiftsmen. I am speaking of the 4 cycle Engine. I have no experience of the 2 cycle sets, and would like to hear something of the advantages claimed for them.

I consider the maintenance and running costs of Oil Engines in small plants as under review compare favourably with Steam Plants. One of our sets, a 74 K.W. Ruston & Hornsby one, had been running for 3½ years (app. 11,000 hours) before we could give it a general overhaul, except once decarbonizing, and then there was nothing else to do, all Bearings went back exactly as they came out. Cylinders, Pistons and Rings were in excellent condition, and just pro forma I changed one Ring in each Piston.

I do not like the idea of a number of small sets as suggested, although I have found no difficulty whatsoever with running two or more of our Ruston & Hornsby's in parallel. Our two small sets are now often running to capacity, occasionally with a slight overload.

Our plant was started about the middle of 1930 with 2—32 K.W. sets, towards the end of 1932 it was necessary to instal a 74 k.W. set, and the installation of another set of that capacity last July was really long overdue, as the Peak load was beyond the factor of safety since the middle of 1934. This shows, that a plant once started creates demand, and helps towards the development of the town.

The comparative estimated capital expenditure and running costs I consider fair, though the total costs of 3—75 K.W. Sets and one 20 K.W. Set quoted to be £4,400— seems to me to be too low, our 74 K.W. Sets cost about £2,000 each, including foundation and erection.

The difference in the cost of Lub. Oil of the two rival Sets seems excessive, our average for the last year is .065d. per K.W.H. and last month it was .048d. I intend to keep it at that, or below that level, and I don't think that small steam plants, with reciprocating engines, can be very much lower.

The idea of a combined Steam and Oil Engine plant appeals to me immensely, in cases, where it is economically feasible. This arrangement would be conducive to a great flexibility I think, especialy in cases where a high Peak Load of somewhat short duration has to be contended with.

A steam plant is out of the question for Port Shepstone owing to the cheapness of Fuel Oil, it now costing £5 17s. 0d. per long ton, including railage, etc. The following figures from the Port Shepstone Plant may be of interest to members :

	1931	1932	1933	1934	1935	1936
Total Units generated :	150,738	191,989	239,837	273,793	335,824	380,000
Cost of Fuel Oil per K.W.H. :	.6d	.563d	.64d	.62d	.57d	.52d .487d
Cost of Lub. Oil per K.W.H. :	.133d	.176d	.117d	.111d	.084d	.065d .048d

(After a few general remarks by the President, the Convention adpourned at 12.25 p.m. until 9.30 a.m to-morrow).

FRIDAY, November 20th, 1936.

The Convention resumed at 9.40 a.m. at the Conference Hall, Empire Exhibition.

The President : We will commence our proceedings this morning by asking Mr. Kane to reply to discussion on his paper.

Distribution Sub-Stations of the Johannesburg Electricity Department.

by R. W. Kane (Johannesburg).

REPLY TO DISCUSSION.

A question has been asked as to the necessity of replacing the existing H.T. Board at Central Sub-Station with a greater number of units of larger capacity; this was partly necessary in view of the additional units required and in addition by the modest desire to lock the stable door before the horse could escape.

No trouble whatsoever has been experienced with the present switchgear and in fact enquiries were first made with a view to increasing the rupturing capacity of the existing units and extending as required, but as this was impossible, the new board was ordered and the present bank of switchgear will be utilized in a more remote suburb of the city.

Transformer failures are one of our very remote sources of trouble and in the last few years I only know of approximately six such failures, two being caused through lightning, one through moisture, another owing to doubtful bracing of the windings, and the balance through sheer old age. If a percentage of failures is still required I would put this value as approximately 1/10th % per annum.

Our series lighting system is only protected on the primary side against overload. The secondary installation is unearthed and no protection allowed for.

In view of the series circuit I can only visualise an open circuit or high resistance fault causing any trouble and in the absence of any experience to the contrary, I would assume that under these conditions the primary switch would clear through overload.

Dealing with Bulk Supply Consumers and the inspection by the Factory Inspector, the equipped chambers are inspected initially by the Inspector when notified by the Department as these chambers are owned by the consumer and not the Department.

We have a similar example in the elevators in any building, only one inspection being customary however for a chamber and not every six months as with elevators.

The Department's load centres are not inspected by the Government Inspector although he has every right to do so, if desired, in this or any town.

Distance between load centres varies according to load demand and available sites, and is not controlled by a definite rule of thumb method as far as distance is concerned, but mainly from an economical low tension distribution point of view.

Mr. Horrell, I think questioned the necessity for the installation of 300 K.W.A. Transformers and although it has not been found necessary to instal 300 K.W.A. transformers in every kiosk, in certain suburbs the demand has warranted such an increase, but when describing the kiosk as being suitable for 300 K.W.A., this expression was principally used to define the space available in the kiosk. We have still a number of ancient transformers in good condition on the system or available for use with a capacity from 100 to 200 kVA. that in bulk appear more like 1,000 kVA. and the size of the kiosk is really designed to permit flexibility in transformer alterations and increases.

The maximum demand instruments are principally installed for supplying details of demand on the transformer and in simplifying the winter load tests. Double pointer straight ammeters would not serve the same useful purpose and in my opinion spot readings are also of doubtful value for load demand statistics, when it is realized that load demand varies from day to day in step with climatic conditions.

Facilities are provided on all incoming and outgoing feeders, however, for spot readings, but we are not in the fortunate position yet to use a standard instrument throughout the system.

In a small town, say, like Pretoria, standardization, I should imagine, would be easily obtained, in view of the necessity for fewer load centres.

In justifying the supply of High Tension where a demand of over 30 kW's. is expected, this must not be confused with an installed load of 30 K.W.'s, it being customary to allow reasonable diversity factors for the different types of loads in the industrial, business and domestic consumers. In the central area we have very few consumers on High Tension with an installed transformer capacity of less than 100 or 150 K.V.A.

I admit that the value given appears extremely low, but when combined with a reasonable amount of latitude and taking a diversity factor into account, I do not think that many consumers have suffered through being compelled to take High Tension.

It will be appreciated also that a figure of 30 K.W. demand is an extremely useful lever in the hands of the Dept. when certain types of load is considered unsuitable for low tension supply.

In conclusion, Mr. Prsident and Gentlemen, may I once more express my appreciation for the opportunity afforded me in presenting a paper before this Convention and for the experience gained by me in the various discussions on this and other papers, in realizing the varying points of view and problems experienced by others.

The Engineering Aspect of Small Municipal Electricity Undertakings.
by W. H. Milton (E.S.C.)

The President : Gentlemen, I have been asked to permit Mr. Milton to speak to a point of explanation, prior to proceeding with the discussion on his paper.

Mr. Milton (Electric Supply Commission) : Mr. President and Gentlemen, there was one point raised during the discussions yesterday, which I feel would better be aired to some extent by members present. I refer really to Mr. Nelson's contribution, from Paarl. Mr. Nelson raised the question, in his particular case, as to how it would be possible for a municipality such as his to develop a cooking load. The peak at Paarl is a day peak, and a fairly extended one. Mr. Nelson then gave the example of 100 stoves being installed, and estimated that installation would result in a maximum demand of 300 kilowatts. He pointed out that the charge for the supply was at the rate of £4 per kilowatt per annum, and proceeded to infer that with a tariff of that nature and a sale of 100 stoves, it was impossible for his municipality economically to undertake the encouragement of such a load by the introduction of a 1d. rate and the offer of Hire Purchase facilities.

But I must say that I was very disappointed that the question has taken its present form because it seems that the municipality of Paarl is still unaware that there is a considerable diversity of use of ranges, when a number of ranges, as great as 100 is sold.

At a former Convention when a paper was presented on the general subject by Mr. Swingler of Capetown ,the results of tests on suburban loading due to stoves was mentioned, and a figure of 1 kilowatt per stove was, so far as I remember, indicated as the probable demand in a relatively small area, with a relatively small number of stoves installed. In Mr. Dawson's paper read before this Convention, a figure of .85 K.W. was mentioned as being the diversified demand per stove and a suggestion was put forward during the discussion that 1.2 kilowatts should be accepted, and was replied to very ably by Mr. Dawson who supported his contention and indicated, if anything, that .85 K.W. per stove was a liberal allowance.

If Mr. Nelson would take a figure of say, 1 kilowatt, he would find that the cost to Paarl of supplying these stoves would not amount to .07d. per unit—that is assuming a relatively small use of electricity per stove of the order of 200 units per consumer per month.

A normal consumption would be nearer 240 in the case of Paarl, because after all, the domestic load in Paarl has never been developed, and it is probable that the first influx of stoves into Paarl would be to the class and type of consumer which make an extensive use of the stove, and would not worry very much about the "bawbees."

If you take the figure of 240 units, the municipality of Paarl certainly can sell at 1d. a unit, (and I am convinced at an even lower rate for domestic cooking), with considerable advantage to Paarl municipality and the consumers.

Mr. Nelson also asks in his discussion how can Paarl sell or develop its load at a profit? I am convinced in my own mind that the first duty of a municipality is to give service to the residents in its area. A Municipal Council is elected to manage the affairs of the community for the good of the common weal, and not to acquire profits. Its first object should be service; but it does seem to be the general principle that all Councils look for profits though these profits come from the very people they represent, and are not really essential.

I trust, Mr. President, that those members here who have had experience of purchasing in bulk, and, shall we say, the selling of electricity in bulk, will give their experiences in spite of "on peak" incidence. in regard to the advisability of developing cooking loads instead of peak instances.

DISCUSSION CONTINUED.

The President : We will continue with the discussion on Mr. Milton's paper.

Mr. W. M. Mail (Kokstad) : Just a few remarks on a most interesting and valuable paper for small undertakings.

Re Automatic Plants :

These in my opinion would only be of use for 50 to 80 consumers for lights only, and would need an Engineer to look after the Undertaking.

Steam Plants :

The experience I had in Kokstad with steam plant before changing over to oil was that unless the load continues for a considerable part of the evening and part of the day and coal is very cheap, say 12/6d. a ton, then fuel oil is cheaper and more flexible to run "that is up to say 150 kW." also as much thought must be given to the boiler plant as this is where the expense in running a steam plant occurs.

As to the claim that steam plant can run continuously longer, this has not been my experience as I have run Diesel Plant for 2 weeks without stopping and could have kept on if necessary, and, on a number of occasions for one week without any trouble.

Diesel Engines :

As to the merits of 2 stroke against 4 stroke, as I have had experience with both types running in the same Power Station I prefer the 2 stroke and the reasons are as follows :—

More even running (Cyclic Variation).
Less wear and tear.
Less maintenance and attention required.
The heavier the load the better the engine runs.
Fuel consumption has been better.
Lubricating oil heavier on light loads, but as good if not better from ¾ to full load, and taking fuel oil and lubricating oil together my experience has been that the 2 stroke is better and maintenance costs less.

The following figures may be of some interest :

Plant Installed :

Two Engines 2 stroke Petter 208 H.P. direct coupled to 92 K.W. D.C. 230/460 Volts generators running at 290 revs.

One Engine 4 stroke 57 H.P. Ruston Direct coupled to 30 K.W. Generator 230/460 Volts running at 500 Revs.

Altitude 4,600 feet.
Summer temperature averages 85.
Winter temperature averages 50.
There is no pumping load, and no day load to give good load factor.

Engine hours for Ruston 4 stroke running 8½ years : 31,063 hours.

Load at present ¼ to full average ¾.

Fuel consumptfion for this year per unit generated average .919 lbs.

Fuel consumption for 8½ years per unit generated .96 lbs.

Fuel consumption when first installed with full load : .73 lbs.

Lubricating oil consumption for this year : 135 gals. 9 months.

Piston rings changed at 5,000 hours, again at
Piston rings changed at 10,000 hours, again at
Oversize rings changed at 15,000 hours, and
New cylinders and Pistons at 23,869 hours.

A number of replacements have been made such as big ends, valves, seatings, rocker arms, lubricating oil and fuel oil pump parts, and numerous small parts.

Valves have to be kept in good order entailing a good amount of attention but less trouble than experienced with steam plant (boilers) that had been installed.

No. 1. Petter Engine. 2 stroke running 5 years 3 months, engine hours 11,034.

Original bearings and Piston rings still in splendid condition, only replacements Atomiser springs nozzles and needles, also Fuel pumps replaced by makers after 2,000 hours running due to pump casings developing leaks. All pumps (3) on each engine developed this trouble at nearly the same running hours.

Fuel consumption average for 5¼ years per unit generated : .92 lbs.

Fuel consumption this year : per unit generated: .80 lbs.

Average load ¾.

No. II. Petter 2 stroke running 5 years 3 months.

Engine hours : 12,125 hours.

Conditions : Same as No. I. Petter.

This set figures :

Fuel oil consumption for 5¾ years carrying average of ½ load : .93 lbs.

This year : average load of ¾ : .834 lbs.

The two Petters have been run in parallel and have had no trouble carrying loads easily and without any fluctuations.

Fuel oil costs £7 12s. 6d. a long ton.

Lubricating oil costs 4/3d. Gallon and for the last nine months the total for the 3 Diesel sets was: .84 lbs per unit generated and the cost

Fuel oil : .60 pence per unit generated.

Lub. oil : .17 pence per unit generated.

TOTAL : .875 pence per unit generated.

The fuel oil is metered to each set and calculation is based on 9.33 lbs. per gallon.

For the last 9 months the consumption of lubricating oil has been :—

Ruston 4 stroke:	135 gallons	50,817 units generated.
Petter 2 stroke:	330 gallons	110,173 units generated.
Petter 2 stroke:	320 gallons	10,2147 units generated.

In Reference to Running Costs :

Kokstad this year generated and sold practically the number of units stated by the author and the running costs as per 1936 estimates were :—

Salaries	£848
Stores	100
Water	24
Fuel oil	850
Lub. oil	250
Renewals	300
Interest and Redemption	909
Insurance	64
TOTAL	£3,345

The author has omitted insurance in his figures. But the estimate for Fuel Oil and Lubricating Oil will be under the amount by £100. and the Revenue increased by £350.

Actually for 9 months including the heavy load of winter the—

Fuel oil bought was only	£593 10 0	
Lub. oil bought was only	167 0 0	
	760 0 0	(9 months)
Estimate for balance of 3 months :		
Fuel oil and lub. oil	251 0 0	
	£1,011 0 0	

Total units generated 9 months:	263,137
October	27,623
Estimate for 2 months	50,000
	340,360

The better figures this year are due to extra time and attention being spent on atomisers and fuel pumps. I am afraid I have made my remarks a little lengthy but the author has brought up some very interesting points, and I think a paper that is long overdue as far as the small undertakings are concerned, as there are more than half of the Undertakings in the Union that come within this generated figure and I would like to offer a paper in reply at the next Convention.

Mr. C. H. Clutterbuck (Chief Inspector of Factories): I have listened to Mr. Milton's paper with great interest and if I may be allowed, would like to offer some comments on that portion which deals with small automatic generating sets.

These plants, together with the distribution systems, fall within the definition of "machinery" subject to supervision under the Factories (Amendment) Act of 1931 and it may not be out of place to quote one or two of the Regulations governing their use.

As you are aware these Regulations are framed to ensure the safety of life and limb and are not concerned with either convenience or efficiency.

Regulation 11 (1) reads :—

> "The operation of or attendance on machinery shall be in charge of a competent shiftsman, but unskilled persons working under his direction may be employed on such operation or attendance provided that the shiftsman exercises effective control."

As Chief Inspector of Factories, I have power to grant exemption from any of the provisions of those Regulations which are inapplicable or unduly onerous and, provided there is no personal risk involved I am prepared to take a reasonable view and consider each case on its merits.

Although my Department is directly interested in the question of employment, I do not intend to be unduly influenced by this factor and realise that it is absurd to maintain unnecessary staff, at the same time there is a limit to the size of plants which may be allowed to run unattended, and I assure you that my discretion will be exercised with great care.

Any exemption which may be granted permitting the operation of generators without attendance will, of course, cease to have effect in the event of any increase in the capacity of the plant and in these circumstances the position will be reconsidered.

Mr. Milton deals with the employment aspect, but this is certainly not clear to me, in fact to my mind this is one of the difficulties which will follow the introduction of automatic plants. Judging from my experience with small municipalities, I am of the opinion that in the case of a municipality which had been allowed to run an automatically controlled plant and in which the electricity undertaking had reached the stage when it became necessary for the machinery to be under the constant control of a shiftsman, any instruction given to provide an operating staff would be strongly resisted.

The foregoing remarks apply to power units only, the position with respect to supervision of electrical apparatus and distribution systems is entirely different. Regarding the plant as a whole and bearing in mind that "machinery" includes all electric apparatus and conductors, the following Regulation must be complied with :—

> "Regulation 5(3): Where plant developing not more than 250 h.p. is erected or used all boilers, engines and other machinery shall be placed under the general charge of a competent person who shall be appointed in writing."

I have reason to believe that small electricity supply schemes are contemplated the promotors of which have the idea that the whole plant can be placed under the charge of a local garage mechanic whose electrical knowledge is usually limited to that required to make repairs to motor car equipment, and is generally not of a high order.

Such an arrangement cannot be accepted. The number of accidents which occur on small municipal distribution systems provide ample evidence that for the protection of the public it is necessary that competent persons should be placed in charge of electricity supply undertakings, however small.

Where the employment of an engineer is not compulsory, the Local Authority owning the plant is held responsible for any accident which may occur and in order to safeguard itself it is only reasonable to expect that there should be no question of operating an undertaking without a qualified person in charge.

I quite appreciate the object Mr. Milton has in view in advocating the installation of automatic plants, at the same time no risks must be taken in the process of educating people up to the use of electricity and in my opinion if a municipal electricity undertaking cannot support a properly qualified electrician, in the interests of safety it should not be allowed to operate.

Mr. C. R. E. Wright (Benoni): With Mr. Milton's permission, I think I can satisfactorily answer all Mr. Nelson's queries and doubts. In the first place, let me assure him that I think all of his troubles are more imaginary than real. From our experience—which would be practically the same as Paarl—I think we are in the same position; we buy our current in bulk, and distribute it, and the amount purchased is practically the same amount as that of Paarl. We instituted a deferred payment scheme, and since then we have put in approximately 600 stoves—that was, to encourage the day load. Well, since that has happened, we have so much encouraged it that our peak actually occurs at 2 o'clock in the day time—not through the stoves, but the industrial load. Notwithstanding this, we are able to sell domestic electricity after the quota—which is 5 units per room—which is reasonable—at ⅜ths of a 1d. per unit and are still able to contribute

£24,000 per annum to the relief of rates, after taking £4,000 out of revenue for extensions. Also, our industrial tariff is down to the very low figure of $\frac{1}{2}$d. per unit. So I do not think that any increase which Mr. Nelson fears in the maximum demand charges is going to affect his average cost of current.

Actually our experience has been that previous to our maximum demand occuring in the day-time, our load factor was in the region of 36 per cent. Now, although our demand has increased by some 900 kilowatts over our previous night demand, our load factor has gone up in the region of 40 per cent. and our average cost per unit for current purchased has dropped from .44 pence per unit to .42 pence per unit. So, although Mr. Nelson fears these extra demands created by a deferred payment scheme for extra installation of stoves resulting in an increased cost, it has clearly proved in our case that there will not be any increase in cost and the demand created by the stove load is not actually superimposed on the industrial demand in our case. I found that the stove demand is most likely to occur between 11 and 12 when the industries are getting ready to shut down for lunch; the industrial demand occurs at 2 o'clock in the afternoon. So, Mr. Nelson, if you can take that on the authority of one who has had experience, I do not think you need have any fear of developing the domestic load. Although we are down to $\frac{5}{8}$ths of a penny, we contemplate reducing our domestic tariff down to $\frac{1}{2}$d. per unit. (Applause).

Mr. Geo. H. Swingler (Capetown): In regard to Mr. Nelson's fears that the development of the domestic load is to say the least of it a doubtful blessing to an Undertaking which purchases its supply of electricity in bulk on a two-part tariff as compared with the position obtaining in the case of an Undertaking which operates its own generating plant, I would draw attention to the fact that the cost of electricity, whether purchased or generated, includes capital as well as running charges. Ordinarily, however, the generating costs are not analysed in this way, whereas in the usual two-part tariff the two sections comprising the total cost are shown separately as a matter of course. In consequence of the capital cost involved in the generation of electricity being to a great extent out of sight it is out of mind so that one is prone to fall into the error of considering that the generation cost is represented only by the running expenses and to look upon the power demand charge of a two-part bulk supply tariff as a payment for which one receives nothing. The fact remains, however, that where load development may be expected the Undertaking which operates its own generating station must install plant well in advance of the actual day by day load requirements and accordingly pays (although it is not readily obvious to it that it does so) capital charges on that plant from the time when it is installed although it may not make full use of that capital for a long time to come, if at all should the load development not attain the anticipated dimensions, whereas in the case of the purchase of electricity on the two-part tariff rate the purchaser pays for the load requirements of his Undertaking as and when they occur and the burden is automatically thrown upon the supplier of meeting those demands and taking the financial risk involved in doing so.

As you know from my observations at previous Conventions some years ago, I was not at one time favourably disposed towards the extensive use of electricity for domestic purposes largely because my personal experience in that direction was unfortunate and I was not satisfied that the appliances then available would give satisfaction generally. Subsequently, however, I was forced to reconsider the matter in the light not only of the fact that no other means lay open to the Capetown Undertaking to develop but also because of the improvements which were effected in the materials used for domestic purposes. The results of the action which was taken in this direction have already been presented to the Association, and as an illustration at this meeting I would mention merely that whilst in 1929, the year before the inauguration of the hire purchase scheme, 8.7 million units were sold for domestic purposes in Capetown, the sales for these purposes in 1936 will amount to approximately 100 million, so that whereas the domestic load in 1929 represented only 14.9% of the whole, this figure has now risen to approximately 57%. An important feature in this connection is that the load factor of the Capetown Undertaking is approximately the same now as it was in 1929 nothwithstanding the fact that since that date approximately 18,000 electric ranges have been installed on the system, and it would appear from such figures as are available that the domestic supply has a load factor of between 35% and 40%. Indeed the domestic load to-day, gentlemen is the best load we have if only for the reason that it is not influenced by conditions of trade. The fact that in Capetown the increase in connected load due to ranges sold only through our hire purchase scheme has amounted to 90,000 kW., whereas the maximum load on the whole system (lighting, industrial and domestic) is estimated to be in the region of only 40,000 kW. is sufficient to show that it is incorrect to consider that each electric range installed will necessarily increase the amount payable under the demand charge section of a bulk supply tariff by the load demanded by that range taken by itself, as I understand Mr. Nelson fears will occur. There is a wide diversity in the load demands of electric ranges, and although the maximum demand due to the installation of electric ranges is estimated by Mr. Nelson to coincide in the case of the Paarl Municipality with the time of maximum demand of the remainder of the system (I do not agree with this view), it does not necessarily follow that this in itself is a disadvantage, for the additional cost of demand and energy charges of the purchased supply would presumably be covered by the tariff rate of charges for domestic purposes and in that way advantage be taken of the diversity in the load demand of the electric ranges.

Relief of Rates :

I would like to make a few comments also on the vexed question of the relief of general rates from the funds of the Electricity Departments, for I feel that in many instances this has an important bearing on the future development of Electricity Undertakings since contributions of this nature are frequently made without sufficient regard being paid to the financial stability of Undertakings. It makes me wonder, for instance, when I see from the accounts of one of the larger Electricity Undertakings in this country that a loan for electricity purposes was raised in 1904 on a 60-year basis, and see that only about half of which had been paid off in 30 years, if any of the plant on which that money has been spent is now in existence. The same Municipality has spent a total of a little over a million pounds on its Undertaking, yet has less than £150,000 set aside in its sinking fund and other reserve accounts. The Undertaking nevertheless contributes relatively speaking heavily to the relief of rates and this contribution is now looked upon as a working expense, for I notice that after, for example, in one year making a contribution of £25,000 to the relief of rates the Department shows an accumulated deficit of nearly £20,000.

I would not like to suggest that no contributions of this nature should ever be made, but I do hold the opinion very strongly that no such contributions should be made until the Undertaking concerned can in fact afford to do so and then only to the extent to which it can afford such sums as may be demanded. I feel particularly strongly, however, that no such contribution should be made unless and until adequate provision has been made for obsolescence, whether through a renewals fund, sinking fund, betterment fund, or any other fund you like to establish, whereby the capital indebtedness can be reduced, and to my mind the reduction of the capital indebtedness should be the first consideration and first charge on the Undertaking. It may be that others present have had the experience with which I have met in the course of the past few daws when although I have reported strongly against a proposal to take for the relief of rates a very large sum which the Undertaking cannot afford and contrary also to the wishes of the Electricity Committee, from the Electricity Department for the relief of general rates, the Concil took that course merely because it found itself financially embarrassed. The proposal was carried simply because a small majority of votes was obtained in its favour. A disturbing feature of the matter is that it is not unusual even while one is conscientiously going to the trouble of pointing out the dangers and difficulties to which the Department is being exposed by action of this nature, one cannot but feel that the minds of a considerable section, perhaps even numerically strong enough to carry the proposal against one's advice, have been made up before learning the facts.

Dealing with the subject from the point of view of maintaining capital indebtedness to a minimum, it is of interest to learn that, for example, the Sheffield Electricity Undertaking with a revenue of £1,200,000 per annum does not contribute anything at all to the relief of rates, the ratio of net loan indebtedness to total capital outlay in this case being .462, that is to say they have paid back more than half of the total money spent on the Undertaking. Similarly, the Edinburgh Electricity Undertaking with a revenue of £868,000 does not contribute anything to the relief of rates and owes only 40% of the money spent on the Undertaking. The Glasgow Electricity Undertaking with a revenue of £1,250,000 per annum does not pay anything to the relief of rates and has paid back 70% of the total money it has borrowed. In Capetown, however, weher the ratio of loan indebtedness to total capital outlay is .50 the contribution to the relief of rates for the year

1937 has been fixed at £100,000 as compared with an estimated total revenue by sale of electricity of £730,000 and indirect contributions in the shape of requiring the Undertaking to provide other services at less than cost are required also. This in the case of street lighting alone amounts to the sum of at least £15,000.

To my mind, Mr. Chairman and Gentlemen, it is important that this Association make definite and strong efforts to get the Provincial Councils to interest themselves in the matter by prescribing the limits and conditions under which Electricity Undertakings may be required to contribute directly or indirectly to the relief of the general rates.

Mr. D. W. Ritson (Stellenbosch): Mr. President and Gentlemen, with regard to the stoves coming on to your peak load, we in Stellenbosch are in the same position as Mr. Nelson is at Paarl. We are on a bulk supply. With regard to stoves; we welcome them, and any other load that we can get hold of. We are in the same position as Mr. Wright in Benoni has spoken about; he is not afraid of stoves, or anything coming on, and you can see what he has done.

I would like to give a few figures from Stellenbosch, to show that we are not afraid of stoves on our bulk supply.

We changed over to bulk supply at the end of 1930. In 1929, on our oil station, we sold 300,000 units. In 1935, we purchased from the Commission 1,528,000 units, and we estimate to purchase in 1936, 1,800,000 units; this for a small dorp with no industries. Our generating costs in 1929 were 2.8; our estimate for 1936 is .8. Our domestic and industrial power units sold in 1929 were 25,000, and our units for domestic power estimated for 1936, will be about 750,000. In 1927 we had an overdraft of £1,000; and in 1931 the Council took £2,000 for the relief of rates. Our change over cost us £4,500, of which £3,500 was paid out of revenue. Our profits at the end of 1936 will be about £3,000.

Those are just a few figures to show that we are not afraid of any peak load coming on.

Councillor D. Nelson (Paarl): As regards the remarks from Stellenbosch about their development since they were connected with the Electricity Supply Commission, their increase in units is from 300,000 to 1,200,000. I think that you will all agree with me that Paarl is one of the most progressive Towns in the Western Province. If you take our town say 8 years ago before we were connected with the Electricity Supply Commission our output of units was also about 300,000 per annum. To-day we are buying close to 9,000,000. I think you should all clap hands at that—the progress Paarl has made in its Electricity development (A voice: The Commission.) and let me say that the increase from 300,000 to 9,000,000 units per annum was not attained by looking after stoves and by competing with the "Aga" stove.

As regards Mr. Milton's remark that we should not make a profit let me assure you that we are losing on domestic loads. If you have to pay £6 per K.V.A. plus .4 of a penny per unit and sell at ⅞d. per unit, you will agree that we are not overcharging or making a profit. I desire to show you that although we are not too keen for stove loads, yet our tariff is very low for them. Stellenbosch may not be effected by a day load, because as Mr. Ritson stated they have no factories hence their load is a night load and they can easily handle stoves. Our load is quite different. Our peak is created in the day time from 11 o'cock at the hour when the householders, also require energy for their stoves.

While listening to Mr. Milton's paper, I asked myself, as to what we should do at Paarl, when unfortunately at the hours from 11 a.m. to 12.30

p.m. all our factories have already created a peak and also the stoves come on with an extra load. I can assure you that the Paarl Electricity Committee are not asleep, and hope you will acknowledge that our development from 300,000 to 9,000,000 units per annum is a proof of my statement.

I quite appreciate all that my friend Mr. Swingler has said. I can assure Mr. Swingler that we are doing our best but we have got to be careful to know which is the best. You do not expect, Mr. Chairman and Gentlemen, that I should be able to argue with the best brains of the Electrical Engineering World who are here to-day, but I must say in conclusion that I have as yet not been enlightened that in our case stoves would mean a profitable income to our department. Thank you, Mr. President.

Mr. Horrell (Pretoria): I do not think Paarl should be faint hearted over this matter. Some little while ago the township of Hercules, a district about 3 miles by 4 miles in area, chiefly occupied by people of poor artisan type, was incorporated in the Pretoria Municipality.

The overhead distribution was carried out with No. 10 and No. 8 bare copper. We immediately set to work to alter the mains to permit of the installation of stoves, knowing at the time we should lose on the transaction for some little while, but there is no doubt about it we shall gain in the end.

Mr. Swingler is quite right when he says it is the diversity factor that tells. There is no doubt about it you must encourage the installation of stoves.

Since we did so our sales have gone up enormously.,In 1928 when there were very few stoves on the mains the sales were 19,000,000 units, while to-day they have reached over 60,000,000 units, which is to a very great extent due to cooking.

We have gone so far as to give free connections to domestic consumers. The more one encourages the use of domestic electrical apparatus the greater are the prospects of the Electrical Undertaking.

Councillor Morrell (Capetown) : Speaking as a Councillor Member, I feel there is not much left for me to say after Mr. Swingler has spoken, as on reference to my notes, I find we have been thinking alike. But arising out of the remarks of Mr. Nelson that they had made a loss of 25 per cent, I do not think that is anything uncommon with new ventures in commerce, because I know of commercial houses which have made a loss of over 25 per cent; and in looking for a reason, one usually finds it is due to a lack of organization and vision as to the potentialities in the selling of essential appliances which has brought this about more than anything else. During the period of ten years which elapsed from the inauguration of their Electricity Undertaking to the time when the Paarl Municipality commenced to take a bulk supply from the Commission their sales of electricity had grown to approximately 528,000 units per annum, and it is interesting to know that during the next period of ten years to date while they have had an abundant supply of electricity available to them from the Commission's system their sales of electric energy have increased to something in the neighbourhoood of 9,000,000 units per annum. On looking around for an explanation of the reason why the Municipality is not selling as many domestic appliances as one would expect one is forced to the conclusion that they have not put the same amount of energy and vision into the development of that side of the business as they have to the industrial side.

Relief of Rates :

Mr. Swingler put forward the question of the relief of rates. I must say, speaking as a member of the Electricity Committee of the City of Capetown, this question has been thoroughly investigated and we are convinced that such a system is wrong financially, wrong in equity and in all respects. As has been illustrated the system of loans which the public subscribe to for the purchase of electrical producing plant ranging over a period of years in one case of 60 years, is wrong. Long before such a period expires the plant is of no use whatever and I think any profit an electrical undertaking can make should first be applied very rigidly to obsolescence and reserve.

In these days of advancement in science—and I will leave the scientific side to you, gentlemen—one cannot foretell what immediate demands may be made upon electricity concerns, either municipal or commercial; and if proper provision is not made with regard to it, we can see at some later date, the ratepayers being called upon not only to pay a rate which would cover all the amenities of the city—all the extra improvements which they require but a special rate to cover and reimburse the Electricity Department's funds, which they have from time to time contributed to general rates account connected with any particular municipality.

I think the principle as now adopted entirely wrong. At a special enquiry held in the City, very eminent accountants and gentlemen of distinction were unanimous in the opinion that it was a wrong principle. I need not go into the details of their report, but there can be no doubt about it. Recently in a debate in the Council Chamber in Capetown, it has been most forcibly brought to the notice of Councillors. Dr. Aiken who, I think, is accepted as a very prominent man on figures and finance, issued a report deprecating the allocation of electricity funds for the relief of rates. That is a very serious situation and I am sorry that at this late period of the Convention we cannot spare much more time to go into the matter.

We Councillors come up here because we like to know who we are mixing with in the many ramifications of our electrical undertakings, and we do feel—at least, I do—speaking personally, that if your Conference was split up into two sections and your purely technical side taken on a separate date it would be an advantage—I am not saying that with any disrespect, but if the portion of the Conference dealing with municipal matters was taken at a different time, Councillors could then do their job and get back to their headquarters. I like to listen to you, but I feel I could do better work by studying the question of the relief or non-relief of rates, as applied to your particular industry if same was separated from the purely technical side.

I was hoping that some other member of the Convention would second Mr. Swingler's proposal, but it has not yet been done. However, I have very great pleasure in seconding the proposal put forward by him, namely that this Conference should support a recommendation to the Administrator or the Government that legislation be passed prohibiting the relief of rates from the profits of any electricity undertakings controlled by municipalities, such profits when realised being applied entirely to the interest of the undertakings. I thank you, Gentlemen.

The President : I think it might be a good thing to put the proposition. We are getting toward the end of the Convention. There has been a proposition put before this Meeting, and seconded. I feel we should confine any further discussion by each speaker to not more than five minutes. This is necessary in order to complete the Convention proceedings in time.

Councillor J. J. Coetzee (Springs) : If this recommendation or resolution which has been proposed is adopted, may I suggest that you collaborate with the Treasurer's Departments with regard to that, and I would suggest, if this resolution is about to be put and adopted, that you do not act entirely on your own, because the various Municipalities have their view and are entitled to be heard. If it is adopted, I suggest you should do so in conjunction with the Treasurer's Departments of the municipalities.

The President : I now call upon Mr. McWilliam to present his paper.

Testing of Coal, Ash and Water at the Pretoria Municipal Power Station.

By E. A. McWilliam, B.Sc. (Eng.)
Engineering Assistant, Electricity Dept., Pretoria.

The analysis of coal ash and water is of importance in checking the operation of a power station. It is hoped therefore that these notes on the testing of coal, ash and water as carried out in the laboratory of the Pretoria Municipal Power Station will be of interest.

The laboratory is a recent addition to the power station. It was built and equipped during the 1933 extensions and came into operation late in 1935. The equipment was recommended by the Consulting Engineers, Messrs. Merz and McLellan.

Wherever possible attempts have been made to estimate the magnitude of the errors in the results of tests and the accuracy of measurements in conjunction with which they are used. The results of tests are then expressed only to the accuracy the tests and measurements warrant. In this way a great deal of unnecessary labour has been eliminated. For instance if the error in the determination of the overall thermal efficiency is two per cent., which is not unusual, it is of little value calculating its value to two decimal places and expecting it to show up minor alterations in the operation of the plant.

COAL :

The coal burnt at the power station is a mixture of peas and duff from the Coronation and Schoongezicht Collieries in the Witbank district. The coal is screened at the collieries through a ¾″ sieve and over a $\frac{3}{16}$″ sieve, the percentage duff in the coal therefore depends on the wetness of the coal as screened.

A weighbridge has not been installed at the power station, the weight of coal received being taken as the invoiced weight. The coal is stored in a concrete bunker where the stock, which is normally about 3,000 tons, can be measured fairly accurately. In any case since the changes in stock are small, the level of the coal in the bunker seldom alters by more than a few feet, and the error in the measurement of the coal burnt over the period of one month depends to a large extent on the accuracy of the invoiced weight This is assumed to be about one per cent because it has been found that over a long period the coal burnt according to the coal meters has agreed to within one per cent with the coal burnt as calculated from the coal received and the change in the coal stocks. In this connection it might be mentioned that the coal is wetted before firing but the constants of the coal meters have been adjusted so that they record the weight of coal on the 'as received' basis.

Sampling :

The accuracy with which coal is sampled is usually difficult to determine. According to the British Standard Specification No. 420 the weight of the sample to be taken does not depend on the weight of the coal sampled, but upon its ash content and the size of the coal. This is true provided the sample is collected in a sufficient number of equal increments spread uniformly over the coal to be tested. The specification states that if in sampling one inch slack containing between 10% and 15% ash, a sample weighing 170 lbs. is collected in 2 lb. increments, the ash content of the sample will be within one per cent of the average ash content of the coal. If the calorific value of the coal is proportional to the combustible in the coal then the calorific value of the sample should be within one quarter of one per cent of the calorific value of the coal supplied.

The coal sampling at Pretoria is based on these lines. The samples collected from the trucks are accumulated in large oil drums with air tight lids, a separate drum being provided for each coal. At the end of the week the samples are reduced to 5 Kg. by quartering. Each sample is then air dried on a tray in the laboratory. The superficial moisture is calculated from the loss in weight obtained by weighing the sample before and after drying to the nearest gram on a Beranger pattern balance.

The whole of the 5 Kg. sample is then quickly ground in a motor driven sample grinder. In this Sturtevant grinder the coal is reduced between two manganese steel discs, the fixed disc being bolted to a swing door which when opened allows the interior to be easily cleaned.

The sample which would now all pass through a $\frac{1}{8}''$ sieve, is quartered and reduced to one quarter lb. weight and ground in a coffee mill to pass through a 32 mesh sieve. Care is taken to see that this mill is thoroughly cleaned after grinding each sample.

This final sample which is kept in a tightly stoppered bottle is tested for inherent moisture, ash and volatile content and calorific value.

Inherent Moisture :

The inherent moisture is determined by drying 1 to 1.5 gms. of the coal in a hot air oven. The oven is provided with a temperature regulator by means of which the temperature is kept constant at 100 degrees C. The coal is weighed to a tenth of a milligram in a silica tray with aluminium cover. The percentage moisture content can therefore be calculated from the loss in weight, after heating in the oven for a period of one hour.

The total moisture in the coal as received is calculated as follows where—

S = percentage superficial moisture
and I = percentage inherent moisture.

$$\text{Percentage total moisture} = S + \left(\frac{100 - S}{100}\right)$$

Volatile and Ash :

For heating the coal in the determination of the ash and volatile content, a Wild and Barfield electrically heated muffle furnace is used. This furnace is provided with an excess temperature cut-out and the usual temperature regulating resistance. An electrical pyrometer is used for standardising the temperature at which the volatile content is read.

In the determination of the ash content a quantity of from 1 to 1.5 gms. of coal is weighed to the nearest milligram in a flat silica tray. This tray is placed in the furnace whilst the latter is heating up in order to prevent mechanical loss due to the sudden evolution of the volatile matter. The percentage ash content is calculated to one decimal place from the weight of ash remaining after complete ignition of the coal.

In all these tests the hot crucibles are allowed to cool in a desiccator with sulphuric acid as the drying agent, and the weighing is carried out as quickly as possible, to prevent the absorption of moisture.

The volatile content of the coal is calculated from the loss in weight (corrected for the loss due to the inherent moisture when one gram of the air dried sample is heated for 8 minutes at 900 degrees C. The coal is heated out of contact with the air in a silica crucible with loose fitting silica plunger and lid.

The coal is weighed to the nearest milligram and the volatile content is reported to one decimal place.

Calorific Value :

The calorific value of the coal is measured in a Mahler Bomb Calorimeter of the latest type with direct motor driven stirring device. The error in the tests made is less than one per cent, the the actual error being unknown because the Beckman thermometer used for measuring the temperature rise has not been standardised.

In this connection attention is drawn to the fact that tests carried out in accordance with the S.A. Standard Specification Nos.— 1924 are reported to four significant figures although the permissable error in the determination of the calorific value is one per cent.

Thermometer corrections are calculated from the formula due to Regnault. (1) The reason for using this formula in place of that recommended by the S.A. Standard Specification is that the latter is based on a combustion period of three minutes and the combustion period of the bomb in question is eight minutes.

The calorific value of the coal is calculated as follows from the weight of coal taken and the corrected temperature rise—

Calorific value in B. Th. Us.

$$= \frac{\text{Bomb constant X temp. rise.}}{\text{Weight of coal.}}$$

The bomb constant, which corresponds to the water equivalent of the calorimeter and its contents has been determined by means of Benzoic Acid (6,324 calories per gram) and Dr. Roth's oil (10,992 calories per gram). The bomb constant obtained from the standardising tests is reduced by 0.5% before using in the above formula in order to allow for the sulphur in the coal burning to sulphur trioxide in the bomb.

The bomb calorimeter tests give the heat value of the air dried coal and the calorific value of the coal as received is then calculated to three significant figures as follows :—

$$\text{Calorific value of coal as received} = \text{Calorific value of air dried coal} \times \frac{100\text{—per cent total moisture}}{100\text{—per cent inherent moisture.}}$$

ASH :

In order to determine the combustible remaining in the ash separate samples are taken daily of the ash sent to the dump from the two boiler houses. The samples are ground in a Cort Mill and reduced to about two lbs. weight. The samples for each boiler house are accumulated in separate drums. At the end of the week the gross samples are well mixed, reduced to $\frac{1}{4}$ lb. weight and ground to pass through a 36 mesh sieve. These samples are dried in a hot air oven at 100° C. and cooled in a desiccator. One to two grams of a sample is heated slowly to red heat in the muffle furnace, the loss of weight being taken as the combustible in the ash.

The ash loss is calculated as follows where—

A = Prcentage ash content of coal
and C = Percentage combustible in the ash.

$$\text{Ash loss} = \frac{100\ AC}{(100 - A)\ (100 - C)}.$$ the assumption being made that the calorific value of the combustible in the ash is the same as that of the combustible in the coal.

WATER :

Before discussing the water tests carried out at the Power Station the feed system and water treatment will be described.

Make up and circulating water are taken from the Power Station Dam. The analysis of the water varies, the main salts in solution being as follows :

Calcium Carbonate	—	5.5	grains per gallon as CaCo3.
,, Sulphate	—	2.0	,, ,, ,, ,, ,
Magnesium ,,	—	7.5	,, ,, ,, ,, ,
Total Hardness	—	15	,, ,, ,, ,, ,

The p.H value is about 7.3

Originally the calcium and magnesium were present only as bicarbonates, but they have been partly converted to sulphates by the effluent entering the dam from the S.A. Iron & Steel Works.

The make up water is pumped to a Kennicott Water Softener where it is treated with lime and soda with alum used as a coagulant. Softening reduces the hardness to three to four grain per gallon (soap test). The water is then fed to evaporators and the distillate passes into the feed system or to the reserve feed tank. When returning water from the reserve feed tank to the feed system it is normally fed into the condenser of a turbine on load in order to deaerate it.

The condensate from the turbines is heated to 140° F. in the feed heaters and it then passes to the balance range connected to the feed pump suction range and the hotwell.

In order to prevent scale formation due to salts entering the feed system through Condenser leakage and in addition to inhibit caustic embrittlement the feed water is conditioned with Trisodium phosphate. A solution of this sodium phosphate is added almost continuously to the feed pump suction range through a small vent pipe carried above the hotwell level. The quantity of hydrated trisodium phosphate added to the feed system varies but is usually about 2.4 parts per million which corresponds to 0.6 P.p.m. of the PO4 ion. In this way the soluble phosphate content of the boiler water is kept in excess of 40 p.p.m. of PO4 this concentration being obtained initially by the addition of a definite quantity of sodium phosphate to the boiler drums when they are filled.

Up to the present no trouble has been experienced with feed line deposits, which may take place with phosphate conditioning due to the low solubility of calcium phosphate. This is possibly due to the low concentration of calcium salts in the feed water.

It has been found necessary, however, to replace the asbestos gaskets originally used on the boilers with steel cased gaskets since the former were attacked by the sodium phosphate. For the same reason it eventually became necessary to replace the earthenware water alarm floats with iron floats.

The main tests carried out on the water samples are as follows—

Dam Water :

The dam water is tested at least twice a week to determine the alkalinity, hardness, and pH value.

The pH value is measured in a Lavibond comparator in which the colour produced in the water sample by the addition of a measured quantity of indicator is compared with standard colour slides suitable compensation being made for the initial colour of the water. The slides are arranged to read the pH value in steps of 0.2 pH.

Soft Water :

Tests for the alkalanity, causticity and hardness of the soft water are made daily in the usual way in order to determine the charges of lime and soda required for the softener.

Owing to the fact that the water contains a large quantity of magnesium it has been found necessary to keep the causticity of the soft water well in excess of half the alkalinity in order to reduce the hardness to 3 grains per gallon and to prevent the after precipitation of the magnesium salts. This means that the concentration of salts in the soft water is high with the result that the evaporators have to be blown down frequently to prevent priming. The use of sodium aluminate in the softening process is being considered since it is claimed that its use gives a water with low residual hardness with minimum excess alkalinity.

Feed Water :

The condition of the feed water is checked by testing samples taken regularly at various points in the feed system with a Dionic conductivity meter.

The pH value of the feed water at the feed-pump discharge is also taken at frequent intervals. The average pH value is about 8.5.

The oxygen content of the feed water is measured by means of the Winkler test and is less than 0.05 c.c's per litre. In order to determine this, more accurate tests are to be made in future by means of a modified Winkler test (2). In this test the titration with sodium thiosulphate which requires frequent standardisation, is omitted. After the addition of the manganous sulphate, alkaline potassium iodide, sulphuric acid and starch solution, the sample is heated to 115° F. The starch solution is then added and the sample is cooled until the characteristic iodine-starch blue colour appears, when the temperature is taken. The oxygen content is read off from a curve relating the oxygen content to the temperature at which the blue colour appears. Provided that care is taken in the preparation of the sample and an allowance is made for the oxygen added with the reagents it is claimed that the error in the determination of the oxygen content need not exceed 0.004 c.c.s. per litre.

Boiler Water :

Since the adoption of the phosphate conditioning of the feed water two years ago no scale has formed in the boilers and in addition no corrosion has been noted. A pinkish colour deposit consisting mainly of iron oxide with some calcium phosphate and magnesium hydroxide is however found on the drums and tubes.

Due to the fact that the water is first softened and then evaporated the quantity of phosphate required is small and no internal coagulant is required to precipitate the calcium phosphate to prevent priming.

The chief salts in solution in the boiler water are sodium hydroxide, sodium carbonate, sodium phosphate and sodium sulphate. There are no chlorides present. The sodium sulphate is formed by the interaction of the sodium phosphate with the calcium and magnesium sulphate is sufficient to prevent caustic embrittlement.

Boiler water samples are taken from the new Yarrow boilers by means of sampling devices connected to their blow-down systems which makes it possible to sample any one of the four drums. Samples from the remaining boilers are taken from the gauge glass drains.

The following routine tests on the boiler water are carried out.

(A) Concentration :

The concentration of the boiler water is checked by means of a dionic conductivity meter.

(B) Caustic Alkalinity :

The boilers operate at a pressure of 360 lbs. per square inch therefore, the decomposition of the sodium carbonate formed by the interaction of sodium phosphate and calcium carbonate is practically complete. It takes sometime however, for the sodium hydroxide to give a hydroxyl concentration of 100 p.p.m. which is that required to ensure that all calcium shall be deposited as tri-calcium phosphate and not as dicalcium phosphate which is not only slightly soluble but requires more phosphate to deposit the same quantity of calcium (3). It is therefore, possible that the addition of caustic soda to the feed water will have to be considered. This will have the advantage of raising the pH value of the feed water and thus preventing feed line and economiser corosion.

The sodium hydroxide content of the boiler water is not allowed to exceed 50 grains per gallon.

The sodium hydroxide and sodium carbonate contents of the boiler water are determined as follows :—

Seventy c.c's of water are first titrated with N/10 nitric acid using phenolphthalein indicator. The titration is then repeated with another 70 c.c.'s which have been previously shaken with 15 c.c.'s of 10% Barium chloride solution in a rubber stoppered bottle. If A. and B. are the c.c.'s of acid used in the two titrations then the

Sodium hydroxide = 4B. grains per gallon.
and Sodium Carbonate = 10.6 (A—B) per gallon.

No allowance is at present made in these titrations for the presence of trisodium phosphate.

(C). Sulphates :

The accurate determination of the concentration of the SO_4 ion is unnecessary and it is, therefore, obtained by comparing the turbidity of 100 c.c.'s of boiler water suitably diluted, with that of the same quantity of standard sulphuric acid solution, the turbidity being produced in each case by the addition of Barium chloride solution followed by vigorous agitation. (4). A simple platium wire tubimeter is used and the tests are carried out in a Nessler cylinder.

(D). Phosphates :

It has been found that the concentration of the SO_4 ion in the boiler water seldom exceeds 250 p.p.m. therefore, if the concentration of the PO_4 ion is kept in excess of 40 p.p.m. to inhibit caustic embrittlement, the formation of scale is also prevented (5).

The PO_4 ion concentration is estimated by comparing the yellow colour produced in a boiler sample with that produced in a standard phosphate solution by the addition of a solution of ammonium molybdate and nitric acid.,

Silica interferes with this test but up to the present the silica content of the boiler water has been negligable. Check tests for the phosphates content are however made.

(F). pH Value :

The pH value of the boiler water is measured by means of the Lovibond comparator using Alizarin Yellow G. indicator. The pH is normally above 11.

References :

(1) British Standard Specification No. 420.

(2) "Determination of Oxygen in feed water" A. C. Dresher, Combustion, May 1936.

(3) "Trisodium phosphate" N. Hall, Power Engineer, Sept. 1933.

(4) "Examination of Water and Water Supplies." Thresh, Beale and Suckling.

(5) "Embrittlement in Boilers" F. G. Straub, University of Illinois, Bulletin 216.

DISCUSSION :

The President : As pointed out by the author, the analysis of Coal Ash and Water, is of great importance in checking the operation of a Power Station. The Pretoria Municipality is to be congratulated on its progressiveness in adding a laboratory to its other attainments. Our thanks are due to Mr. McWilliam for his very lucid and detailed description of the methods employed, and their results. The paper is open for discussion.

Mr. G. C. Brown (Volksrust): There is one question I would like to ask. In the earlier part of the paper, mention is made of wetting coal. One can understand wetting coal when only duff is used, but one would hardly think it necessary when it was mixed with peas. I would like to know the reason why coal is wetted at the Pretoria Power Station?

The Author, in reply to Mr. G C. Brown, said: The coal is wetted at the Pretoria Power Station in order to obtain satisfactory ignition of the coal in the boilers with Bailey water cooled furnace walls. The total moisture content of the coal as fired is normally between 7% and 8% and the stack loss due to this moisture is approx. three quarters of one per cent. This loss is more than compensated for by better combustion resulting in a reduction of the ash and stack losses.

RELIEF OF RATES.

The President : We will now turn to the resolution, moved by Mr. Swingler and seconded by Councillor Morrell of Cape Town. The proposition is that :—

> "This Convention once again desires to bring to the notice of the Authorities, municipal and provincial, the adverse and detrimental effect of the practice of taking profits derived from municipal electricity undertakings for the relief of the general rates, and urges that steps be taken to obtain the necessary legislation to limit such contributions, as now apply 'overseas.' "

Councillor Allison (Pietermaritzburg): Speaking to that resolution, I would first of all like to point out, that, according to the Constitution of this Association, it can be claimed that Councillors vote separately from engineer members; and I think you will agree that that is wise. I think it will also be well for you to refer to the list of members attending this Convention; you will find on the list 35 Councillor members, and 58 others —there are one or two more; there are six or eight for Johannesburg; I have not included those, they are not present. There are 37 Councillor members and 58 Engineer members; which shows that the Councillors could be out-voted all the time. Then you have 33 Engineering Trades Representatives, and 8 Associate members.

The President : The latter have no vote.

Councillor Allison (Pietermaritzburg): That may be so, but at every Convention I have been at, I have never noticed or seen that there has been a call for a division so that the different members could be separated; and yet it is provided in you Constitution that any member can call for a sectional vote on any particular subject. I think it is wise before we proceed to vote on this, that that fact should be known.

Secondly, there has been no notice given that the matter was to be under consideration and it was not placed on the Agenda. Therefore, Councillor members who came, did not come prepared to speak or put forward points one way or the other on this particular subject.

At the last Convention at Pietermaritzburg this matter was brought up, and it was agreed that it should be referred to the individual Councillors of each Municipality to be dealt with; I think we want to be very careful in this matter. I do not think it is quite fit and proper that a matter of this sort which is very far-reaching and has important implications, should go direct from an engineer's convention to the Provincial Councils. I think, if it is going to be dealt with at all, a recommendation from this Conference should go to each individual for the Councils themselves to discuss it, and then put it forward, if necessary, to the Provincial Councils. But for a resolution to go direct from an Engineering Conference over the head of the Councils whom the engineers serve and represent I think would not be quite fair, and I think it may, in some instances, cause a little friction. I am sure it is the last thing in the world that this Engineers Conference desires, that there should be friction between its officials and the Council. Therefore I would appeal to the member who has moved this motion to withdraw it. I personally am in favour of tariffs being reduced—in fact, it is only a few months ago that I moved a resolution in that direction; but notwithstanding that fact, I think it may do this Association more harm than good if such a resolution were forwarded direct from this Conference to the Provincial Councils and I am more than sure that the Provincial Councils would not take the same view of it, as if it came from the Councils. True, it will not bring, perhaps, any finality, but nevertheless I would appeal to the mover to withdraw the resolution.

Mr. Swingler (Cape Town): With the seconder's permission, I would like to withdraw the word "Provincial"; that it would go to each Council first, and not the Provincial Council. I take it that would meet your point?

Mr. Allison (Pietermaritzburg): Yes.

The President: It is now suggested the proposal be amended. It is open for any discussion. It is an important point.

Councillor D. Nelson (Paarl): With reference to taking money from the Electricity Department for the General Account, we all know that the profit brought in by Water, Abattoir and other departments goes to the General Account, and I think that the General Account is entitled to some revenue from the Electricity Department. The only thing I would like to say is that there should be a basis of contribution, say 5% on Gross or nett profit, whereas at present a sum is taken from the Electricity Department without any basis at all. I would therefore like to see that Mr. Swingler bring this matter up in the Executive Committee as to what percentage the Electricity Department should contribute to the General Account.

The President: On a point of explanation; the resolution really covers the point you are making. It says here, "such contributions as apply oversea," where it is a matter of legislation. So you see that gives a very definite scale.

Councillor D. Nelson (Paarl): It is not, I hope, the intention of this Convention to force them into legislation. Let the Municipal Congress discuss it and come to an arrangement. On the Provincial Council they have very few representatives, and they do not know the "ins and outs" as we know them. I rather think that we should give them a lead and say on what scale we are quite prepared to work together with the Council.

Councillor Morrell (Cape Town): Might I just point out that the last clause in that resolution refers to the overseas rule, and that, Sir, lays down the limits and has a permissive clause placing no direct responsibility on any particular municipality to apply it. It lays down the scale and it might just as well be termed a permissive clause. In connection with the remarks made by Mr. Allison, might I suggest, with the mover's permission, that we say, "Municipal Councils and United Municipal Associations." That means that when the United Municipal Association meets, all these members of the Association will have a further chance of discussing it.

Mr. Swingler (Cape Town): When I said, "overseas," I know it is not always palatable to say, "Great Britain"; but I had in mind the Electricity Supply Act, 1926, of Great Britain, which lays down the procedure; and once you have sufficient reserve, you can contribute up to 1½% of the net total capital indebtedness; it is all laid down. I did not think it policy to mention, "Great Britain."

The Secretary : Might I say that in my circular, either this or last year, I quoted the very Act Mr. Swingler refers to.

Councillor Allison (Pietermaritzburg) : I have pleasure in accepting the amendment. I think this should meet with everybody's approval, and I think we want to progress if we can. I understand that in Durban they have a similar position. I know they can only contribute a certain amount, up to 4%. So it is actually in operation at Durban at the present moment, and they cannot contribute more than that. I believe it is a sound proposition. If we could work on similar lines to that, I think we would be working towards some goal, which is perhaps desirable.

Councillor Allen (Roodepoort - Maraisburg) : That is another way of putting it; it is the question of a controlled profit on electricity supplied by or through Municipalities.

I should apologise for not being present when the matter was introduced into the discussion. I would ask that the matter be postponed for discussion to-morrow morning, so that we shall be able to put forward something that will be in the interests and for the advancement of the Electrical Industry of South Africa. It appears that a similar resolution was brought forward last year, and it came before the Council I represent. There is a danger of hastily passed resolutions being regarded as merely pious expressions of opinion. That is not the intention of this Convention. By taking four steps, instead of one, we shall achieve the best results with general civic support.

The President : We only meet once a year, and a large number of questions are brought up at the Conventions for discussion and decision; and it is extremely difficult : we do not know what members are going to bring forward. So I do not think we can quite adopt the principle that everything should be put on the agenda. On the other hand, the question of delaying decisions on this matter may be sound; that is for the meeting to decide.

Mr. H. Bahr (Klerksdorp); For your information, gentlement, I would like to point out that myCouncil took a resolution some 18 months ago to take 10% off clear profits as an extra contribution to Renewals and Depreciation Fund. I wanted 20%, but had to be satisfied with 10%.

Discussion then took place on the advisability of sending the Resolution to the United Municipal Executives as well, but was not generally supported.

Councillor Allen (Roodepoort-Maraisburg): I wish to move an amendment to the resolution. In the first place, where it says "take exception to taking profits," I would like to put in the word "unlimited," before "profits," and in the second place to ask that this Association send on the Resolution to be considered by each individual Municipality and I move accordingly.

In regard to the limitation of profits that applies overseas; is it on the basis of the overseas limitation? which I understand is a very small percentage. It seems to me that we should get further in this matter if a lead were given to the smaller Municipalities who buy in bulk. If you allow this resolution to go forward, I am afraid that you will not get even a short step further. This Convention is a very important one, and it seems to me that, in addition to passing a resolution like that, some lead should be given. If the lead is the overseas limit, then you may as well not pass the resolution at all. We do require money from the Electricity Funds to assist the General Fund; we do require it, and it must be continued in the interests of the permanent property owners of the area. I say we should go step by step, and, if the lead could be given from the Executive of this Association, may I just remind my friends from Cape Town that when the proposition was raised in regard to publicity, the question of the resolution was deferred to the responsible Executive, and, as far as I understand, a meeting was held the following morning. It seems to me that this Association should educate Municipalities; you do not do it simply by throwing a resolution at them. If this went to the Municipalities, I think the object of the Association would be achieved in the long run. Let it go either to the collective body or the individual.

The President: I might say that for two years in succession this matter has been dealt with; a letter has been sent, in these cases to the Town Clerks of the various Municipalities, setting out the resolution of the Association. You will notice the resolution itself says, "As now apply overseas." They did not want to mention any specific country. But in the letter we sent to the Councils previously we did say what the law was regarding this matter in Great Britain and also in South Africa; but in South Africa, at the moment, we have not got anything quite in line.

The President: We have a definite proposition, gentlement, moved and seconded. Is there any further discussion on this matter?

Councillor Middlebrook (Durban): I would like to second Mr. Allison's amendment.

Councillor Allison (Pietermaritzburg): I move to delete the words, "Municipal Association Executive," or "United Municipal Executive" ; I think the words are there; and, in the first instance, add, "Unlimited profit."

Councillor Allen (Roodepoort-Maraisburg): May I move that the Executive of this Association place before the Municipalities what they regard as a reasonable rate of profit for such an important undertaking as the Electricity Industry of South Africa..

Councillor Coetzee (Springs): I will second that.

The President: Would you mind repeating that.

Councillor Allen (Roodepoort-Maraisburg): That this Association recommends to the Executive that it place before the Municipalities of South Africa what, in their opinion, would be a reasonable rate of profit for Municipalities using their electricity supply for trading departments."

Mr. Swingler (Cape Town): Would not Mr. Allen's point be met if we added and left it to the Council to suggest what would be a reasonable basis on which contributions should be made.

Councillor Allen (Roodepoort-Maraisburg): I would like it to go with the resolution. I do not want to oppose the resolution; I want to supoprt it.

Councillor Coetzee (Springs): May I just explain this aspect: there is no doubt about it that Municipalities have, in the past, either with or without justification, taken profits, and in some cases huge profits, from the electrical undertakings. Whether that policy is justified or not, is perhaps not a material point at this juncture. The thing that matters, I think, is that Municipalities have committed themselves financially in regard to certain undertakings over certain periods of years, and they may have looked to the profits that have been derived in the past from Municipal undertakings. Would it be wise, at this stage, at a stroke of a pen, to say the thing is going to be altered? If such a thing is going to take place, it should be done gradually, over a period, so that one can adjust matters to the new position that is to be created.

The President: Councillor Allen has suggested we add this to the resolution :—

"And this Convention resolves, further, that the Executive Council be asked to refer to

the Municipalities what, in its opinion, would be a reasonable rate of profit having regard to the existing circumstances in South Africa."

Discussion took place on the exact wording of the Resolution and it was finally agreed to put the following Resolutions to the meeting :—

(1) That this Convention once again desires to bring to the notice of the municipal authorities the adverse and detrimental effect of the practice of taking unlimited profits derived from Municipal Electricity Undertakings for the relief of the general rates and urges that steps be taken to obtain the necessary legislation to limit such contributions as is the practice overseas.

(2) That the Council of the Association be asked to indicate to the municipalities what in its opinion would be a reasonable rate at which contributions to the relief of rates should be based.

Declared carried, with one dissentient.

The President : Before calling upon Mr. Milton to reply to the discussion on his paper, there are a few things I have to mention as a recommendation from your Council.

AMENDMENTS TO RULES.

I have to bring to your notice that, in altering the Rules and Constitution at the last Convention, we inadvertently created quite a hardship on certain of our members who unintentionally became derated. In Rule 3, it is therefore recommended we alter the one word, "member" to "honorary member" and "engineer member"; is that agreed to?— Agreed.

Further, in Rule 3, under "Engineer Members," we find to-day there is a very strong feeling that as your Association has grown considerably, and as some of the undertakings now are getting very large, is is considered desirable that some of the assistant engineers on these large undertakings should be Engineer Members instead of Associate Members. This has been discussed by your Council, and it is strongly recommended that the following be added to Rule No. 4 under "Engineer Members," "and in the case of an undertaking the sales of which are 20 million units and over, any duly qualified assistants recommended by the Chief Electrical Engineer" Is that agreed to? (Agreed).

PAPER FOR NEXT CONVENTION.

The President : One item I have to mention is that during discussion Mr. Mail offered to furnish a paper bearing on the subject of Mr. Milton's paper at the next Convention, which I will ask the Secretary to make a note of.

AFFILIATION.

There were one or two smaller items left in my hands at the last Convention: One was the suggestion that we affiliate with the Associated Scientific and Technical Societies. I have gone into the position and it has also been discussed by your Council. You will apppreciate that the Associated Societies have invested a considerable sum of money in their building, and so on. They have a club, which is licensed, and anyone utilising that club, must **ipso facto** be a member, with certain reservations regarding visitors, which apply generally to all clubs. Now, to become a member of the Associated Societies one must pay a subscription; all the members of the Affiliated Societies are liable for these subscriptions each year. Any Institution or Association that becomes affiliated is itself responsible for the payment of the subscription of all its members. So that if any member fails to pay his subscription, the Association must pay the Associated Societies to the full extent; if there are any defaulters, the Association or Institution must pay. The subscription is £1 1s. 0d. per annum for town members, and half-a-guinea per annum for country or outside members.

It was felt by your Council that there was little to be gained by the Association by affiliation over and above any facilities that we have at present. At present, as you know, we co-operate in every possible way with the Associated Societies; you nearly always have one of your representatives on any committees formed there, and you really are fully represented. We cannot visualise any great benefit, more especially to our country members who perhaps do not visit the Associated Societies from one year's end to the other, and we feel it is impracticable to join. It would mean that each of you who lives in this City would have to pay an additional guinea each year over and above your present subscription and that those who live away from this centre would have to pay an additional fee of 10/6d. Your Council recommends that this matter be dropped for the present. (Agreed).

There is one other matter, that of Status. It arose out of a committee formed by the Associated Societies. That Status Committee is still at work. The matter has not been made public, but I can assure you a lot of very useful work is being done and any result attained will presumably be beneficial to this Association. You are represented on that committee by some of your members who are affiliated by reason of being members of other affiliated institutions. Your Council recommends that you leave the Status question to that Committee for the present. (Agreed).

I will now ask Mr. Milton to reply to the discussion on his paper.

The Engineering Aspect of Small Municipal Electricity Undertakings.

by W. H. Milton.

REPLY TO DISCUSSION.

Mr. President and Gentlemen. It has been very gratifying to me to receive so much discussion and criticism and, in some cases, support. I am, however, in the very fortunate position of having the last say.

Several of the points raised are to be explained by the system of control of Municipal Undertakings, viz., by Municipal Councils. A Municipal Council is in a difficult position as regards the control of any of the revenue earning departments of a municipality. The successful control of a business cannot be placed in the hands of gentlemen who hold office for one or two years, and who are liable to be displaced from time to time. Unless there is a very definite continuity of control the general policy of any commercial undertaking cannot be well established or clearly followed. Many of the controversial subjects which arise in the control of electricty undertakings, I think, are due to the changing control personnel.

In reply to Mr. Muller, the cost of reticulation per consumer apparently present a difficulty when designing a scheme, but when consumers in outlying districts are approached with an effective tariff indicating suitable minimum of a contribution towards the capital cost of the scheme a refusal of the terms would result in reticulation of outlying districts being avoided until the development of the area concerned warranted reticulation. If the required terms are accepted there is no difficulty on the score of cost.

Mr. Horrell's remarks in connection with Hercules were of particular interest in this regard.

Mr. Muller's remarks regarding a "restricted hour" service is very true, and it was one of the features which led me to suggest in my paper that automatic plants might be considered to get over some of the difficulties. Where such schemes are established, of course, there is no doubt that, electricity being self-advertising, the consumers will in time demand continuous supply and will be quite willing to make that supply possible.

As regards Mr. Muller's reference to the Ogrobis Falls, these are a long way from any material load, and, whilst many of us are apt to think that the establishment of a power station or a source of power will automatically establish industries. That, unfortunately, is not true in the commercial world, except in very exceptional circumstances.

Mr. Muller condemned the use of small sets in municipal undertakings without mentioning the size. I think he was criticising the small set mentioned in my example, and if so, I agree. I put forward the alternative of three 12½ K.W. sets and a 5 K.W. set. I would be inclined to leave the proposal at three small sets if possible. Had I not included a small set (of the order of 5 K.W.), criticism would have immediately been levelled at me on the grounds that I was avoiding capital just to prove my argument. Actually the small sets used throughout the country are of considerable service during the short period of their actual usefulness, provided they are installed with sufficient foresight. The selection and installation of a small set should be based on a very definite knowledge of local loading conditions. There have been cases, of course, where small sets have been installed and the undertaking has been supplied with step-up and step-down transformers and the use of high tension transmission. Where such plant and apparatus is to be used, another difficulty, other than that of actual power capacity of the small set is that the power factor at times of light load on such a scheme is extremely low, and a small set may be loaded electrically without being loaded mechanically.

He also commented on my suggestion of an oil plus steam station, and recommended that plants of that type should only be introduced when oil plants were in existence in the first place. Very few municipalities in this country commence with an electricity undertaking at that stage where 150 to 200 K.W. of load is in sight within a reasonperiod; the majority have commenced with the prospects of loads of 10, 12, 25 and 50 kVA. My suggestion had in mind that oil plants would be in existence and that the existing oil sets, or even an additional oil set with steam plant, would assist in tiding over the critical period referred to in my paper and ultimately establishing a complete steam station. The principle of utilising oil engines for peak load, I do not think can be condemned on the failure of one particular application.

Mr. Bahr deprecated the insertion of a rejection clause in the specifications. I personally would not go so far as to say that a rejection clause is useless. To my knowledbe a rejection claus saved one municipality from a disastrous purchase.

He also criticised my suggestion of the use of fire-tube boilers. I made that suggestion hoping that more criticism would come forward in regard to the efficiency and operation costs and difficulties of maintenance as between water-tube and fire-tube boilers. By fire-tube boilers I did not necessarily have in mind the locomobile unit.

Actually, as pointed out in the paper, the principle item militating against the initial adoption of steam plant, is its first cost, and there are cases where a decision is difficult in view of the possibility that councillors and their friends may have been over optimistic. Towns are very jealous of each other, and towns inaugurating schemes are particularly so. You will find one town pointing to another, "They have just put in a plant of two 25 kilowat sets; we should have fifties. The engineer responsible for inaugurating a scheme must be guided by the responsible people in a municipality, as to its probable prospects, development, and business activity. The cheaper type of boiler plant does offer a near course where the more orthodox plant might involve risk due to optimism As regards the question of the difficulties of maintenance of a fire-tube boiler in comparison with the water-tube boiler, I must say that I do not agree with Mr. Bahr. Anyone who is capable of satisfactorily maintaining a water-tube plant should be equally capable of handling a fire-tube type.

As regards the revenue due to an Electricity Undertaking, if revenue offsets the cost of supply of electricity, no more should be claimed. If a council cares to, and does make profits on the sale of a secondary product, that is no concern of the electricity undertaking.

As regards the question of insurance as an alternative to a contribution to reserve fund, that, gentlemen, is a point on which I am not prepared to express an opinion. The value of an insurance service is always very difficult to assess.

Mr. Nelson pointed out that, in comparison with other developments, his municipality had increased from 300,000 units to 9,000,000 units; and he made a particular point there that that increase was not from domestic supplies. In my view it seems a pity that the supply to domestic consumers is not being developed concurrently with industrial sales. I personally feel that the domestic supply should receive as much consideration as the industrial development.

Mr. Nelson stated that, as far as domestic sales were concerned, he made a loss of 25%. This is a surprising statement and calls to mind criticism levelled, from time to time, by some auditors against contracts and tariffs for the supply of electricity. I have found that in most instances such a "loss" is arrived at by comparing the lowest rate in the tariffs with the average cost of generation per unit sold. Such a comparison may be very misleading. Here I would appeal to your Councillor members to appreciate that the sale of electricity as a commodity is entirely a specialised art. There are many cases where electricity is sold at an appreciable profit though on a basis of average it would appear a very definite loss is being incurred. Having these aspects in mind I would question Mr. Nelson's statement that his domestic supplies are sold at a loss of 25%, and I would ask him what effect it would have on his revenue and expenditure position if he did not supply those domestic consumers? He would probably find that they are profitable people after all. This latter method of analysis, by the way, is also dangerous, because, after all, you cannot examine any given section of your consumers, from a Revenue and Expenditure aspect, without studying also the expenditure on assets, and an analysis of this nature becomes a difficult task in most instances. One must have some regard as to the reason for the initial installation of plant and service mains. The people or purposes for which the plant is primarily installed may reasonably be expected to pay the principal cost.

Incidentally, in regard to my earlier reply to Mr. Nelson, in connection with the stove load and possibly selling the current for the purpose at 1d. a unit, Mr. Swingler in mentioning a similar aspect later, indicated that in Cape Town the average units used per consumer for electrical cooking over a large number of ranges was 245 units per month. He also mentioned that the additional number of units required for water heating was 155. The figure of 240 is a very common one, and you will find it frequently confirmed. Mr. Nelson also mentioned that he did not desire to spend additional money on reticulation. Actually, the surplus from development of the domestic load should be more than sufficient to cover capital charges on additional capital outlay in distribution. It seems however, to be a not unusual feature in municipal schemes that councils are afraid to provide capital to give future service. The general practise seems to be that of following up a development when it becomes compulsory to do so, rather than anticipating requirements and fostering development of the undertaking.

Incidentally, for Mr. Nelson's benefit, I would again mention the factor of diversity which was so strongly emphasised by many of your members, and I would point out that no Municipal electricity undertaking could carry on satisfactorily unless there was diversity.

Mr. Runtzler mentioned he had had very considerable experience of fuel, steam and oil plant, and I was pleased to hear that he supports the use of small Diesel Oil Plants for the smaller undertakings. He even went so far as to say he would prefer to operate an oil station at a slightly higher cost than a steam station, in view of certain facilities offered by the oil plant for quick starting and quick trasnfer of load.

In regard to Mr. Mortimer Mail's contribution, I was very pleased to learn how closely my estimates approximated his actual conditions.

Mr. Wright confirmed that the development of the domestic load would be financially satisfactory to a Municipality buying in bulk even though the domestic load had an "on peak" incidence. Mr. Wright is paying, of course, on a two-part tariff similar to that which rather worries Mr. Nelson.

I would like to thank Mr. Swingler for the manner in which he so ably indicated the advisability of developing the domestic load; and I must say I was very pleased to hear him say that, whilst he had been an opponent of these developments in earlier years, he had fully appreciated the folly of that opposition, and that he is now perfectly willing to admit that he was wrong in the past, and that the development of the domestic load is of vital necessity to the successful development of the smaller undertakings which are not entirely industrial.

I must thank Mr. Ritson for his confirmation of the effect of the development of a domestic load on the general development of an undertaking and its financial prospects.

It was pleasing to note from Mr. Horrell's discussion that the Pretoria Municipality appreciated the advisability of forestalling development and keeping if possible well ahead of the demands on the reticulation net-work. Consumers then, are in the position to develop their use of electricity freely and without hindrance.

As regards Mr. Clutterbuck's discussion; I must say I was quite aware of the fact that the Factories Act and the Mines and Works and Machinery Act, do not provide for such a type of plant being made use of in this country. To my mind, however, there is no reason why some step should not be taken to amend or modify an Act if it is shewn to stand in the way of development. The chief objection raised to the use of these automatic plants is the lack of effective control on the distribution net-work, and not the generating plant itself. As far as that is concerned, however, I cannot see how effective control of the reticulation net-works in the Union is being achieved today when the plant installed is less than 250 horse power; (incidentally, such a plant is far in excess of anything I visualised for automatic operation. What I had in mind was plant of the order of say, 8, 10, 12 kilowatts, maximum load, that is a matter of 20 to 25 horse power of plant and not 250).

Where such small plants are installed and a staff is employed by a municipality, wages offered are usually so low that the competency of the men finally employed is naturaly doubteful. I do feel very strongly on that aspect; when a municipality is so small as to need only a 12 kilowatt plant, it is obvious that the total revenue must be insignificant—so insignificant that it is impossible for such a municipality to employ a really satisfactory man to look after its undertaking.

Even in connection with a larger plant, where they do feel that they can employ someone, and where they are shall we say, working to very fine limits, the type of man employed is hardly likely to safeguard the community by his care of the reticulating net-work and house services, and, if the Act is to be as effective as it is desired, it does seem to me it should be amended to give someone the power to ensure that the personal in charge of plant of lower rating than 250 horse power is competent when it comes to the question of operating municipal undertakings.

I personally cannot see how even a skilled man can prevent accidents on the distribution net-work of electricity undertakings, and I would have been pleased to have heard from Mr. Clutterbuck the type of accident that he had in mind. Presumably however, the accidents usually arise from the house service connections, between the nearest pole and the roof, possibly in the vicinity of the swan-neck or leading-in tube. To my mind that difficulty could be overcome on "automatic" schemes ensuring that before any house service connection was energised it should be inspected by a competent person. Once it is inspected and passed, it should not require continual observation to ensure that it remains safe. I doubt very much whether any municipal electrical engineer makes an inspection of house service connections at less frequent intervals than once a year; it is probable that they do not get looked at at that frequency therefore, after a net-work has been passed and the house service connection has been passed, it only needs such inspection as the Government provides for safe boiler plant to ensure that the safety of the community is maintained. If, therefore, that is the difficulty visualised by the Chief Inspector of Factories, I feel it can be overcome and automatic plants could be introduced into small undertakings. It should be at the discretion of the Chief Inspector of Factories at any time to demand that a competent engineer should take charge, and in these circumstances his fears as regards the improvement of labour conditions in the country are groundless.

The automatic plant should result in the development of loading to such an extent that larger plant is required, or plant extensions become necessary. I think the Chief Inspector of Factories could then step in and say, "Before that plant is installed, you must employ a competent engineer"; and it rests in his department's hands to see that the labour position is not prejudiced, but rather assisted by the introduction of such plants and ultimate development of employment.

Mr. Allinson rather indicated that with engineering plant installations, we should provide for a large number of years without involving expenditure on extensions. In my opinion, I am satisfied that the most economic period to provide for without additional steam and oil engine plant being required is in the order of five to six years. It is very difficult to visualsie conditions beyond that stage, and, in any case, if plant is to be installed which has to remain without further extension for ten, fifteen or twenty years, it is clear that the scheme will be over-capitalised and will probably develop serious accumulated deficits in the long run. It is far wiser to buy in small quantities at frequent intervals, than in one large quantity now, and then draw from stocks.

The subject of tariffs has been dealt with by several speakers. In my paper I made it clear that the design of tariffs must be in the hands of a competent person, having a wide experience of the subject. The sale of electricity is not as simple as the sale of most other commodities. I know many consumers would prefer to buy on a flat rate of say 1d., 1½d. or 2d.; but that is purely due to lack of knowledge of the purchaser of the commodities. I have dealt with cases where a consumer has been held out for a flat rate against a municipality which desired to put in a sliding scale, or two-part tariff. I have been able to show to the consumer that in his own interests it is preferable to take the sliding scale. Unless he is expecting to use less electricity than his stated requirements, his costs will be less on a sliding scale. If, however, he is contemplating a use far less than his stated requirements, it is up to the municipality to see that he bears a fair proportion of the cost. And, in consequence, the municipality itself would not be justified in entering into a flat rate contract without a minimum.

The next point is the vexed question of the Relief of Rates. I expected some discussion would occur on this subject, but did not think so much time would be spent. In my paper I mentioned this was dealt with exhaustively and fairly acrimoniously at Maritzburg, and I hoped to indicate that it was not my desire to spend much time on the aspect. The subject has been again fairly fully discussed and I feel called upon to reply very briefly.

I would like to point out at this stage, that I have absolutely no axe to grind in this matter, and I have nothing to gain, my views being entirely impartial. An engineer is a man who is necessarily interested in his job, whether the particular work that he is studying is his own, or someone else's—and like most of us in our respective spheres of life when we do see abuses taking place, we feel called upon to protest.

It was asked, "who brings consumers together for the electricity undertaking?" The reply was, "The Municipality." I think a little analysis of the position by the gentleman who asked and answered that question will show the falacy of his answer. Without an electricity undertaking, I am afraid many other communities in South Africa would be considerably more backward than they are to-day.

A town which I visited not so very long ago, produced evidence to show that considerable building activity would ensue within two years (under guarantee if only the municipality would inaugurate its own electricity scheme, and piped water supply. Until such times as those facilities were available, the potential residents concerned might just as well live some five to six miles away from the town with their own water supply and their own Delco sets. There was no incentive to go the town to share in paying the rates if there were no other facilities than a few streets partially made, and a few shops somewhat nearer home. The improvement of a town in any way is naturally accompanied by an increase in the revenues of a municipality from all sources, so that to say that the electricity department can only exist because the municipality is behind it, is an unjust statement though true.

A municipality's business resources and status is very largely wrapped up in the success of its electricity undertaking.

Mr. Allison quoted the population of Pietermaritzburg as being approximately 24,000 Europeans and the ratepayers approximately 3,500. From this I would assume that there would be about 4,000 to 4,500 consumers on the undertaking. It was unlikely however, that all ratepayers would be consumers of electricity.

It was also stated that increasing the rates would have the tendency of driving people away. To my mind, there is a very distinct fallacy in that argument, in that the object of that increase in rates, as suggested at this Conference, is to avoid profits from the electricity department being passed to rates, to that self-same extent. Take, for example, £15,000 from the electricity department for the relief of rates (I am not talking of 'Maritzburg, but generally), if the rates were increased to bring in a revenue of £15,000 and the electricity tariffs were dropped to avoid that profit of £15,000, the total money paid into the municipal coffers by the residents of the districts, would remain the same. (Hear, hear). If the incidence of the electricity profits from electricity revenue —is the same as the incidence of the rates. No one would notice anything, if the general rates and electricity tariffs were both adjusted. The objection does arise, however, because the incidence of rates, differs from the incidence of electricity bills.

In the circumstances therefore, it would seem to be much more equitable to the community to redistribute the revenue resources of the municipality, to ensure that charges which are normal and direct charges against a Municipality's General Expenditure should be recovered by way of rates, and that costs recoverable from the individual trading departments should be recovered from the respective departments themselves. If, of course, it is felt that the rates are an incorrect method of obtaining the general revenue required, it seems to me that some attempts should be made to direct the attention of the people responsible for the legislation to the position in order to revise the present municipal taxation laws and not adopt the present subterfuge to overcome the difficulty, if difficulty there is.

I quite agree with Mr. Allison that where a municipality has evolved its electricity undertaking at the expense of an accumulated deficit, the deficit is a direct charge against the electricity undertaking and should not be written off and forgotten; it is a cost which should remain a debit against the municipal undertaking, together with all costs of financing the deficit, such as interest, etc. It is reasonable that an electricity undertaking should redeem its obligations to General Fund in respect of the financing of previous losses. This procedure has been followed by several municipalities in this country. Of course, it is unfair to debit the losses of subsidiary departments (e.g. tramways or transport) against the electricity scheme.

As an illustration that this is generally reasonable I can quote a recent example. The Commission is considering taking over an electricity undertaking which has been operating at a deficit for a long period. The charges shown against the would be difficult to pass those increases on to undertaking include all past deficits financed from the Municipality's General Fund, and losses which have been so financed are still considered a liability on the electricity department. The Commission on taking over the undertaking will be required to make good those deficits by reimbursing the General Fund.

The example of boarding houses was quoted as indicating how the electricity tariff could enable a Council to recover revenue from people who were not direct ratepayers. Actually, people living in boarding houses do not pay direct electricity accounts, the landlords or proprietors allow for the cost of electricity in the rental of rooms and incidentally also must allow for the amount levied on their premises in the way of rates.

A further point was made that so long as costs were not prohibitive it was all to the good of the commonweal; but I disagree there. Any arbitrary reshuffling of sources of revenue is unsound, and it is safe to say that the incidence of arbitrary charges is only fair to a few, the general effect being that several must suffer at the expense of others who benefit unreasonably.

I am of the opinion that one of the diffuculties that the ratepayers are faced with is that, in the event of failing to divert certain portions of electricity profits to the relief of rates, it would involve so small an increase in the rates that it the tenants, and the tendency would then be for the ratepayers to be detrimentally affected as individuals, because in that their own sources of income would be somewhat reduced. In my own experience landlords are rather inclined to pass on a 10/– per annum increase in the rates by a 10/– increase in the monthly rental.

It has also been stated that in some cases towns have reached the limits of their rates—that they cannot impose any higher rate, and it is therefore essential that they take profits from the electricity department to cope with increasing expenditure. It seems to me such a statement is an admission that the maximum revenue which the law permits the municipality to use for meeting its commitments in a general municipal way, is insufficient for the municipality concerned, and therefore the municipality is either guilty of extravagence, or the law is wrong. It would appear to me that the direction of endeavour there should be to reduce the expenditure in other directions, to come within the maximum revenue obtainable from rates, rather than to obtain money by rating the electricity department, and making the electricity department an indirect rate levying machine in order to overcome limitations imposed by law.

I would mention some methods of indirect taxation frequently adopted, they are— (1) the relief of rates; (2) abnormally low prices for street lighting and street lighting provided at a definite loss (I have known it supplied free); (3) low charges for electricity supply to a water department, etc.

As regards this vexed question, there is no doubt that some limited amount could be justified as being a reasonable contribution from the electricity department to the municipality for services rendered or facilities offered, and also to establish, shall we say, some central reserve for the good of the municipality as a whole. But, nevertheless it seems to me that electricity department balance sheets should show the extent to which funds have been passed from that department into other departments, or the general fund of a municipality —whether from the electricity department, to general fund, or have come from general fund to the electricity department; in other words, the accounts should indicate the accumulated deficit or surplus, as the case may be, from year to year.

In conclusion, however, I would like to mention an important aspect of the problems, namely, that an engineer, if he is to be worth his salt and to be called an engineer, must have a good working knowledge of finance, and a complete knowledge of the business side of his undertaking. It is not sufficient for an engineer merely to make sure the plant generates electricity; he must be in a position to make sure that the plant runs economically, and that the finances of his undertaking are sound; in other words, he must be a general business manager, as well as an engineer, the two terms being synonymous where an engineering project is concerned. (Applause).

The President : Gentlemen, I have had several requests that we should close the session early this afternoon. You have a very busy evening in front of you. The buses will be here at 4 o'clock; so it is not proposed to resume after refreshment. Under these circumstances, Mr. Reed's paper on the "Testing Equipments for smaller electrical undertakings" will be taken as read.

Testing Equipments
FOR
Smaller Electrical Undertakings

By T. W. Read, A. (S.A.)I.E.E.,
Test Engineer, Johannesburg Electricity Department.

At your last Convention, a very excellent paper was presented by Mr. A. M. Albertyn, B.Sc.. A.M.I.E.E., Test Engineer of Capetown, on "Some Considerations on the Selection and Maintenance of Electricity Meters." I entirely agree with the views he expressed in his paper. Arising out of this valuable paper, your President, Mr. Rodwell, broached the subject of the preparation of a paper on small inexpensive testing equipment, that would be suitable for electricity supply authorities, where limited capital expenditure and the size of the undertaking would not warrant the inclusion of the more elaborate layout necessary with larger undertakings. It is with this end in view and in order to assist the smaller undertakings that this paper is presented with a hope that it will be of value to many Engineers.

It will be appreciated that a full comprehensive thesis on meter testing, maintenance and routine work can hardly be considered as coming within the scope of the subject under review.

The Engineer whose testing facilities are essentially limited is still anxious to attain a very high standard of accuracy in so far as meter testing is concerned, and in fact of all measuring instruments peculiar to any one undertaking. He is always faced, however, with difficulty in obtaining the necessary funds for the provision of a suitable sub-standard and testing equipment to attain such accuracy.

The economic value of high grade testing facilities cannot be over estimated, as in most of the smaller towns in this country the reticulation costs per capita are usually of high order; this is due generally to the fact of the sparsely populated areas to be reticulated. It becomes incumbant, therefore to see that losses due to the innacuracy of the consumers' meters are at a bare minimum. It is felt that in the near future legislation will be enacted by Parliament (as in other countries) whereby definite degrees of accuracy in meters will have to be maintained and officials appointed to check both the methods used and the results obtained.

In most cases it will be found that the capital cost of a testing equipment that is commensurate with the size of the undertaking, will be considerably more than offset in the saving effected by the maintenance of a high degree of accuracy in the meters installed.

TEST ROOM :

I will now endeavour to give a general outline of the minimum requirements for the establishment of a testing department, assuming that in most cases single phase meters are being used.

The question as to how many meters a supply authority must have on circuit before a testing department should be established is often debated. Various figures are quoted, but there is no agreement on the subject. Probably the main reason for this difference of opinion is one of finance. Notwithstanding this fact, however, the time when meters could be tested in any odd corner and by any slipshod method is definitely past. Electricity is generated, measured and sold at a fixed price per unit and the consumer is entitled to be assured that the meter which registers his consumption is reasonably accurate. Therefore, a well lighted room of suitable area, equipped with the necessary apparatus for testing, a good mechanician's bench and complete record equipment is a decided asset. It creates an atmosphere of efficiency and confidence in both parties, a factor which is very important where the price per unit is high, and the entire revenue of the supply authority depends upon its meters.

INSTRUMENTS :

This is a most important item, and I would like to emphasise very strongly at this stage that on no account should testing instruments be bought on price. High grade instruments may seem very costly in the first instance, but, when carefully handled and well looked after, they are a good investment and prove the cheapest in the long run. It will be appreciated that they must not be used as general utility instruments.

The essential instruments required are as follows :—

(1) A Voltmeter with suitable ranges.

(2) An Ammeter with ranges of 2.5 and 5 amperes used in conjunction with a suitable current transformer for the higher ranges.

(3) A single phase wattmeter of 2.5 and 5 ampere capacity with suitable voltage ranges and to be used with the above current transformer for higher ranges.

These should all be high grade instruments shielded against stray fields, having a knife edge pointer with mirror reflector, and a guaranteed accuracy of $\frac{1}{4}$ to $\frac{1}{2}$ of 1 per cent, and, further, should only be used for standardising purposes.

In addition to the above the purchase of a good rotating sub-standard watthour meter with suitable ranges of current and voltages for the actual testing of meters is recommended. This instrument should be checked for accuracy periodically against the standard wattmeter. Finally, a reliable stopwatch will be required, the accuracy of which must be beyond dispute. A watch with a press back to zero action is preferable to the usual fly back action where the watch is in constant use.

For the lower current ranges a tapped non-inductive resistance wound with No. 28 manganin wire is used, giving ranges of 10/20/60/100/250 watts; all these tappings are brought out to a small selector switch, the contact studs of which are No. 3 B.A. screws, by means of which various loads can easily be selected.

The transformer is calibrated by means of limiting resistances in the secondary circuit to give full range readings of 5/10/20 amperes, these resistances being brought out to a second selector switch to facilitate easy change over. It will, of course, be realized that the output of the transformer is determined by the impedance in the circuit; too many meters will drop the current below the calibrated range and will necessitate the use of an ammeter in the circuit. We have, however, tested 6/10 ampere meters in series in conjunction with a rotating sub-standard meter very successfully with this transformer.

The transformer and resistances are mounted in a small box 12″ x 6″ x 10″. On the front panel is fitted a small thermal release switch, the two selector switches and three 3 point plug sockets. The left hand plug socket is the current; the centre is the shunt potential and the right hand plug either for .5 power factor test or soldering iron. This small unit has been used for bench work, meter testing and testing meters in situ, and when used in conjunction with a small portable bench stand and rotating sub-standard meter, it forms a complete inexpensive testing unit suitable for 5/10/20 ampere meters. Where it is desired to test meters on an approximate .5 power factor and 3 phase supply is available, the current transformer and shunt potential circuits should be connected to the red phase and the white phase brought in through a fuse to the third plug socket (which in that case must be wired in the reverse manner to the shunt potential plug.) After testing the meter at unity the shunt plug can then be plugged in to the white phase,

TESTING LOAD :

The most common method of creating a load for testing small size meters is by means of a lamp bank. This necessitates a considerable amount of wiring, numerous switches, generally done in a haphazard manner, and is often very unsightly. It not only uses considerable current but means must be taken to dissipate the heat generated, which is a very undesirable feature in any test room. The more modern practice is to use low voltage loading transformers, regulated either on the primary or secondary side. These can be purchased very reasonably, but, if desired, suitable loading transformers capable of testing up to 24 meters of 10 ampere capacity can easily be built up from old current transformers. At a later stage, I propose to describe to you three types of loading transformer units built up and used in the test room of the Johannesburg City Council's Electricity Department.

TEST BOARD :

Designs in test boards vary considerably and are largely determined by the type and number of meters in use. The ideal in view is to so design the board that meters of all types and sizes can easily be accommodated and that all necessary controls are incorporated on it. A well designed test board is a great asset to any supply authority; it is always ready for use and thus saves considerable time when meter testing is not part of a daily routine.

MECHANICIAN'S BENCH :

A well designed mechanician's bench, while not absolutely necessary, is nevertheless very desirable. Great care has to be taken in the dismantling, examination and re-assembling of meters. A well equipped bench fitted with drawers for tools and spare parts, bench light, rotating vice and bench testing transformer, wired up for testing reassembled meters for shunt running, starting and running on light loads tends towards efficiency and economic maintenance.

METER RECORD EQUIPMENT :

It is very necessary that a complete record should be kept of every meter owned by the supply authority. I would strongly recommend a modern card index system for this purpose.

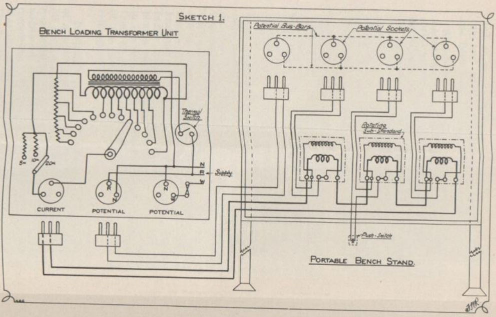
On these cards provision should be made for the following details :—

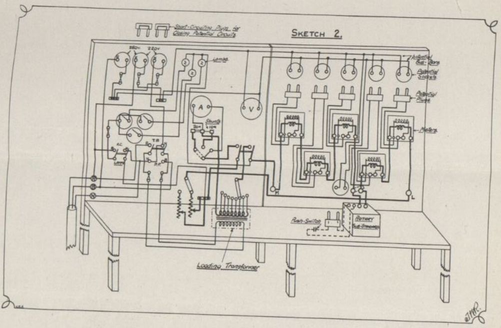
Size, number, make and type of meter.
Date when placed in service.
Address of premises where meter installed.
Date of its installation.
Result of initial test.
Tests in situ.
Date meter returned.
Result of test found.
Record of complaints and faults.

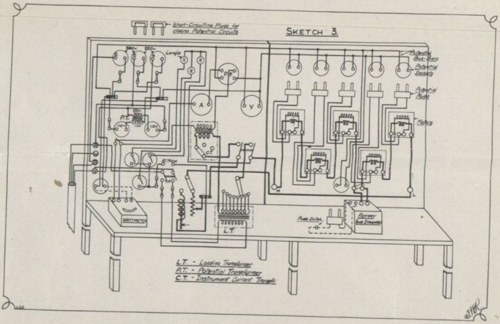
These details should give you a complete history of the meter while in use. Meter reading should be recorded on separate cards and placed in a loose leaf binder of such size as to be convenient for carrying around. All cards can be designed and printed to meet your particular requirements, as no two supply authorities work under the same conditions.

Having now given a brief outline on the requirements of a small modern test room, I would like to offer a few practical suggestions on single phase meter testing. I will deal first with the question of loading transformers.

In sketch No. 1 is shown the design and wiring diagram of a small bench loading transformer used on the mechanicians benches in the testing branch of the Johannesburg Electricity Department. The details of the transformer are as follows :— The iron core is that of an old current transformer having a sectional area of 1 sq. in.; the primary is wound with 2 200 turns of No. 28 s.w.g. enamel copper wire; the secondary has 18 turns of No. 14 D.C.C. wire, tapped every second turn, which gives when the primary is energized at 220 volts and the selector is on the 5 ampere resistance approximately half an ampere per tap.


Sketch 1.
Bench Loading Transformer Unit
Thermal Switch
Supply
N
R
W
5∝
20∝
CURRENT
POTENTIAL
POTENTIAL
Potential Bus-Bars
Potential Sockets
Rotating Sub-Standard
Push-Switch
Portable Bench Stand.


Short-Circuiting Plugs for closing Potential Circuits
Sketch 2.
380v
220v
Lamps
A
V
Potential Bus-Bars
Potential Sockets
Potential Plugs
Meters
Push-Switch
Rotary Sub-Standard
Loading Transformer


Short-Circuiting Plugs for closing Potential Circuits
Sketch 3.
380v
220v
Lamps
P.T.
C.T.
A
V
Potential Bus-Bars
Potential Sockets
Potential Plugs
Meters
WATTMETER
L.T.
Push-Switch
Rotary Sub-Standard
L.T. - Loading Transformer
P.T. - Potential Transformer
C.T. - Instrument Current Transfr.

and an approximate .5 power factor test taken; this test especially should be taken after a meter has been totally dismantled and reassembled.

Sketch No. 2 shows a layout for a small permanent test board designed to test 12 meters in series by means of a rotating sub-standard. The switchboard is built in on the left hand side of the test board. The panel may be of sindanyo on which is mounted a volt-meter. Ammeter scaled to 5 amperes direct reading and taken off shunts for 10 and 20 ampere ranges, a changeover switch for unity and inductive load test, main load switch, transformer selector switch, etc.

The main load is taken from a somewhat larger transformer through a carbon rheostat and selector switch to the meters. The details of the transformer are as follows :— Core type core section 2.64 sq. in. Flux density 40,000 lines per sq. inch; the primary consists of 940 turns of No. 22 s.w.g. D.C.C. wire and the secondary is wound with 48 turns of No. 8 s.w.g. in 12 sections. Both windings are wound half on each limb of the iron core. The total load obtained from this transformer when the primary is energised at 220 volts equals 35 amperes at 9 volts. The tappings are as usual taken to the selector switch and by means of the carbon rheostat any variation of load can be obtained. An approximate .5 power factor can be obtained by changing over the phases either in the potential or current circuit in the usual way. Starting current on meters is tried by means of a small lamp bank on the top of the panel. The rest of the sketch is I think self-explanatory.

In Sketch No. 3 we have a more complete layout of a test board designed to take 24 meters up to 50 ampere capacity. This will of necessity be a more expensive unit, as it entails the purchase of additional instruments and apparatus, but, when completed, will be a most useful equipment. Starting current is ascertained by means of lamps. The loading transformer is wound as follows :—

Shell type, minimum core section 4.59 sq. ins. Flux density, 41,500 lines per sq. in. The primary is wound with 520 turns 22 s.w.g. D.C.C. wire and the secondary with 20 air spaced turns copper strip .0375 sq. in. in ten sections, brought out as usual to a selector switch. The load obtained from this transformer as on all other loading transformers will vary in accordance with the number of meters in circuit, but, controlled by means of a carbon rheostat in the secondary circuit, we have tested 24—10 ampere meters and 20—50 ampere meters through their current transformer very successfully, the maximum current obtained being 80 amperes at 7 volts without any undue heating.

Instead of the usual throw-over switch to the .5 power factor, an adjustable choke coil is included in the equipment and can be easily connected to the circuit in place of the carbon rheostat by means of a changeover link. By this means any lagging power factor can be obtained. The constructional details are as follows :— Iron circuit, shell type with retractable core, core section 2.03 sq. ins. wound with 37 turns of No. 8 s.w.g. This gives ample control.

It is advisable that in addition to the standard wattmeter the following miniature instruments should be incorporated on the board, i.e., Voltmeter, Ammeter and Power Factor meter. The current range of the latter two instruments can be of the 5 ampere capacity and taken in series with the wattmeter off an instrument current transformer with a 25 V.A. secondary capacity, or they may be calibrated to work off shunts with a selector switch for the various ranges, as shown in Sketch No. 2. These switchboard instruments are for observation only, but should be of the 1st grade type. The actual testing can be done either by means of wattmeter and stop watch or by rotating sub-standard. Sketch No. 3 gives all wiring diagrams and I think I can be followed very easily. Care must be taken, however, where the supply to the test board is obtained from a 3 phase system to see that the current and potential circuits are in phase with each other.

All these boards are designed for single phase meter testing. Three phase meters can, however, be successfully tested on single phase circuits in the following manner :— The current coils of the meter are connected in series and the potential coils in parallel; the watts passing through the meter are multiplied by two in the case of a 3 phase, 3 wire meter, and three in the case of a 3 phase 4 wire meter. The balancing of the meter elements is done by placing the current coils in the case of two elements in opposition to each other, and in the case of three elements any 2 elements first, then the 3rd against one of the 2, after which the meter is connected in the usual way and tested.

I have advocated the use of rotating sub-standard watthour meters for general use in meter testing. A brief description of these instruments may not be out of place. Primarily, they are the ordinary induction type watthour meter, arranged, if desired, with several ranges of currents and voltages. In place of the kWh dial train a special circular graduated dial is devised, on which one revolution of the pointer equals one revolution of the disc. Smaller dials are also provided to give the total number of revolutions taken during the test. A resetting device is fitted, by means of which all hands can be reset to zero after each test. The instrument is operated off the potential circuit by means of a push switch which must have a snap action and be of robust construction. The whole is mounted in a neat case which is portable and easily handled, either in the test room or on consumers' premises.

METER TESTING AND FORMULA :

When testing these sub-standard meters for accuracy against a wattmeter and stopwatch, it is advisable to let them warm up for at least an hour before taking the test. The testing constant is usually given on the test certificate and the following formula may be used in testing :—

$$\frac{T \times W}{R} = K.$$

T = time in seconds;
W = watts passing through the meter;
R = revolutions counted during test;
K = testing constant.

For example, let us assume that the constant of the meter is 2,400 watt seconds. We pass 1,000 watts through the meter; take 10 revolutions of the disc and obtain 24 seconds on the stop watch; using the above formula we get—

$$\frac{24 \times 1{,}000}{10} = 2{,}400$$

If the resultant figure obtained is less than the constant the meter is fast; if more, then it is slow.

To work out the percentage accuracy of the result, we use the following formula :—

$$\%\ \text{acc.} = \frac{K - k}{k} \times 100.$$

K = constant of meter;
k = figure obtained in test.

In all these tests the watts must of course be kept steady.

I would like at this stage to point out two possible sources of error that may creep in when testing meters. The first is starting and stopping errors in the stop watch; it is therefore advisable to take a number of revolutions, so as to get a good reading on the stop watch; further, at least three tests on each load should be taken and the results averaged to obtain accuracy. The second error is in counting the revolutions of the meter disc. It may seem ridiculous to mention this point, but there is a tendency on the part of an untrained man to count one at the same time as he presses the stopwatch or push switch, with the result that he counts one revolution short and obtains an error in his test. I have cured this fault by insisting that the man should count nought, one, two, etc.

In testing meters by means of a rotary sub-standard we may have to test meters with varying constants and speeds; it is then necessary to know how many revolutions of the sub-standard equals the revolutions of the meters under test. In some cases the revolutions per kWh are not given on sub-standard meters, but as the testing constant is given we can work out the revolutions by using the following formula :—

$$R = \frac{T \times W}{K}$$

T = 1 hour. 60 x 60 = 3,600 secs.
W = 1,000 watts.
K = testing constant of meter;

for example $\frac{3{,}600 \times 1{,}000}{2{,}400} = 1{,}500$ revs. per kWh.

Having determined this figure you now work out the proportion of the R per kWh of the sub-standard and the R per kWh of the meters under test. It is a good practice to work out and tabulate these figures beforehand and keep them handy for reference. In testing, if the reading of the sub-standard is less than the correct proportion the meter is fast, the reverse being slow; in deciding the accuracy of the meter under test any error in the sub-standard at that load must be allowed for. The great advantage in using the sub-standard meter for testing is that it is less susceptible to errors due to variation in load than the other method, since both the meter and the sub-standard register the same values of load.

Where meters are tested for accuracy against a wattmeter and stop watch, it is necessary to ascertain the testing constant of the meter. In practice we find on the meter label the number of revs. per kWh; for example, a 10 ampere meter gives the figure of 375 R. per kWh by the formula $\frac{3{,}600 \times 1{,}000}{375} = 9{,}600$ watt sec. which is the testing constant; in testing the meter we use the formulae previously given $\frac{T \times W}{R}$ for speed and $\frac{K - k}{k} \times 100$ for percentage accuracy.

When testing a number of meters in series, it is essential to open all shunt links and connect the shunt circuits to the potential in parallel. The meters should be warmed up for at least 1 hour before testing and then the following tests carried out: See that there is no creeping on shunt; try starting current; follow by the usual accuracy tests on 1/10, 1/4, 1/2 full loads and .5 power factor. When it has been found necessary to manipulate either light load or power factor adjustments in addition to the magnetic adjustment the meter should be re-checked for creeping and at several other loads. It has been observed in some makes of meters that any adjustments of light load or power factor adjustment affects the whole curve of the meter.

We now come to the most important test of all, that of the dial train or register. Dial ratio errors, faulty trains, such as bent wheels and spindles, are not unknown to us. For the purpose of this test, a good practice is to take a meter which has a good curve over all loads check its registration at full load, by means of a wattmeter, for several hours, keeping the load steady; the registration of the meter should equal the true watt hours if accurate. When completed this meter should be placed in series with every set of meters tested and their dials checked against this standard meter. When the test is completed, do not fail to replace the shunt links, also megger test the meter for insulation to frame. Finally, when setting the meters to zero do not force the hands round, or you may bend the shaft and the pointers will touch the dial plate and stop the meter from registering.

GENERAL ROUTINE :

In general practice we have very little fault to find with the modern A.C. meter, but in view of the long transit it has undergone before it reaches us it is advisable to examine the essential features of the meter very carefully and recalibrate it to the desired degree of accuracy before placing it on circuit. It is also essential that when a meter is returned to the test room, a test, as found, should be taken and recorded on its card before it is overhauled for re-issue. This precaution is necessary in view of the fact that it may have been registering incorrectly and the consumer may dispute the reading of his new meter.

When erecting meters on circuit, it is essential that all stranded connections should be sweated together and well screwed home, to prevent heating by ensuring good contact in the terminal block or cutouts. When inspecting meters on circuit for faults, if consumption is low, enquire courteously of the consumer for any possible reason on his part, also examine magnets for dirt on poles. .Test shunt coil for open circuit by means of a steel spatula; the magnetic field will show the position. Examine dial for friction. Do not alter position of magnets or remove jewel and top guide unless they come to a definite fixed position. Finally, examine connections carefully to see that the consumer is not tapping the supply in any way. If unable to arrive at any satisfactory solution, change the meter and continue the investigation in the test room.

On the other hand, if consumption is high check up consumer's load; if found satisfactory, examine for shunt creeping by switching off consumer's main switch, or test for a leak in the installation. To do this, loop the consumer's two leads together and place them in the load terminal of the meter. Switch on consumer's switch. If a leak to earth exists the meter will register; failing this the only course is to test the meter. It may have been flashed by lightning and the magnets weakened. Should a leak be discovered, however, cut the supply off until repaired; you may save life. Enter the report on the meter card for future reference.

A few useful tools to have on hand, in addition to the usual heavy tools in general use, are as follows :—

Watchmaker's lathe, eyeglass, screwdrivers, tweezers, spatula, pegwood, brass scratch and soft hair brushes, small nose pliers, nickel needles for testing jewels. Further, most manufacturers of meters have kits of special tools for use on their meters which can be obtained and are very useful.

In conclusion, I trust that despite its limitations on the subject of meters, the paper may be of some service, especially to those who carry on their work in remote districts.

I hope you will visit the Testing Branch of the Electricity Department during your visit, when we will be only too pleased to demonstrate with a view to eliminating any difficulty you may have on the subject.

The President : In the preface to the paper the author has pointed out, during the discussion on Mr. Albertyn's paper at the Convention last year, it was shown that small electricity undertakings could not afford expensive testing apparatus, and that some cheaper methods could be used. I feel therefore that the paper and information will be of considerable value.

Re Mr. MILTON'S PAPER.

Councillor Allison (Pietermaritzburg) : I would like to clear up two points raised by Mr. Milton in his reply to the discussion on his paper.

The President : We will take them now, but I would ask you to be brief as there are a number of gentlemen who want to get away.

Councillor Allison: I would just like to say on the first point raised by Mr. Milton,—I realise the privilege given me in getting up to reply to him—

I said I had been asked by an engineer to bring something forward about future development and extensions, and that great care should be taken to see that sufficient foresight was adopted in this matter, not only as regards the plant or machinery, but the laying of wires and cables. I know definitely, and give illustrations of where wires were only put in sufficient for long periods in a short space of time, and the number who came on to the area eventually was so great that they had to put in fresh wires. I think Mr. Milton did not understand that.

Mr. Milton : No, I did not.

Councillor Allison (Pietermaritzburg): We in Natal are not the same as you in the Transvaal; we do not charge for a lot of the services, like sewerage, on the basis of services rendered. Here in the Transvaal, if you get no sewerage, you would not have to pay for it; but in Natal the people who get sewerage facilities pay the same as those who do not, and people who get dirt cart removals pay the same as those who get none. I do think that this Convention should not discuss which services should be run at cost and nothing more; if we did that, we would not get very far. In Natal we lost money on our electricity supply; now that we have improved, quite a substantial profit is being set against what we lost in the past. Each town or province has to be taken on its own merits. That is not being done. I think to mix up the financial aspect and the engineering aspect like Mr. Milton has done, is wrong. If I may throw out a suggestion which I think will help in the future, I would say those two subjects should be kept separate.

The President : After some general announcements remarked that the session to-morrow, the closing day, would be very short and that he would like all members to attend, if possible. Having thanked those present for their attendance, the Convention adjourned at 4.5 o'clock p.m. until to-morrow at 9.30 a.m.

SATURDAY, November 21st, 1936.

The Convention resumed at 9.50 a.m. at the Conference Hall, Empire Exhibition.

The President : There is only one thing outstanding, so far as I am aware—that is the discussion on Mr. Read's paper,

"Testing Equipment for smaller Electrical Undertakings"
by T. W. Read.

DISCUSSION :

Mr. Muller (Krugersdorp) : I have listened with much interest to the paper by Mr. Read, particularly as I have for some time contemplated the establishment of a suitable test room, and this now shows signs of materialising.

We all realise that meter testing is very necessary to the supply undertaking, and only fair to the consumer.

Meters may be tested for :—

(a) Complaints from meter reader or consumer.
(b) Complaints and also all new meters.
(c) Routine testing of all meters in addition to occasional complaints.

To fully justify the expense of test room equipment and maintenance, I think it would be desirable to adopt the latter course.

Having decided on the general procedure, the cost of the undertaking and period of time between consecutive tests of a consumers meter must be determined.

The cost can be briefly allocated as follows :—

(i) Accommodation : This cost would be largely determined by the space that can be made available in existing buildings and would therefore be a matter decided by local conditions.
(ii) Furniture, Records and Equipments :— Members who are thinking of starting a test-room for the first time, naturally wonder what they are to allow,

as the cost does not end with the purchase of the various instruments mentioned. It would be interesting and instructive if Mr. Read could give a rough estimate to cover the above items.

(iii) Staff and Cost of Current : This would largely depend on local conditions. But it would be interesting to know what Mr. Read considers the minimum staff requirements, and the average units consumed per 1,000 meters tested.

The period for a complete cycle, i.e., time between consecutive tests of the same meter, would probably be a compromise depending on the staff one can afford and the number of meters on the system and new meters purchased per annum.

The author would render a considerable service to those of us who do not profess to be experts at meter testing, if he would express an opinion on what a meter tester can be expected to do in a day, and the period that a meter can normally be expected to function accurately without attention, as these would be deciding factors of individual requirements.

Mr. I. J. Nicholas (Umtata): With regard to the testing equipment of the small towns, Mr. Read's paper has proved very interesting indeed. It gives the small towns some idea what testing instruments are available for their use and within their means. We know that in the large towns, they can, and do have, very elaborate testing equipment which the small town could not possibly afford.

In Umtata we have taken advantage of the elaborate testing equipment of the large undertakings and each year we send away one or two house service meters to be tested and get a certificate of the test all for 15/- per meter. This meter is then used as a check meter. Every three years we send our rotating sub-standard meter to be tested. We have made the practice of sending all meters to be tested to the Victoria Falls and Transvaal Power Company.

From experience we find that on account of having so few meters to be tested by my department and with such long intervals between testing periods that the human error of the meter tester becomes a big factor. In order to reduce the human error to a minimum the meter tester practices with the house service tested check meter and the rotating sub-standard meter until he gets consistant test results. This takes from haf a day or more but the practice so gained gives the meter tester the necessary confidence and accuracy and so this testing of other House Service Meters can be relied upon.

We find that this method of having a standard House meter tested and using it with a rotating substandard meter and meter rack is all that is necessary and all we can afford and has proved effective in our case.

Mr. L. B. Sparks (Pietersburg): I did not intend to contribute to the discussion, but as an Engineer from a small municipality, I would like to express my appreciation to the Council or whoever is responsible for this paper, for the way in which they have looked after the small municipalities this time. We are taking back with us a great deal of information; and I would like to thank those also who have prepared this paper, for the object they have had in mind, namely, the helping of the engineer representing the small municipalities.

The President : Mr. Poole has a small contribution from Mr. Dwyer. I will ask him to read it now.

Mr. Dwyer (contributed) : I am extremely sorry that I am unable to be present at the reading of and discussion of Mr. Read's interesting and instructive paper on the important subject of meter testing.

It will be recalled that during the discussion on Mr. Albertyn's paper on the same subject last year, I endeavoured to stress the necessity of a cheap though reliable equipment for medium and small Undertakings, whose finances are such that they cannot afford the expensive equipment such as used in the larger towns. It came to me therefore as a pleasant surprise to find that Mr. Read had tackled this subject.

Up to the present far too little attention has been paid to Meter testing in the smaller towns, with the result that consumers do not place that measure of confidence in the Electricity Department, which is so essential in the interests of development. It is pleasing to note that at least these matters are being taken up seriously, and a paper such as the one under discussion is certain to have a marked effect in fostering the inauguration of a Meter Test Room in even the smallest Undertaking.

Mr. Read has taken great pains to decide the building up of equipment for different needs, and I am sure that delegates of many of the smaller Undertakings will consider this matter when they have returned to their respective towns.

I would like to suggest that Mr. Read give a rough estimate of the cost of the equipment for the benefit of those residing in the more remote parts of the country, where it is difficult to obtain prices of suitable components.

In conclusion, I wish to congratulate Mr. Read for his instructive contribution and trust that his paper and the discussion thereon will tend to stimulate interest in this all-important subject.

Mr. Horrell (Pretoria): One can quite understand it is difficult for engineers in the smaller towns to obtain expensive apparatus for testing and calibrating electricity meters.

A method adopted in Pretoria in the early days might be of some assistance. A batch of new meters was put on test, each one in series with the other. Out of that number 90% in all probability would be running within 1% of each other. Out of this number three or four would be selected and used as the standard meters. This method proved to very satisfactory and was in use for many years.

The President : There being no further contribution to the discussion, I have to announce that the reply will be published in the proceedings.

REPLY TO DISCUSSION :

(communicated).

It is interesting to note that Krugersdorp is about to establish a testing department and I would like to suggest that in view of the close proximity of that town to Johannesburg a visit be paid to the Johannesburg Electricity Department's Test Room before a start in design and purchase of equipment is made.

In connection with the matter of accommodation in existing buildings, it must be remembered that the essential features are space and light. Natural light is preferable to artificial lighting.

In regard to furniture, records and equipment, these items will naturally vary considerably, depending entirely upon the size of the undertaking.

The record system I have in mind is a 6″ x 4″ visible card system, the price of which varies from £5 for 100 card index to £28/10/- for 1,000 card index supplied in steel cabinets; this is used for test records; for the meter readings a loose leaf folder is recommended, the cost of which, plus 1,000 cards is approximately £2.

The matter of cost for equipment, other than instruments, is somewhat difficult and depends entirely upon the number of meters in service.

The small bench testing set given in Sketch 1 should not cost more than £25 including labour and would be very suitable for the smaller Undertakings with a limited number of meters in service. In connection with the building of this set, I would recommend a larger wire for the secondary of the loading transformer than that given in the paper, which was the only size obtainable when the sets were built.

In Sketch No. 2 the switchboard and accessories would cost approximately £50; the testing bench itself being of wood, the price would vary slightly according to local conditions but should not exceed £10., plus an additional £5 for plugs and terminals.

Sketch No. 3 being a more complete layout with additional accessories would cost approximately £120. Labour costs in the building of these testing equipments will vary considerably, depending entirely upon the ability and knowledge of the man concerned. On the other hand many meter manufacturers design testing equipments complete, these may be obtained at prices from £130 to £800 depending entirely upon the requirements of the undertaking. A mechanicians bench complete with vice and light—£15.

Staff and Cost of Current.

It is not possible to give a pricise answer to this question as so many varying conditions arise. In the establishing of a permanent test room a minimum of three men would be required, especially if meter reading is part of its routine. The average unit consumption depends upon the number of meters tested in series, a fair average would probably be from 3 to 4 units per set of 12 meters. The number of meters tested per day depends entirely upon the type of equipment used, the type and size of meters and the necessary adjustments to be made; these factors vary so considerably that no figure is possible.

The period that meters can be normally expected to function accurately was ably answered by Mr. Albertijn in his reply to discussion on his paper last year. The modern A.C. single phase meter should register correctly from 5 to 7 years.

In reply to Mr. Dwyer who suggests that approximate prices should be given of various components, these prices will naturally vary in accordance with the cost of transportation. Dealng with the instruments mentioned in the paper, the approximate prices delivered in Johannesburg are as follows :—

High grade instruments—

Voltmeter	£36	0	0
Ammeter	£32	0	0
Current Transformer suitable for using Ammeter and Wattmeter in series	£32	0	0
Single-phase Wattmeter	£42	0	0
Switchboard Voltmeter	£8	0	0
Switchboard Ammeter	£8	0	0
Switchboard power factor Meter	£20	0	0
Rotating sub-standard Meter	£25	0	0
Stop-watch	£8	10	0

Carbon resistance from £4 10s. 0d., depending upon the capacity required. Switches, plugs and wire will vary in price in accordance with local conditions. Cheaper instruments may, of course, be obtained, but I strongly recommend that high grade instruments only be obtained for testing work.

Mr. I. J. Nicholas (Umtata) in describing the methods used at Umtata certainly shows an appreciation of the needs for accuracy in meter testing, but fails to realise the effect of long transportation of his submeter after checking by the Victoria Falls & Transvaal Power Company rough handling in transit to Umtata will cause an appreciable error in the meter. I would like to suggest that not less than six meters be sent for testing and that they be checked by dial against each other on return and only those coming nearest be used as sub-standards. I agree that errors can arise when testing meters for speed in the starting and stopping of rotating sub-standards or stop watch—practice is essential.

Mr. Horrell (Pretoria) offers a very practical suggestion for those in difficult circumstances, unfortunately it means that the percentage error of the selected meters have to be assumed as 100% accuracy.

In practice I have not yet found the meter which after its long journey from overseas has tested out at 100% accuracy.

We shall shortly be closing but I would like any member or delegate to bring forward any matter of interest, under "General" which he desires. You will appreciate that I shall have to curtail discussion.

SUPPLY REGULATIONS.

Mr. Muller (Krugersdorp): Just how long do you think it would take before we can expect the standard regulations to come into force? Why I am asking is, our regulations very badly need an overhaul. It is going to be rather a job. If we do anything now, and then the other regulations supersede, it would be rather a waste of time I think.

The President: Your Council has gone into the question carefully. A committee was formed in Johannesburg called the Safety First Committee, representing I think all the various interests in electrical engineering, and, as a basis for their work, they took the suggested by-laws prepared originally in Capetown and presented to this Association some two years ago. These were gone into by the Safety First Committee on which this Association had members sitting. My assistants together with others put in a large amount of work, and finally agreement was reached on all points. The whole matter is now in the hands of Mr. E. T. Price, of the Electricity Supply Commission, who is getting them all into order. These regulations will have appendices to them to which each municipality will add certain items which they may require to meet local conditions. These suggested by-laws are being prepared and we hope they will be adopted as standard throughout the Union.

We hope to have these suggested by-laws ready early next year, and then steps will be taken to attempt to make them uniform throughout South Africa. In this case, we understand it cannot very well be brought under any actual Government regulations, but will have to be dealt with by the various provinces. The Electricity Supply Commission representative has stated that they are definitely going to adopt them as standard; and that should give us a lead to work on. When this matter again comes before your Council, we hope to be in a position to say, "This has been definitely adopted by the Electricity Supply Commission for their undertakings," and then it will be for you to recommend your Councils to adopt it in your particular areas, and to add whatever you find is necessary to these standard regulations to suit your particular local conditions.

Mr. Muller (Krugersdorp): Would it not perhaps be possible, so soon as the copies are really complete, to have them circulated to members; so that in my case, whether it becomes law or not, I would immediately get rid of my antiquated regulations and adopt these. If they are adopted, there is no harm done.

The President: We are hopeful that we shall have sufficient copies almost immediately they are ready to circulate to our members. (Hear, hear).

Mr. Milton (Electric Supply Commission): I have only a few words to say. Your President has put the position very clearly; but I wish to add that in the case of the Commission's regulations, these will probably be proceeded with, without further reference to this body, for reasons very well known to yourselves. When proceeded with, the regulations, of course, will be gazetted in the Provincial Gazettes and they require the approval of the Minister of Mines and Industries. As they will be gazetted, everyone will have an opportunity of seeing them.

GENERAL.

Mr. Sparks (Pietersburg): I do not know whether the Engineers here know that the post of Town Engineer and Electrical Engineer have been separated in the town of Randfontein. I want to congratulate Randfontein on taking a great step towards efficiency. (Hear, hear and Applause). I speak from experience, because I have held the post of Town Engineer in charge of Roads and Works and the Electrical Department, and I know that the two jobs cannot be run efficiently by the same man, because there is a tendancy to develop the one at the expense of the other. I want heartily to congratulate Randfontein on the step they have taken.

Councillor Patterson (Randfontein): I must thank Mr. Sparks for the compliment he has paid Randfontein. It is nice to hear sometimes that you are doing something in the right way. I can assure you that Randfontein, although one of the youngest municipalities on the Reef, is out to do the right thing. This matter has not been done to favour any individual but from the point of view that Electricity has now reached such a stage as to be worthy of its own Head of Department in any municipality. (I thank you).

THANKS OF APPRECIATION.

Councillor Spilken (Umtata): I would like to express my appreciation to the Association for all the very fine papers and very interesting week I have spent over here. I will take back some very pleasant memories. I have met a lot of friends here. All I can say is this, I think, by the time I get back to Umtata I shall be a qualified engineer, after all I have listened to. I do sincerely hope that I shall be in the fortunate position of attending the next Convention in Durban.

The President : If there is nothing else to be brought forward under "general" I have just simply to thank you for your attendance at this Convention and to say how pleased we in Johannesburg have been to have you here. The Mayor and also the Chairman of the Electricity Committee are unable to be present this morning, so on behalf of the City, I want to say how pleased we have been to have you here. We hope you will take back with you very pleasant memories of Johannesburg. I am sure that the Convention itself has been very useful to many of our Councillor and Engineer members, especially those from the smaller centres who do not have the opportunity in the ordinary way of meeting and discussing their problems with their colleagues in the larger centres. I am sure from that point of view, it will be a great help to the various towns that you represent; but apart from that, we hope, too, that you have been able in this very strenuous week to get a little pleasure out of it, and that you will take back happy memories of your visit here. (Hear, hear and Applause).

Councillor Delport (Krugersdorp): On behalf of the Council of the Krugersdorp Municipality, this being the first Convention I have attended of your electrical engineers, it gives me great pleasure to propose a hearty vote of thanks to yourself for the very impartial manner in which you have presided at this Convention. (Hear hear) I can assure you, sir, that you have at all times been ready to take their views into consideration, which has gone very far to help members like myself who do not know very much about the job. I have thoroughly enjoyed all the papers which have been read here. Many of them have been very dry to the ordinary layman like myself; but I hope that at your next Convention after you have had several dry papers and discussions, you will introduce a new system, and that you will get somebody to come forward and give a witty paper from your side, , one which will brighten up the proceedings. I attended the last municipal Convention held at Pretoria, where we had a lot of dry papers, some given by Engineers, generally very long and parts very dry. I was requested by the Municipal Association of the Transvaal to give them a paper on "The Wit and Humour of Councillors" (Laughter). I gave that paper, which was very well received, from all quarters, and it brought new life to the proceedings.

Councillor Allen (Roodepoort): We are indebted to you sir, for the patient manner in which you have dealt with the Councillor members to this Convention and for the kindness extended to us in every respect. I wish to suggest that at your next Convention a paper should be given dealing with the question of tariffs by a Councillor member. I heartily support the vote of thanks proposed by Councillor Delport.

Councillor Fereday (Salisbury): Now that the time has come to say good-bye, I just wish to say what a great pleasure it has been to me personally to attend this Conference, to renew old acquaintances and to make new friends. We are all assembled here with the common object of service; and it has been a very great pleasure, sir. I think a Conference of this kind is perhaps of greater value to those members who come from long distances than those who are nearer the hub of the Universe, as it were. I do wish to say quite sincerely that we in Rhodesia, thoroughly appreciate the attitude of those in the Union, for allowing us to participate in a Conference such as this.

I was very favourably impressed, sir, with the remarks of Dr. van der Bijl at the opening ceremony, and his remarks concerning the closer association of the Union of South Africa and Rhodesia (Hear, hear). Those remarks were, I am pleased to remind you, very ably supported by yourself, sir, from the Chair, and we in Rhodesia do appreciate very sincerely those sentiments. It is a fine thing for a Conference of this kind to allow us to get together. I think it matters not whether we come from the south or north of the Limpopo, if we are all out for service. We are all good South Africans (Hear, hear). I have appreciated that spirit which has prevailed right throughout the Convention, and that has made, to some of us from the north, this Convention par ticularly enjoyable. I do feel, sir, that it has been a very successful Convention in every way.

Some of these papers to the layman are perhaps difficult to follow, and are more helpful to the Engineer; but I do wish to congratulate the Council of this Association on the splendid spadework which they have done, and also to congratulate them on the papers which they have put up before us. I think we have all found—even Councillors—the papers intensely interesting, and I am sure very helpful and instructive.

I would like to thank the Mayor and Council of Johannesburg for the wonderful hospitality which they have bestowed upon us (Hear, hear and loud applause). We, in Rhodesia, are rather apt to be conceited at times, and thought we knew something about hospitality; but we have learned something during this Convention and I am sure I am speaking for all my Rhodesian friends when I say we do appreciate everything and thank the Mayor and Council of Johannesburg for their wonderful hospitality.

In conclusion, I wish again to congratulate the Council on its good work, and I congratulate the Council and all of us on the fact that you, sir, are our President for the ensuing year (Hear, hear). I do gladly support the remarks of our friend from Krugersdorp regarding your very able and genial chairmanship, and I am sure this Association is going on from strength to strength, and that this forthcoming year is going to be a great year for the Association. I do not want to speak at any greater length, sir, but I do feel that the good achieved by the Association is becoming more and more marked, and I believe, that there are good results from a Convention such as this which are not at once obvious or apparent, but very very far-reaching. Sir, I wish to again congratulate the Council and wish the Association of Municipal Electricity Undertakings another very happy and progressive year, and I trust we shall all meet again at Durban next year, and renew our friendship. I thank you, sir. (Applause).

Mr. Milton (Electricity Supply Commission) : Mr. President and Gentlemen. Had I risen earlier I would have said almost all that my friend Mr. Fereday has just said; and from the point of view of the Electricity Supply Commission, his remarks apply equally well. In addition, however, I have to thank you on behalf of the Electricity Supply Commission for the privilege you have afforded the Commission in inviting its delegates to your Convention. At the same time I would like to thank you for the very patient hearing which you gave me personally, when presenting my paper, and reply during the last two days.

Mr. Clutterbuck (Chief Inspector of Factories) : I wish to thank you on behalf of my department, and personally, for the opportunity afforded me of being allowed to attend your Convention and also the outstanding social events in connection therewith. It is very pleasing to note the increase in strength and importance of your Association; and from my point of view, it is very valuable to have an Association which I know so truly represents the interests of electricity supply.

Councillor Spilken (Umtata) : I would like to move that the Executive Committee write to the Mayor and City Council of Johannesburg and also the Victoria Falls Power Company conveying our appreciation for our welcome and very pleasant stay here and I hope the Convention will support me in that.

There are others who have helped to make this Congress a success; they know who is who and who should get the thanks; but the Mayor and City Council and the Klip Station people should receive our very warm appreciation for the kindness extended to us.

The President: Your Council will carry out that recommendation.

Well, gentlemen, thank you very much for all the kind things that have been said about Johannesburg, the Mayor and City Councillors. I also have to thank you, on behalf of your Council, for the very nice things said about them.

With regard to the personal reference I can only say that if you have all enjoyed yourselves as much as I and certain members of my staff who assisted, have enjoyed this week, then you have all had a very happy time.

Mr. Gyles (Durban) : Gentlemen, I think we ought to propose a hearty vote of thanks to Mrs. Rodwell for the very able manner in which she has entertained the lady visitors.

Councillor Spilken (Umtata) called for three cheers for the President and Mrs. Rodwell, which were heartily responded to.

The President in expressing his thanks said he would convey the appreciation of members and delegates to Mrs. Rodwell.

The Convention then terminated.

Association of Municipal Electricity Undertakings.

of South Africa and Rhodesia.

LIST OF VARIOUS MEMBERS, as at December, 1936.

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H. J. van der BIJL, Electricity Supply Commission, Johannesburg.

J. ROBERTS, Electricity Supply Commission, Durban.

E. POOLE, Box 147, Durban. (Secretary and Treasurer).

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