PROCEEDINGS

of the

Seventeenth Convention

of the

Association of Municipal Electricity Undertakings.

of South Africa and Rhodesia.

(Founded 1915)

MUNICIPALITY

OF UMTATA

HELD AT

UMTATA

From Monday, November 20th to

Thursday, November 23rd,

1939.

PRICE SEVEN SHILLINGS and SIX PENCE.

I. J. NICHOLAS, PRESIDENT.

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ASSOCIATION OF

Municipal Electricity Undertakings.

of South Africa and Rhodesia.

Founded 1915.

EXECUTIVE COUNCIL, 1939.

President :

I. J. NICHOLAS (Umtata).

Vice-President :

J. S. CLINTON (Salisbury).

Past Presidents :

H. A. EASTMAN (Capetown).
A. T. RODWELL (Johannesburg).

Councillor Members :

E. SPILKIN (Umtata).
C. OLLEY (Salisbury).
G. C. STARKEY (East London). (*Alternate.*)
W. FOWKES (Cape Town). (*Alternate.*)

Other Members :

D. J. HUGO (Pretoria).
C. KINSMAN (Durban).
A. Q. HARVEY (Springs).
G. M. PIRIE (Bloemfontein).

Secretary and Treasurer :

E. POOLE,
P.O. Box 147 — Durban.

SUB-COMMITTEES & REPRESENTATIVES.

PAPERS SUB-COMMITTEE:

C. KINSMAN,	Durban.
H. A. EASTMAN,	Capetown.
G. G. EWER,	Pietermaritzburg.
E. POOLE,	Secretary and Treasurer.

RELIEF OF RATES SUB-COMMITTEE:

Clr. W. JAMES,	Capetown.
,, L. HOFMEYER,	Stellenbosch.
,, G. F. ROBBINS,	Pietermaritzburg.
,, J. PARRY,	Springs.
,, E. SPILKIN,	Umtata.
E. A. BEHRENS,	Port Elizabeth.
H. A. EASTMAN,	Capetown.
J. H. GYLES,	Durban.

SUPPLY REGULATIONS SUB-COMMITTEE:

A. Q. HARVEY,	Springs.	**Periodical Testing:**
J. H. GYLES,	Durban.	C. KINSMAN.
H. A. EASTMAN,	Capetown.	H. A. EASTMAN.
G. M. PIRIE,	Bloemfontein.	G. M. PIRIE.
G. G. EWER,	P. M. Burg.	A. RODWELL.
D. J. HUGO, *Alt.*	Pretoria.	
A. ROSSLER,	Cradock.	
E. A. BEHRENS,	Port Elizabeth.	

REPRESENTATIVES—

World Power Conference (Local Committee):

A. RODWELL,	Johannesburg.

South African Standards Institution:

A. Q. HARVEY,	Springs.
G. R. E. WRIGHT,	Benoni (*Alternate*).

Safety Precautions Committee:

A. RODWELL,	Johannesburg.
G. R. E. WRIGHT,	Benoni.
A. Q. HARVEY,	Springs (*Alternate*).

Electrical Wiremen's Registration Board:

A. RODWELL,	Johannesburg.

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.
1936-37	A. RODWELL	Johannesburg.	E. Poole.
1937-38	J. H. GYLES,	Durban.	E. Poole.
1938-39	H. A. EASTMAN.	Capetown.	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.

PAST ORDINARY MEMBERS OF COUNCIL (Continued).

Councillors :	*Alternate Councillors :*	*Engineers :*
	1935 - 1936 :	G. H. Swingler (C.T.).
T. P. Gray (J'burg).	H. W. Daly (Pretoria).	J. H. Gyles (Dbn).
J. McLean (P.E.).		T. Millar (H'smith).
		E. H. Behrens (P.E.).
	1936 - 1937 :	G. H. Swingler (C.T.)
H. Middlebrook (Dbn).	F. Morrell (C.T.).	T. Jagger (L'smith).
T. P. Gray (J'burg).	J. McLean (P.E.).	E. A. Behrens (P.E.).
		G. M. Pirie (Bltn).
	1937 - 1938 :	L. L. Horrell (P'toria).
H. G. Capell (Dbn).	H. Middlebrook (Dbn).	J. S. Clinton (S'bury).
W. James (C.T.).	L. Hofmeyer (S'bosch).	A. Q. Harvey (Springs).
		G. M. Pirie (Bltn).
	1938 - 1939 :	D. J. Hugo (P'toria).
E. Spilkin (Umtata).	G. C. Starkey (E.L.)	J. S. Clinton (S'bury).
W. James (C.T.).	W. Fowkes (C.T.).	A. Q. Harvey (Springs).
		G. M. Pirie (Bltn).

Association of Municipal Electricity Undertakings

of South Africa and Rhodesia.

MEMBERS AND DELEGATES AT UMTATA, 17th CONVENTION, NOVEMBER 20th to 23rd, 1939.

1st Row, Seated (names in capitals are Members of Council) : Clr. T. Maim (Roodepoort), Clr. A. Z. Berman (Cape Town), K. T. Robinson (Elliot), R. D. Coulthard (Oudtshoorn), T. P. Ashley (Queenstown), Clr. G. C. Starkey (East London), Clr. L. W. Deane (Bloemfontein), G. M. PIRIE (Bloemfontein), A. Q. HARVEY (Springs), D. J. HUGO (Pretoria), A. RODWELL, Past President (Johannesburg), H. A. EASTMAN, Past President (Cape Town), I. J. NICHOLAS, President (Umtata), Clr. E. SPILKIN (Umtata), Clr. Q. Hemming, Mayor (Umtata), J. S. CLINTON, Vice-President (Salisbury), Clr. C. OLLEY (Salisbury), C. KINSMAN (Durban), E. POOLE, Secretary and Treasurer (Durban), Clr. S. L. Hodgson (Springs), Clr. R. Moore (Springs), W. Houreld (Randfontein).

2nd Row : H. Bickley (Nigel), A. Mitchell (Durban), Clr. A. B. v. d. Linde (Roodepoort), A. Rossler (Cradock), L. L. Horrell (Pretoria), F. Stevens (Ladysmith), H. Bahr (Klerksdorp), H. R. Bevington (Knysna), P. H. Newcombe (George), Clr. E. W. Wright (Benoni), D. W. Ritson (Stellenbosch), G. E. H. Jones (Mafeking), F. W. Joubert (Visitor), H. P. Alexander (Visitor), C. Mullins (Visitor), J. Poole (Visitor), G. R. E. Wright (Benoni), S. F. Peck, Town Clerk (Bloemfontein), R. Macaulay (Pretoria), Clr. H. Verity (Johannesburg), Clr. R. S. v. d. Spuy (Nigel), E. A. Behrens (Port Elizabeth), W. J. Seller (Boksburg), J. Iverach (Grahamstown).

3rd Row : S. G. Redman (Johannesburg), Clr. A. C. T. Bloe (Port Elizabeth), H. A. Tinson (Visitor), P. G. Muller (Krugersdorp), Clr. H. G. Capell (Durban), B. E. Mahon (Visitor), Clr. Major J. Raftery, J.P. (Durban), W. F. Hayes, Town Clerk (Vryburg), W. D. Ross (Potchefstroom), J. Ward (Visitor), W. H. Milton (Johannesburg), Clr. A. A. Webb (Benoni), W. Roome (Visitor), Clr. A. S. Holland (Johannesburg), Clr. C. H. Baskerville (Salisbury), Clr. F. Kockott (Port Shepstone), Clr. G. F. Robbins (Pietermaritzburg), C. H. Adams (Middleburg), W. Rossler (Ladybrand), A. Cairns (Visitor), E. H. Bennett (Visitor), C. L. Evans (Visitor).

4th Row : M. M. Smith (Matatiele), A. Foden (East London), N. H. Hancox (Visitor), W. G. Ballard (Visitor), S. G. Mortimer (Visitor), H. L. Groom (Roodepoort) ; — ? — G. A. Dalton (Visitor), A. Tilley (Visitor), Clr. V. Calderbank (Potchefstroom), F. N. Sutherland (Visitor), C. Chase (Visitor), Clr. J. G. Shoeman (Krugersdorp), G. H. Williams (Visitor), A. Elliott (Uitenhage), J. J. Kruger (Adelaide), T. M. Mocke (Piet Retief), P. C. Grandin (Vryburg), C. Runtzler (Port Shepstone), J. H. Gyles (Durban), W. M. Mail (Kokstad), W. G. Mail (Visitor), E. R. Smith (Visitor), C. E. Gregor (Standerton), L. B. Sparks (Pietersburg).

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 formed are :—

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

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

(c) To arrange and hold periodical 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 Undertakins.

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.

Seventeenth Convention.

UMTATA.

Programme

Sunday, 19th November, 1939.

8.0 p.m.—Meeting of Council.

Monday, 20th November, 1939.

8.30 a.m.—Council Meeting.

9.0 a.m.—Registration, Issue of Papers, &s.

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

10.15 a.m.—Annual General Meeting. (Municipal delegates and visitors may attend, but only members are entitled to vote.)

AGENDA.

1. Annual Report of Secretary & Treasurer;
2. Election of President;
3. Valedictory Address by Retiring President;
4. Presidential Address;
5. Venue of next Convention;
6. Election of Officers;
7. Supply Regulations;
8. General. (Reports of Sub-Committees, &c.)

The following are the retiring Officers :—

President —H. A. Eastman (Capetown).

Vice President —I. J. Nicholas (Umtata).

Past Presidents—J. H. Gyles (Durban).
A. T. Rodwell (Johannesburg).

Other Members—

Councillor E. Spilkin (Umtata).
" W. James (Capetown).
"(Alt.) G. C. Starkey (East London).
" W. Fowkes (Capetown).

D. J. Hugo (Pretoria).
J. S. Clinton (Salisbury).
A. Q. Harvey (Springs).
G. M. Pirie (Bloemfontein).

1.15 p.m.—Civic Luncheon (By kind invitation of His Worship the Mayor and Council of Umtata).

Ladies Luncheon (by kind invitation of the Mayoress).

3.0 p.m.—Official photograph and visit to first Hydro scheme and central Power Station.

8.0 p.m.—Cinema Entertainment. (Guests of Council).

Tuesday, 21st November, 1939.

8.30 a.m.—Council Meeting.

9.30 a.m.—Paper by Mr. A. Foden (East London), "The Engineer, his Education, Training and Duty to the Community."

12.45 p.m.—Luncheon Adjournment.

2.30 p.m.—Visit to second Falls Power scheme.

8.0 p.m.—"Yeoman of the Guard" (Guests of Council.)

Wednesday, 22nd November, 1939.

8.30 a.m.—Council Meeting.

9.30 a.m.—Paper by Mr. W. H. Milton (Electricity Supply Commission) "Electricity Tariffs."

12.45 p.m.—Luncheon adjournment.

(Afternoon free for Golf, Tennis, Bowls &c.)

8.0 p.m.—Civic Reception and Ball.

Thursday, 23rd November, 1939.

8.30 a.m.—Council Meeting.

9.30 a.m.—Paper by W. H. Mail (Kokstad) "Diesel Plant."

12.45 p.m.—Luncheon adjournment.

2.30 p.m.—Visits to places of interest.

ANNUAL SUBSCRIPTIONS.

The Annual Subscriptions of all classes of Members become due on 1st September, and the Secretary and Treasurer will be glad to receive any subscriptions, not yet paid, during the Convention Week.

Association of

Municipal Electricity Undertakings.

of South Africa and Rhodesia.

MEMBERS AND OTHERS ATTENDING THE CONVENTION.

HONORARY MEMBERS:

L. L. Horrell. E. Poole.

ENGINEERS AND COUNCILLORS :

ALICE—
C. L. Evans.

ADELAIDE—
J. J. Kruger.

BENONI—
G. R. E. Wright.
Councillor A. A. Webb.

BOKSBURG—
W. J. Seller.

BLOEMFONTEIN—
G. M. Pirie.
Councillor L. W. Deane.
S. F. Peck (Town Clerk).

CAPE TOWN—
H. A. Eastman.
Councillor A. Z. Berman.

CRADOCK—
A. Rossler.
Councillor G. L. E. Venter.
P. de K. van Heerden (Town Clerk).

DURBAN—
C. Kinsman.
Councillor J. Raftery.
,, H. G. Capell.

EAST LONDON—
Councillor G. S. Starkey.
A. Foden.

GEORGE—
Councillor E. W. Wright.
P. H. Newcombe.

GRAHAMSTOWN—
J. Iverach.

JOHANNESBURG—
A. T. Rodwell.
Councillor H. H. Verity.
,, A. S. Holland.

KLERKSDORP—
H. Bahr.

KNYSNA—
H. R. Bevington.

KOKSTAD—
W. Mail.

KRUGERSDORP—
G. J. Muller.
Councillor J. G. Shoeman.

LADYBRAND—
W. Rossler.

LADYSMITH—
F. Stevens.
Councillor H. Quick.

MAFEKING—
G. E. H. Jones.

NIGEL—
H. Bickley.
Councillor R. S. v. d. Spuy.

OUDTSHOORN—
R. D. Coulthard.

MATATIELE—
H. H. Smith.

MIDDLEBURG (C.P.)—
C. H. Adams.

POTCHEFSTROOM—
R. D. Ross.
Councillor H. W. Calderbank.

PIETERSBURG—
L. B. Sparks.

PIET RETIEF—
T. M. Mocke.

PIETERMARITZBURG—
Councillor G. F. Robbins.

PORT ELIZABETH—
E. A. Behrens.
Councillor A. C. Bloe.

PORT SHEPSTONE—
Councillor F. Kockott.
C. Runtzler.

PRETORIA—
D. J. Hugo.
Councillor D. P. van Heerden.

QUEENSTOWN—
T. P. Ashley.

RANDFONTEIN—
W. Houreld.

STANDERTON—
C. E. Gregor.

ROODEPOORT—
Councillor A. B. v. d. Linde.
" T. Main.
H. L. Groom.

SALISBURY—
J. S. Clinton.
Councillor C. Olley.
" C. H. Baskerville.

SPRINGS—
A. Q. Harvey.
Councillor R. Moore (Mayor).
" S. L. Hodgson.

STELLENBOSCH—
D. W. Ritson.

UMTATA—
Councillor Hemming (Mayor).
" E. Spilkin.
I. J. Nicholas.

UITENHAGE—
A. Elliott.

VRYBURG—
P. Grandin.
W. F. Hayes (Town Clerk).

OTHER MEMBERS:

J. H. Gyles (Durban); R. Macaulay (Pretoria); W. H. Milton (Johanneesburg).

SUNDRY DELEGATES:

Electric Control Board :	C. Mullins.
Electricity Supply Commission :	W. H. Milton; H. P. Alexander.
Union Government :—	
S.A. Railways & Harbours :	G. A. Dalton.
Labour & Social Welfare :	F. W. Joubert, Pretoria.
Public Works (Electrical) :	W. C. Roome (East London).
S.A. Inst. Electrical Engineers :	A. Rodwell.
Sundry Visitors :	W. G. Mail, A. E. Val Davies, A. P. Cairns, A. Strydom, K. T. Robinson, J. Poole, B. Quick.

ELECTRICAL TRADES :

British General Electric Co., Ltd. :	J. P. Thomas, G. Mortimer.
Chloride Elec. Storage Co., Ltd :	A. C. Tilley.
English Electric Co., Ltd. :	F. N. Sutherland, B. E. Mahon.
Hubert Davies & Co., Ltd. :	J. Ward, C. Chase.
S.A. Lamp Association :	E. H. Berry.
Merz & McLellan (S.A.) :	S. G. Redman.
Johnson & Phillips (S.A.) Ltd. :	E. H. Bennett.
Reyrolle & Co., Ltd. :	W. J. Gibbons.
Reunert & Lenz, Ltd. :	G. H. Williams.
S.A. General Electric Co., Ltd. :	H. A. Tinson.
S.A.C.M.A. :	E. R. Smith.
Wilson & Herd :	E. R. Smith. H. N. Hancox, W. Ballard.

LADIES :

Mesdames : Ashley ; Berman ; Behrens ; Bloe ; Coulthard ; Eastman ; Elliott ; Foden ; Gibbons ; Gyles ; Harvey ; Mullins ; Olley ; Quick ; Ritson ; Rodwell ; Raftery ; Rossler ; Sparks ; Seller ; Smith ; Starkey ; Val Davies ; Verity ; Wright, and the Misses Gyles and Wood.

OFFICIALS :

A. Mitchell, Reporter (Durban ; E. Poole, Secretary and Treasurer (Durban).

PROCEEDINGS
OF THE
Seventeenth Convention
MONDAY, 20th November, 1939.

THE Seventeenth Convention of the Association of Municipal Electricity Undertakings (Union of South Africa and Rhodesia) was opened in the Town Hall, Umtata, at 10 a.m. on Monday, 20th November, 1939, and was attended by representatives from 40 Municipalities, including 26 Councillor Members, 39 Engineer Members, 3 Associates, 10 Engineer Visitors, 16 Trades representatives, 6 Sundry Visitors, and 27 Ladies, a total of 127.

The President, Mr. H. A. Eastman (Capetown), in the Chair : Ladies and Gentlemen,—On your behalf I have very great pleasure in extending a most cordial welcome to His Worship the Mayor of Umtata, who has kindly consented to open our Seventeenth Convention.

OFFICIAL WELCOME.

His Worship the Mayor of Umtata (Councillor Quex de V. Hemming): Mr. President and Members of the Association of Municipal Electricity Undertakings of South Africa and Rhodesia, Ladies and Gentlemen,—It is a very real pleasure to me to see so many new faces in this Town Hall this morning. I am very glad indeed, Mr. President, that notwithstanding the outbreak of war in Europe and the state of war existing between South Africa and Germany, you and your Committee decided not to postpone, but to hold, the Association's Convention this year in Umtata as arranged. I take it that this decision was actuated by the realisation of the fact that

properly directed action and purpose are more valuable than remaining dormant and inactive. I am sure that the slogan of your Association and its individual members will be "business as usual" in this troubled world, but with a proper and correct mental attitude to such military demands as may be made upon it and its members.

As the sphere of influence of the Association of Municipal Electricity Undertakings of South Africa extends to the whole of South Africa and beyond to Southern Rhodesia, many of you will have come great distances both down and across South Africa to attend this Convention at Umtata, which is the Capital and the Administrative centre of the Transkeian Native Territories. I think one may say verily that these Territories can be regarded as one of the "Gardens of Eden" in this magnificent country of South Africa, for there is to be found in them some of the finest scenery to be found in this country which is noted and famous for the grandeur and beauty of its scenery. I trust that those of you who have come here for the first time have been impressed by the attractiveness of these Territories.

I am able to say, without fear of contradiction, that I have the privilege and the honour of being the first Mayor of Umtata to welcome a Convention of your Association to this town, and as Umtata has been a Municipality for over fifty years, it may truthfully be said that to-day is a "red letter day" in the annals and history of this town. I know I am very proud indeed of being its Mayor on an occasion so distinctive and important.

I do not propose, in this address of welcome to you, to touch upon the objects and activities of your Association, or upon the value and importance of Municipal electricity undertakings in general, or individual electricity enterprises in particular, as, I dare say, Mr. Councillor Spilkin,

who is the Chairman of the Electricity Committee of this Municipality, will deal with these matters in the Toast which stands in his name at the Official Luncheon which is being given by the Municipal Council of Umtata in honour of the presence of this Convention here. I may say that the aim and object of the Municipal Councillors and citizens of Umtata will be to see that you have a good, interesting and enjoyable time during your short sojourn among us, and to create in you all an irresistable urge to re-visit these Native Territories and this town of Umtata.

Mr. President, may I give expression to the wish that the deliberations of this Convention will not only be interesting from the point of view of Municipal electricity undertakings, but of lasting value to the Association itself.

I have a very pleasant announcement to make, and that is that from to-day onwards the President of your Association will wear a Chain denoting his Office, and I shall ask Mr. Poole, the only foundation member of your Association present, to perform the ceremony of enchaining your present President with his insignia of Office.

Mr. President, it gives me very great pleasure now to declare this Convention open, with warm greetings of welcome from the Municipal Councillors and Citizens of Umtata. (Applause.)

INVESTITURE OF PRESIDENT.

The Secretary and Treasurer (Mr. E. Poole, Durban) : Mr. Mayor, Ladies and Gentlemen,— At our Capetown Convention the Council decided that the dignity of the Association should be upheld by the adoption of a badge of office for the President to wear on occasions such as this. As one of the few remaining Foundation Members of the Association I appreciate very highly the compliment paid me to invest Mr. Eastman with this badge of office. I am sorry that the badge has come so late in his term of office, and that he can wear it only for a very short time. However, in

this case the words of the old proverb are applicable: "Better late than never." (Applause.)

Mr. Poole then invested Mr. Eastman with the chain of office to the accompaniment of sustained cheering.

APPRECIATION OF WELCOME.

The President : On behalf of the Association, I thank you very sincerely for the cordial welcome you have extended to us, and for the way in which you have inaugurated our Convention. We have been looking forward to our coming to Umtata, one reason being that not many of us have been here before, while another is that we have heard quite a lot about your electrical undertaking and the way in which it is run.

We appreciate your action by reason of the fact that notwithstanding the outbreak of war at a time when we did not know how we would be affected, your Council took the first opportunity of reaffirming their invitation to us to come to Umtata. That we appreciate very much indeed, especially in view of the fact that so many other conferences which were to be held in different parts of the country have been postponed. We thank you and your Council for the arrangements you have so kindly made.

To Mr. Poole, ladies and gentlemen, I merely want to say how deeply and sincerely I appreciate the honour of being the first President to wear this badge of office, which is inscribed with the names of other Presidents. I truly appreciate this signal honour and also the words spoken by Mr. Poole. (Applause.)

NEW MEMBERS.

Before we proceed with our agenda, I would like to announce the election of some new members, namely Mr. P. A. Giles (East London), Mr. M. D. Stuart (Blantyre), the Municipality of Blantyre, and Mr. W. Littlefield (Victoria West). I also

have pleasure in extending a very hearty welcome to Mr. A. Foden, of East London and Mr. C. Kinsman, of Durban, in their new capacities as City Electrical Engineers of their respective towns, on which appointments I offer them my congratulations. (Applause.)

CONFIRMATION OF MINUTES.

The proceedings and minutes of the last Convention have already been circulated, and I would like a proposal that they be confirmed.

Councillor Robbins (Maritzburg): I move their confirmation.

Mr. Clinton (Salisbury): I second.

REPORT AND BALANCE SHEET.

The President: The next item is the consideration of the annual report of the Secretary and Treasurer, which I will ask Mr. Poole to read:

SEVENTEENTH REPORT and BALANCE SHEET of the

Association of Municipal Electricity Undertakings for the period ending August 31st, 1939.

Mr. President and Gentlemen,

I have the honour to present herewith the Seventeenth Report and Balance Sheet covering the affairs of the Association since the 1938 Convention held at Capetown.

MEMBERSHIP.

While there have been a few changes and transfers in membership during the past year, our total members remain the same, the comparative figures for the past two years being as follows:—

	1938.	1939.
Honorary Members	2	3
Councillor Members	53	56
Engineer Members	56	58
Associate Members	2	1
Associates	20	15
	133	133

Among the membership changes may be mentioned the names of two of our Past Presidents —Mr. J. Mordy Lambe, City Electrical Engineer of East London and Mr. J. H. Gyles, City Electrical Engineer of Durban ,both of whom retired from Municipal service on reaching the retiring age, but, we regret in Mr. Lambe's case ill health unfortunately accelerated his retirement.

We can ill afford to lose the membership of our leading Municipal Electrical Engineers—Mr. Lambe having joined the Association so far back as 1919 and Mr. Gyles in 1929, but we are pleased that in Mr. Gyles' case he still retains his association with us by having transferred to the class of Associate, as have other retired Past Presidents.

LICENSING OF ELECTRICIANS.

At long last the Bill for the Licensing of Electricians has become law, having been Gazetted on May 10th, 1939, and is known as the "Electrical Wiremen's and Contractors' Act," No. 20 of 1939.

While this Association can take credit for so active a part in bringing this measure forward, there still remains the Regulations portion that has yet to be legalised before the Act can be fully applied. These Regulations have been drafted for some little time and are a very comprehensive set of Regulations approved by those concerned.

At our Capetown Convention a Sub-Committee was appointed to carry out negotiations and it was hoped that these Regulations might have been promulgated under the Factories Act, but that has

been found impracticable, and it has been pointed out by the Government authorities that the promulgation of such could only be arranged by each Municipality concerned.

As this will involve a big expenditure by each Municipality, it was felt that such expenditure could be shared by the grouping of the various Municipalities in each Province, who would then share in the one expense of translating, printing and promulgating, and with this end in view your Sub-Committee has been dealing with the matter, and their report is awaited at our next Convention.

PRESIDENT'S BADGE OF OFFICE.

The Council at our last Convention decided on the purchase of a President's Badge of Office, which has now come to hand. It is of a very pleasing design and is attached to a suitable collarette, on which is attached bars bearing the names of all our Past Presidents, and other bars will be added from time to time with the names of successive Presidents engraved thereon.

FINANCIAL.

The financial position of the Association is, I am pleased to say, in a satisfactory position, there being a small gain for the year of £2 7s. 8d. The income for the year was £25 lower than last year, due chiefly to fewer sales of Proceedings as well as a lesser number of advertisements.

The expenditure, however, was approximately £95 up on that of last year, due to a much larger Proceedings issue as well as heavier Convention expenses, due to the six-day Convention as against the previous four-day one.

The arrears only amount to £2 2s. 0d. in respect of two subscriptions.

I am,
Mr. President and Gentlemen,
Yours faithfully,

E. POOLE,
Secretary and Treasurer.

10th October, 1939.

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS
of South Africa and Rhodesia.
REVENUE AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st August, 1939.

Expenditure:

	£ s. d.	£ s. d.
Convention Expenses—		
Reporting	42 0 6	
Printing advance papers	8 17 6	
Programmes and Badges	17 5 0	
Secretarial Expenses	32 5 4	
		100 7 10
Audit		3 3 0
Statistical Tables		10 0 0
Donation (World Power Conference)		10 0 0
Printing Proceedings		160 10 2
Sundry Printing, Stationery, &c.	27 12 0	
Less sales	13 18 0	
		13 14 0
Salary—Secretary		80 0 0
Secretarial expenses—		
I.M.E.A.	4 13 9	
Postages and Railage	19 1 2	
Telegrams and Phones	2 1 4	
Sundry	1 11 2	
		27 7 5
Bank charges	4 14 9	
Less recovered	5 3	
		4 9 6
Written off—		
Subscription, 1937/38		1 1 0
Balance being excess Revenue over Expenditure		2 7 8
		£413 0 7

Revenue:

	£ s. d.	£ s. d.
Subscriptions		226 16 0
Proceedings		81 5 0
Advertisements	78 15 0	
Less Commission paid	18 11	
		77 16 1
I.M.E.A.		5 18 6
Statistical Tables		21 5 0
		£413 0 7

BALANCE SHEET AS AT 31st AUGUST, 1939.

Liabilities:	£ s. d.	£ s. d.
Subscription paid in advance		2 2 0
Accumulated Fund—		
Balance as at 31/8/38	420 17 1	
Plus gain for year	2 7 8	
		423 4 9
Add accrued Interest Union Loan		48 19 2
		£474 5 11

Assets:	£ s. d.	£ s. d.
Investment—		
Union Loan Certificate	200 0 0	
Accrued Interest	48 19 2	
		248 19 2
Presidential Badge		31 8 ?
Sundry Debtors—		
Subscriptions for 1938/39		2 2 0
Cash at Bank		191 16 0
		£474 5 11

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 shown by the books.

J. C. JOHNSTON, C.A. (S.A.).
Auditor.

10th October, 1939.

The President: I will ask someone to move that the report and accounts be adopted.

Mr. Rodwell (Johannesburg): I have much pleasure in moving their adoption.

Mr. Hugo (Pretoria): I second.
Agreed.

ELECTION OF PRESIDENT.

The President: We now have to elect a President for the ensuing year, and I have very much pleasure indeed in proposing Mr. I. J. Nicholas, the Electrical Engineer of Umtata. Many of us have known him for a long time, and I feel that the interests of the Association will be safe in his hands. (Applause.)

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

The President: It has been proposed and seconded that Mr. Nicholas, of Umtata, be our President for the ensuing year. If there are no further nominations I have much pleasure in declaring him elected. (Applause.)

The newly-elected President was then invested with his insignia of office.

The President (who performed the ceremony): I know he will wear this chain of office with dignity and credit to the Association. (Applause.)

Mr. Nicholas then took the Chair.

The President: Ladies and Gentlemen, I thank you very much for the honour you have paid me, and which I appreciate very highly. It is now my privilege to call upon the Vice-President to give us his valedictory address.

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Retiring President's Valedictory Address.

By H. A. EASTMAN, B.Sc., A.M.I.E.E., M.I.Loc.E.

Gentlemen,

It was inevitable that the carrying out of work on behalf of your Association and of that work in which it is interested falling within the immediate province of other bodies was to some extent hindered by the feeling of unrest that was brought about by the series of international crises that occurred throughout the past year.

I am pleased to be able to report, however, that since our last Convention the Electrical Wiremen and Contractors Act, 1939, has received the Governor General's sanction after a difficult passage through the House of Assembly. This marks the culmination of thirteen years of effort on the part of your Association to interest sufficiently the powers that be to recognise in this way the importance of ensuring as far as possible that only properly trained and conscientious workmen will be engaged in electrical wiring installation work. The date upon which the Act will be brought into operation has not as yet been fixed, pending, I understand, the completion of the work of drafting regulations under which details of the provisions of the Act will be carried out.

The extent to which the provisions of the Act can be applied is, in a measure, linked up with the introduction of standard regulations for the supply of electricity, for it is obvious that the intention of the Act cannot be given effect to fully unless standardised wiring regulations exist for application in the various areas in which the Act will be made to apply. The Sub-Committee appointed at the last Convention to go into ways and means of

bringing about the standardisation of electricity supply regulations has done a great deal of work in this connection which forms the subject of a separate report to be submitted at this Convention.

The Sub-Committee has been confronted by many difficulties, not the least of which have arisen out of the existence of different systems of control exercised over electricity undertakings by the respective Provincial Administrations in the four Provinces. Fearing that these difficulties might prove to be the cause of considerable delay in reaching the desired result by concerted action on the part of municipalities, representations were made early in the year on behalf of your Association and also on behalf of the South African Institute of Electrical Engineers to the Government Department concerned that the Government, in order to give full effect to the provisions of the Electrical Wiremen and Contractors Act, should itself introduce wiring regulations for universal adoption as a standard. The Department concerned recognises that a standard set of regulations governing the supply and installation of electricity for adoption throughout the Union is very necessary and deems the regulations proposed by the Association to be suitable for the purpose, but it has been found impracticable for the Government itself to promulgate them.

During the past year the Government introduced the Hire Purchase Bill which had as its object the elimination of abuses and malpractices that have been found to exist in certain classes of hire purchase and instalment sales business. The Bill, however, included certain provisions which it was felt by some undertakings might adversely affect their development in certain directions. The fundamental principle on which the objections were founded was that hire purchase arrangements forming part of a scheme for the development of a public service, that is to say in this instance, the supply of electricity from a public supply authority had entirely different objects

from those appertaining to hire purchase sales of goods by private concerns made for their own individual benefit. Representations accordingly were made on behalf of the Council of the City of Capetown and also the Electricity Supply Commission to a Select Committee appointed to consider the subject of the Bill on matters to which it was felt that exception should be taken because of their inapplicability to the non-competitive hire purchase arrangement in operation by those undertakings. The representations, however, were not accepted and the Bill as amended by the Select Committee still contains provisions which are no less objectionable to supply authorities than those to which exception was taken in the first draft. It is expected that the Bill will be brought up for a second reading during the next session of Parliament when an opportunity may arise of drawing further attention to the points at issue.

As you will have seen from the Annual Report of the Secretary and Treasurer, the affairs of the Association are generally satisfactory.

The losses in membership are balanced by the number of new members, and the revenue exceeds expenditure by a small margin.

I am very glad to be able to say that none of the losses in membership have been caused by the great Reaper, though I am sure that you join with me in regretting that our old enemy, Time, has removed from the active list of members two past presidents of the Association, Messrs. J. H. Gyles of Durban and J. Mordy Lambe, who both retired on pension during the year from the positions of City Electrical Engineer of Durban and East London respectively. Mr. Gyles' services are, however, not entirely lost to the Association as he has requested transfer to the list of Associate Member. To both of these gentlemen we express the sincere wish that they may be spared many

years of health and happiness to enjoy at their leisure the fruits of a lifetime spent in unremitting service to the public.

It is a source of gratification to your Council that this Convention should be so well attended notwithstanding the feeling of unrest, not to say of uncertainty, that has been brought about by the recent change from peace to war conditions, for this must be taken as an indication of the very great interest taken both by Council and Engineer members in the work of the Association and all that it stands for.

At our last Convention attention was drawn, in the course of the Presidential address, to the need for bearing in mind that after a spell of favourable conditions for development the time was approaching when plant and equipment required for extensions would have to be bought on a rising money market to enable electricity to be sold at the lower charges for which demands are constantly being made notwithstanding the tendency towards a steady increase in the unit cost of production because of rising costs of fuel, wages and overhead expenses. When referring to those matters at that time the present-day state of affairs was not contemplated, and although our hands are now tied to some extent in following up the means then discussed of meeting the position, it may nevertheless be worth while briefly to consider the outlook for the electricity supply industry under present-day circumstances. The main underlying factor in this matter is, of course, the complete dependence of industrial development on the existence of adequate supplies of electricity at economic rates and the impossibility, without supplies of electricity, of obtaining the social amenities which we look upon as being, and are in fact, essential to civilised existence.

A comparative analysis of the industrial position in South Africa and in European countries during the past few years brings out the interesting fact

that whereas both in South Africa and overseas industrial expansion has taken place on a large scale, this in South Africa has been born of confidence in the future, whereas elsewhere it has developed out of widespread lack of confidence.

A minor boom in industrial expansion that has been brought about mainly—as is the case in overseas countries—through the production of goods for a special purpose for use within a short time, and whether used during that time or not are either wasted or become obsolete, is fundamentally on a less secure foundation than one such as is the case in our country that has arisen out of steady progress in the production of goods for long-term beneficial use by the community.

The reason for this, of course, lies in the fact that development of this kind is likely to be adversely affected to a far less effect by changing conditions elsewhere and may even be enhanced at the expense of countries not so fortunately placed in their relations with others.

Accepting the dictum that history repeats itself as still holding good, even the most pessimistic among us must be heartened when he considers the position of the electricity supply industry before and after the Great War. When he finds, for instance, that during the period 1915-1918 the use of electricity for industrial purposes in the Union of South Africa nearly doubled itself and when he realises that at the outbreak of the present war the demand for electricity in the Union was increasing at a greater rate than ever before, and especially when he appreciates the fact that this increase was due in approximately equal proportions to uses for mining and other purposes. In this connection it is to us particularly noteworthy that the present-day supply of electricity by municipalities alone to private consumers, amounting to about 1,000 million units per annum, is approximately equal to

the total output for all purposes at the end of 1918, and that of this quantity nearly one-half is used for domestic purposes.

Since then the number of factories in operation has doubled itself and the annual output has increased fourfold. Moreover, with few exceptions these new factories have been established mainly to supply the home market, a market which cannot be seriously affected by war conditions such as at the present time we expect will continue to exist in this country.

Turning now to the probabilities for the domestic use of electricity in the immediate future. we come naturally to the special value of such supplies to electricity undertakings because of their inherent stability, a feature to which reference has been made on many occasions at our Conferences when comparing sales under this heading with those for industrial purposes in times of trade depression. So far from an immediate general trade depression being likely, however, the indications are that industrial activities will increase for some time to come. The only check that might be experienced in the development of supplies for domestic purposes is that caused by the slowing down of one section of industry, namely building work, but even should this persist its effect will be small on total sales and can readily be more than offset through the field for increasing the sales in existing premises.

And finally regarding the immediate future, those of the older generation will remember that some of our undertakings during the Great War had actually to discourage the connection of new electrical apparatus because of the impossibility of making the necessary extensions to power station and distribution plant and equipment.

At that time no material used on a large scale by electricity supply undertakings was manufactured in this country, but in this respect we

find an entirely different position now in that since then works for the manufacture of lamps, cables, structural steelwork, poles and other items in general use have been established.

Moreover, as compared with the position that on the outbreak of the Great War the country from which we obtained most of our supplies of this kind was totally unprepared to continue her export trade, the position nowadays has been clearly defined by the President of the Board of Trade in a recent statement to the effect that the British Government attaches vital importance to the maintenance of export trade at the present time and that it trusts that manufacturers and exporters will in the national interest take the fullest advantage of all opportunities for export.

Thus in every direction the indications are that so far from war conditions bringing about a check in the development of the electricity supply industry, they will tend to establish it more firmly than ever to the still greater benefit of the inhabitants of what even at the present time on the basis of consumption per head of population is one of the leading countries in the world.

Taking a glance into the more distant future, with evidence in all directions of the destruction of life and property inseparable from hostilities, it is remarkable, though deplorable in its inference, to find that war conditions bring about a speeding up of developments of all kinds at an altogether abnormal rate and that these developments invariably bring about the still more extensive employment of the universal servant, electricity. That this will happen again is certain, for whilst civilised life exists the supply of electricity as a national service essential to its existence must continue to expand.

In conclusion, on handing over the reins of office to the incoming President I take this opportunity of wishing him every success. He will find, like

all of his predecessors have found, that there exists in the Executive Council a common bond of interest in the work of the Association so firmly established that he can look forward with confidence, should occasion arise, to receiving hearty co-operation and unstinted assistance in all matters of policy, and he will find also that the details of its work are ably handled by our Secretary and Treasurer, Mr. E. Poole.

I was absent from the Union for a little over three months from May to August of this year, during which period Mr. J. H. Gyles very kindly acted on my behalf in so far as the principal affairs of the Association were concerned and Mr. Swingler carried out certain work relating to electricity supply regulations that would have devolved upon me had I been present in Cape Town. To these gentlemen I tender my special thanks for what they have done, and I would like to place on record also my appreciation of the enormous amount of work done during the year under difficult circumstances by the convenor of the special committee dealing with the standardisation of electricity supply regulations.

The President then read his address.

Presidential Address.

By I. J. NICHOLAS,
Municipal Electrical Engineer, Umtata.

Gentlemen,

It affords me great pleasure to take this first opportunity of expressing my thanks and appreciation of the honour you have conferred upon me, and through me, to the towns of the Transkeian Territories, more particularly Umtata, which is the first small town to have been accorded this great honour.

I do believe my election as President is due to the goodwill of the members of this Association in deciding to hold its seventeenth Convention at the Capital of the Transkeian Territories, and I have no doubt that no matter how small the town or village you come in contact with in the Territories, the people will give you a warm welcome.

Umtata, to most of the members of the Association, is just a spot on the map, but nevertheless important, and many members may have wondered what to expect from the town. I may say, however, that due to our hydro generating plants, the Council, through my advice, have been able to pilot the scheme through eighteen years of difficulty, and to-day the financial statement shows a surplus of £2,000 per annum. Due to this prosperous financial state, Umtata was in a position to invite the Association to hold this Convention here.

During your short stay in Umtata we hope your time will be enjoyably spent, for the Mayor and Councillors have arranged a full programme for your entertainment.

The revenue of the Electricity Department this year, will be £12,000, and as our population is barely 3,000, this means the revenue per head of population is £4 ; units sold, 550 per head. These figures compare with those of towns three times the size of Umtata.

You will notice the absence of large factories and works. We have none. Our revenue is derived from domestic and small industrial consumers. Low tariffs have resulted in Umtata becoming fully electrically minded. But before I outline the development of the Electricity Department I will, as briefly as possible, give some idea of the activities of our Native Affairs Department, "The Bunga," for I feel the prosperity of Umtata is very closely bound up with this Native Policy.

The Annual Session of the General Council opens at Umtata about March or April.

The General Council system was introduced in the Transkeian Territories in the year 1895 by the creation of District Councils in four districts for the better government and the general welfare of the Native people in the Transkei.

From this small beginning 44 years ago, by the year 1927, the system had gradually extended to all the districts in the Transkeian Territories (except Mt. Currie which is an European area and has only one Native location). The 19 districts of the Transkeian Territories General Council and the 7 districts of the Pondoland General Council amalgamated into one body known as the United Transkeian Territories General Council from the 1st January, 1931.

The General Council Constitution included provision for the appointment of an Executive Committee consisting of the Chief Magistrate, three Magistrates and four Native Members of the General Council.

The General Council consists of the Chief Magistrate of the Transkeian Territories as presiding officer, the Magistrates of the 26 districts and 82 Native members, i.e., three from each district and the Chiefs of Eastern and Western Pondoland, Tembuland and the Amagcaleka, who are ex-officio members.

The Session is conducted with open doors and procedure is more or less parliamentary in form. Considerable use is made of the Committee system.

The Territories comprise an area of 16,000 square miles inhabited by approximately 1,250,000, of which 18,000 are Europeans and 13,000 are Coloured.

The operations undertaken by the Council include agricultural and pastoral development; the maintenance of over 4,000 miles of roads and the construction of numerous bridges to meet present-day requirements; a large scheme of soil reclamation work, etc.; grants to five State-aided and seven mission hospitals and the half-cost of the treatment at Nelspoort Sanatorium of Native patients from the Transkeian Territories suffering from tuberculosis.

Since 1903 a sum of £4,400,000 has been spent by the General Council on Native development in the Transkeian Territories, and to-day a quarter of a million pounds per annum is spent by this Department.

This expenditure has all been met from taxes paid by Natives within the Transkeian Territories.

Thus it can be seen that the spending power in the Transkei is great and Umtata benefits thereby, with the result that all Municipal Departments have grown tremendously. In particular the records show that the Electricity Department has grown at a fast rate to keep pace with the other activities of the Transkeian Territories. In addition, credit must be given to Umtata's Council's policy of low tariffs, off peak hot water, hired hot water systems and electric ranges and hire purchase schemes.

The tariff for business is 4d. per unit for lighting and ¾d. for heaters and small power.

For private residences, after a monthly quota of approximately 2s. 9d. a room, all excess units over this monthly quota are sold for ¾d. nett.

For hot water, a flat rate of 1s. per 100 watts at "off peak" loads, controlled by timeswitch, which supply is available for 19 hours per day and has resulted in our having 170 hot water installations. Of this total 90 hot water installations are hired out to our consumers.

Of the 380 domestic consumers we have 154 using electric ranges for cooking purposes at ¾d. a unit. Of this total there are 44 electric ranges on hire.

As a result of this Department's scheme of hiring out hot water systems and electric ranges, the revenue has been increased by £2,000 per annum.

Due to the 134 Killowatt " off peak " hot water, the load factor has improved from 20% in 1928 to 44% in 1938.

Over the same period the sale of units has increased from 131,000 to 1,678,651, whilst revenue increased from £5,350 to £10,696. The estimate for 1939 is £12,000.

The loads have increased from 76 Killowatts in 1928 to 576 Killowatts in 1939.

The cost per unit sold has dropped from 10.53d. in 1928 to 1.53d. in 1938, and the working cost for 1938 was 0.45d. per unit sold.

Capital account stands to-day at £81,000 and capital cost per killowatt installed has dropped from £165 to £72.

Over the same period the consumers for light have increased from 340 to 492, and motor power users from 18 to 37 respectively.

Working expenditure has increased from £5,760 to £8,580. The deficit in 1928 was £400, and in 1932 £770, but there was a surplus of £2,100 in 1938. These figures speak for themselves.

On your tables you will find descriptive matter concerning the working details of the hydro plants, and together with my staff we will be only too glad to answer any questions and show you any special point which may be of interest to individual members.

I hope, as this is the first time the Convention has been held in one of the smaller towns, that those Engineers and Delegates who come from other smaller towns will find much of interest in our works and methods, and be able to take away pleasant and helpful memories.

Engineers and Delegates from the larger centres will come in contact with the difficulties of running a smaller town electricity supply, and I look forward to helpful suggestions during our informal discussions outside our actual Convention meetings.

In conclusion, Gentlemen, I am glad to see such a large attendance here, which in itself has justified your decision to be with us to-day.

VENUE OF NEXT CONVENTION.

The President: We now have to consider the question of the venue of the next Convention, and I shall be glad if someone will make a proposal.

Councillor Olley (Salisbury): I would like to propose that the next Convention be held in Salisbury. In regard to the date, I think the most suitable time will be during the first two weeks in October. I can assure you not only of a good welcome but that you will find much more in Salisbury than can be found in most of the smaller towns of South Africa. If you hold the Convention in October it will not be in the rainy season. As to our roads, we have a speed limit of fifty miles per hour. (Laughter.) You can get there and you can get back . (Applause.)

Councillor Baskerville (Salisbury): I second. We are tremendously interested in your next Convention being held in Salisbury. We very

much appreciated its being held there some years ago, and we would like to see you there again. I am sure you will have a hearty welcome.

Councillor Moore (Springs): You will remember that last year my Council extended an invitation to the Convention to come to Springs. We all understand the reasons why we should go to Salisbury next year, but I wish to say that we shall be very pleased to see you in Springs the following year.

The President: I feel I am voicing the feelings of the whole of the Convention when I say how greatly we appreciate the invitation that has been extended so cordially from Salisbury, and that we heartily accept it.—Agreed. We also appreciate the invitation extended by Springs for the following year.

ELECTION OF VICE-PRESIDENT.

The President: With regard to the election of a Vice-President, I would like to move the election of Mr. Clinton. of Salisbury. (Applause.)

Mr. Rodwell (Johannesburg): I have great pleasure in seconding that.

Agreed.

The Convention then adjourned for refreshments.

Upon resuming the election of officers was proceeded with.

ELECTION OF OFFICERS.

Past Presidents.

The President: The next business is the election of Past Presidents. Mr. Eastman is, of course, the Immediate Past President, but as Mr. Gyles, the next immediate Past President has retired

from Municipal service, I would like to nominate Mr. Gyles' predecessor—Mr. Rodwell, of Johannesburg.

Mr. Muller (Krugersdorp): I second that proposal.

The President: There being no other nominations, I have pleasure in declaring Messrs. Eastman and Rodwell as Past Presidents.—Agreed.

Councillor Members of Council.

The President: It is usual in electing Councillor Members on the Council to elect one from the town represented by the President, and the other from the town represented by the Vice-President, i.e., one from Umtata, and one from Salisbury. I would like to nominate Councillor Spilkin, and would like someone to nominate a representative from Salisbury.

Mr. Rodwell (Johannesburg): For the sake of continuity I beg to nominate Councillor Olley, of Salisbury.

Councillor Venter (Cradock): I beg to second Councillor Olley.

Mr. Eastman: I second Councillor Spilkin.

The President: There being no further nominations, I therefore have pleasure in declaring Councillor Spilkin and Olley elected.

Agreed.

The President: It is usual to have alternate Councillors. Will you please nominate two alternates?

Councillor Capell (Durban): I beg to nominate Councillor Berman, of Capetown.

Councillor Robbins (Pietermaritzburg): I would like to nominate Councillor Starkey, of East London. — Agreed.

Engineer Members of Council.

The President: We now have to elect four engineer members of the Council and it is usual to have one member who is near the Secretary.

The following five members were nominated: Messrs. Kinsman, Hugo, Pirie, Foden and Harvey, which necessitated a ballot.

The ballot resulted in the election of Messrs. Kinsman (Durban), Hugo (Pretoria), Pirie (Bloemfontein) and Harvey (Springs).

REPRESENTATIVE ON ELECTRICAL WIREMEN'S REGISTRATION BOARD.

The President: We now have to elect a representative on the Registration Board as provided for by the Electrical Wiremen's and Contractors Act. I would like to propose Mr. Rodwell.

Mr. Hugo (Pretoria): I beg to second.

Agreed.

SUB-COMMITTEE REPORTS.

The President: We will take the reports of the sub-committes, and I will first call upon Mr. Rodwell, who is our representative on the World Power Conference Sub-Committee to give us his report.

World Power Conference Report.

By Mr. A. RODWELL.

Mr. President and Gentlemen,

At our last Convention at Capetown I reported that owing to the unsettled state of Europe the international crisis had seriously interfered with the work of the World Power Conference.

It will be remembered that the first World Power Conference was held at London during the year 1924; the second, at Berlin, in 1930; the third, at Washington, in 1936.

The objects of this, our Association, to promote discussion, to exchange experiences and to furnish technical and scientific information, follow closely that of the World Power organisation. This operates: To consider how sources of heat and power may be adjusted nationally and internationally by Conferences of engineers, technical experts, fuel experts and authorities on scientific and industrial research. It deals with technical education in different countries and considers means by which the existing facilities may be improved in addition to discussion on the financial and economic aspects of industry internationally.

The annual meeting of the International Executive Council of the Conference was held in Vienna during September of 1938 and representatives of 28 countries throughout the world attended. The Vienna Sectional meeting took place at the same time and 200 papers were presented. The third statistical Year Book of the World Power Conference has been published, together with other numerous publications and reports of International Commissions and Sub-Commissions. When we consider that at the last Conference meeting in Vienna, Czecho-Slovakia, Danzig Free City and Poland took part, the

realisation that the war has practically closed down this and other world organisations for international progress of the nations is more fully understood. In the meantime, it has been arranged by Sir Harold Hartley, of Britain, that the headquarters should be moved from London to Arnhem, in the Netherlands, under the Chairmanship of the Vice-Chairman, J. G. T. Bakker, and it is hoped that it may be possible to proceed with some of the work in a neutral country until such time as the war clouds lift and this and similar organisations may again function freely for the advancement of science and the betterment of the peoples of the earth.

A. RODWELL.

The President: I thank you for your report, Mr. Rodwell. It is very clear and interesting. I would now like to have the report of the South African Standards Institution.

S.A. Standards Institution Report.

By Mr. A. Q. HARVEY.

This report is purely formal. Copies have been sent to the town clerks, and I believe the town engineers are also to get them. The specifications which have been accepted will be published shortly in the name of the S.A. Standards Association, and will be on sale. Than that I have nothing further to report.

Mr. President and Gentlemen,

This Report includes the work done by the South African Standards Institution during its fourth year's activity, for the period 1st June, 1938, to 31st May, 1939.

The Association is represented by the following bodies, who are all members of the Main Committee :—

Department of Agriculture and Forestry.
Department of Commerce and Industries.
Department of Irrigation.
Department of Labour.
Department of Mines.
Department of Posts and Telegraphs.
Department of Public Works.
South African Railways and Harbours Administration.
Association of Mine Resident Engineers.
Association of Municipal Electricity Undertakings of South Africa and Rhodesia.
Chemical, Metallurgical and Mining Society of South Africa.
Geological Society of South Africa.
Institute of South African Architects.
Institution of Certificated Engineers, South Africa.
Institution of Municipal and County Engineers (S.A. Branch).
Natal Institute of Engineers.
South African Institute of Electrical Engineers.
South African Institution of Engineers.
South African Society of Civil Engineers.
British Electrical and Allied Manufacturers' Association.
Electricity Supply Commission.
Natal Coal Owners' Association.
National Federation of Building Trade Employers in South Africa.
South African Chemical Institute.
Rand Water Board.
South African Federated Chamber of Industries.
South African Iron and Steel Industrial Corporation, Limited.
Transvaal Chamber of Mines, Consulting Engineers.
Transvaal Coal Owners' Association.
Transvaal Iron and Steel and Engineering Industries Federation.

MEETINGS.

During the past year eight meetings of the Committee were held. The average attendance at the meetings reflects a keen interest on the part of members in the work of the Committee.

DRAFT BRITISH STANDARD SPECIFICATIONS.

The following draft British Standard Specifications were examined by the Committee during the period under review:—

CE(CR)	8451	Mining Type Transformers (Revision of B.S.S. 355).
*CE(ELG)	8871	Tungsten-Filament Electric Lamps (other than General Service Lamps).
*CE(EL)	9010	Earth-Leakage Circuit-Breakers for Use on Consumers' Premises.
*CE(ELG)	9099	Street Lighting on Traffic Routes (to supersede B.S.S. 307).
CE(ELG)	9148	Steel Tubular Lighting Columns for Street Lighting.
CE(EL)	9260	Rubber-Insulated Cables and Flexible Cords for Electric Power and Lighting.
CE(EL)	9357	Distribution Boards (up to and including 100 and 250 volts to earth).
*CE(ELG)	9542	Classification of Symmetrical Light Distributions from Lighting Fittings B.S.S. 398.
CE(EL)	9312	Lamp Caps and Lampholders for Architectural Lamps.
CE(EL)	9786	Rubber Mats for Electrical Purposes.
CF(ELG)	406	Reinforced Concrete Columns for Street Lighting.
CF(EL)	490	Electrical Performance of Transformers for X-ray Apparatus.
CF(EL)	553	Electric Mains-operated apparatus for Radio, Acoustic and Visual Reproduction (Safety Requirements).
*CF(CR)	711	Trailing Cables for Mining Purposes.
CF(AC)	611	Electric Landing Lamps for Aircraft.
CF(AC)	612	Electric Incandescent Lamps (other than Landing Lamps) for Aircraft.
CF(CR)	1312	Bolted Flameproof Cable-Couplers Primarily for Use in Mines and having Portion capable of being Used as Detachable Dividing Boxes.
*CF(EL)	1539	Paper-Insulated Cables for Power and Light.
CE(ME)	9934	Trailing Cables for Electric Lifts.

CF(CR)	1234	Flameproof Electric Light Fittings for Use in Coal Mines and Other Places where Inflammable Gas or Vapour may be present in the surrounding atmosphere.
CF(EL)	1335	Cooker Control Units for Use in 2-Wire Circuits of not more than 250 volts declared Pressure.
CF(EL)	1943	Standard Voltages for Transmission and Distribution A.C. systems (Revision of B.S.S. 77-1932).
CF(WE)	2170	Rating of Electric Arc Welding Plant and Equipment, and for Welding Accessories.

Comments were submitted by the Committee on the draft specifications marked with an asterisk. The last four draft specifications on the above list will be further discussed at later meetings.

ADOPTION OF BRITISH STANDARD SPECIFICATIONS AS SOUTH AFRICAN STANDARD SPECIFICATIONS.

98—1934	Dimensions of Edison-Type Screw Lamp Caps and Lampholders.
269—1927	Rules for Methods of Declaring Efficiency of Electrical Machinery (excluding Traction Motors).

STANDARDS ASSOCIATION OF AUSTRALIA.

The following draft Australian Standard Specifications were discussed by the Committee:—

C. 81 — Trailing Cables for Mining Purposes.
C. 123 — Ap — The Electrical Equipment of Petrol Service Pumps.
C. 117 — Ap — Lampholders.
E. 32 — Ap — Road Traffic Control (Electric) Light Signals.
C. 122 — Ap — Plug Socket Adaptors.
C. 126 — Ap — Transformers for the Production of Extra-Low Voltages.

STANDARDS ASSOCIATION OF NEW ZEALAND.

The following New Zealand draft Specifications were examined:—

1094 Plugs and Sockets of the Flat Pin Type for Use on 10 amperes 250 volt Circuits.

1125 Recommended Illumination Values.

INTERNATIONAL ELECTROTECHNICAL COMMISSION.

At a meeting of the Committee held on the 8th November, 1938, the Chairman summarised the report of Dr. Bernard Price, who, as the official South African delegate, attended the Plenary Meeting of the International Electrotechnical Commission.

At a meeting held on the 9th May last, it was agreed that the suggestion be put forward that Mr. C. J. Monk, now overseas, be asked to represent the Institution at the International Conference on Large Electric High-Tension Systems in June, to be held under the auspices of the Electrotechnical Commission in Paris.

The Specifications and the reports of the meetings of the various technical advisory committeees, published by the Commission have proved of great interest to members.

Following the Union Government's decision to become a member of the International Electrotechnical Commission mentioned in the last Annual Report, the Institution has been regularly supplied by that Commission with the minutes of its various Advisory Committees and other publications.

INTERNATIONAL CONFERENCE ON LARGE ELECTRIC HIGH-TENSION SYSTEMS.

An invitation having been received for the Institution to be represented at the forthcoming International Conference on Large Electric High-

Tension Systems to be held in Paris under the auspices of the International Electrotechnical Commission, Mr. C. J. Monk, Assistant Engineer (Electrical) of the Victoria Falls and Transvaal Power Company, Ltd., and Chairman of the Electrical Engineering Sectional Committee of the Institution, has kindly consented to represent the Institution at the Conference in question.

ACKNOWLEDGMENTS.

The Committee takes this opportunity of expressing its indebtedness to the following sources for help in the examination of draft British Standard Specifications and in the consideration of the adoption of British Standard Specifications:—

Municipal Electrical Engineers of Johannesburg, Durban, Cape Town, East London and Port Elizabeth.
Public Works Department.
Department of Posts and Telegraphs.
Union Steel Corporation of South Africa, Ltd.
South African Railways and Harbours Administration.
Victoria Falls and Transvaal Power Company, Ltd.
South African General Electric Company, Ltd.
African Cables, Ltd.

A. Q. HARVEY,
Representative.

Springs,
4th September, 1939.

The President: I thank you, Mr. Harvey, for your report. I now call on Mr. Rodwell, as our representative, to give us his report on the Safety Precautions Committee.

Safety Precautions Committee Report

By Mr. A. RODWELL.

Mr. President and Gentlemen,

During the year under review, two meetings only were held, both being devoted solely to the promulgation of the new draft Electricity Supply Regulations. This matter was being considered simultaneously by the Supply Regulations Sub-Committee of our Association. The members of the Safety Precautions Committee meet in Johannesburg, and it is a disadvantage that, owing to the great distance from Johannesburg of our Association's Supply Regulation Sub-Committee members, it is not possible for them to hold joint meetings when dealing with matters which affect our Association members. I would suggest, however, that it is desirable that a member of the Association's Supply Regulations Sub-Committee should attend meetings of the Safety Precautions Committee, so that expression could be given to the views of each Committee and the co-ordination of their work thereby facilitated.

A. RODWELL.

Mr. Milton (Johannesburg): On the Safety Precautions Committee we have as our representatives Mr. Wright, of Benoni, and Mr. Rodwell, of Johannesburg.

Mr. Rodwell (Johannesburg): That is perfectly correct. When speaking of this matter on my report of the work of the Safety Precautions Committee, I pointed out that whilst our Association was represented there, no member of our Association's Supply Regulations Sub-Committee was a member of the Safety Precautions Committee and I felt it desirable that the Chairman of our Supply Regulations Sub-Committee should sit on the Safety Precautions Committee to assist to co-

ordinate the work of the two Committees when dealing with maters affecting our Association, and I should like to withdraw from the membership of the Safety Precautions Committee in favour of Mr. Harvey, the Chairman of our Supply Regulations Sub-Committee.

Mr. Venter (Cradock): I support Mr. Rodwell's suggestion that a Supply Regulations Sub-Committee member sit with the Safety Precautions Committee.

Mr. Milton: May I call attention to the fact that the Safety Precautions Committee is a standing Committee. It is, therefore, not for this Convention to nominate or elect members to sit on that Committee.

Mr. Rodwell: The Safety Precautions Committee is a very live Committee indeed and includes the following representatives :

S.A. Institute of Electrical Engineers	3
Institution of Certificated Engineers	3
Association of Municipal Electricity Undertaking of S.A. and Rhodesia	2
National Federation of Building Trade Employers	1
Electricity Supply Commission	1

ELECTION OF COMMITTEE REPRESENTATIVES.

The President: I now call for nominations for our representatives on the various Committees.

WORLD POWER CONFERENCE:

Mr. Harvey: I propose Mr. Rodwell (Johannesburg).

Mr. Eastman: I beg to second.

Agreed.

S.A. STANDARDS COMMITTEE:

Mr. Pirie (Bloemfontein): I propose Mr. Harvey (Springs), with Mr. Wright (Benoni) as alternate.

Councillor Bloe (Port Elizabeth: I second that.

Agreed.

SAFETY PRECAUTIONS COMMITTEE:

The President: I call for nominations for the Safety Precautions Committee. The retiring members are Mr. Rodwell and Mr. Wright.

Mr. Foden (East London): I propose their re-election.

Mr. Bevington (Knysna): I beg to second.

Mr. Rodwell: Following upon what I have stated previously, I am prepared to withdraw, and would rather like to do so in favour of the chairman of the Supply Regulations Sub-Committee.

Mr. Wright (Benoni): As a member of that sub-committee, I do not think we all realise the amount of work put in. I support the re-election of Mr. Rodwell, who has done most valuable work.

Mr. Milton: In view of Mr. Rodwell's position, I do not think he should stand down. His services are invaluable.

The President: Those in favour of Mr. Rodwell and Mr. Wright please signify.

Agreed.

Mr. Wright: I think it is the intention of the Association that the Chairman of the Regulations Committee should be on the Safety Precautions Committee. If Mr. Harvey could be elected it would be a good thing.

Mr. Rodwell: Yes; I feel that the Chairman of the Supply Regulations Committee should be added to that Committee, with their sanction.

The President: It is for the meeting to decide.

Agreed.

The President: We now come to the report of of the Regulations Supply Committee.

Mr. Harvey: I have prepared a report, which has been printed and circulated, but since I have come to the Convention one of our members has handed me an 11-page letter on the same subject, which I have not as yet had time to read. The subject happens to be a very large one and it will occupy some little time and create some discussion, and as members are scattered all over South Africa I feel I would like to have a meeting of the sub-committee before the matter is discussed by the Convention. If this matter could be left over for some future date we can discuss it and put up recommendations from sub-committee of the Association.

The President: Are members in favour of that suggestion?

Agreed.

Mr. Rodwell: I take it that the Chairman of the sub-committee will bring the matter forward at the earliest possible moment?

Mr. Harvey: That is the idea. Perhaps the sub-committee can meet some time this afternoon.

The President: Yes, I think that can be arranged.

DATE OF NEXT CONVENTION.

The President: We still have a little time at our disposal for discussing any question membera might like to bring forward.

Mr. Wright: I would like to suggest that next year's Convention be not held in October or November. I think it should be held about Easter. This might well be considered by the Council.

Councillor Capell: I support Mr. Wright. Last year I pointed to the danger of the various Municipal Conferences clashing. To-day there is a Traffic Conference at Capetown, there is our Convention here, and in less than two weeks we shall have the Transport Conference. In these circumstances it is difficult for Councillors to do their duty and attend all of them. Apart from that there is the question of the municipal elections. During October in most towns the elections are being contemplated or the Councils are forming their new committees. I would again emphasise that the Convention be held earlier in the year, but not later than July.

Mr. Foden (East London): I would like to endorse the remarks of the previous speakers. In October and November we are usually busy with the estimates which are a very important factor.

Councillor Berman (Capetown): I hope you will not fix Easter, as the Treasurers' Conference is on then. I suggest that August is the best month.

Councillor Olley (Salisbury): In May we are having an Engineers' Conference in Salisbury. There are other Conferences in the early part of the year, and there are also the Jubilee celebrations.

Mr. Rodwell: I think we all appreciate the difficulties confronting Salisbury by having so many Conferences there. While that may be so, it must be realised that it is extremely difficult for Councillors to get away, and if it were possible for Salisbury to push the date forward a month it would be a great advantage to quite a number

of people. I would like to suggest that the Convention be held in August or September. We must take Salisbury's position into consideration.

Mr. Seller (Boxburg): My Council feels that the Convention is held at the wrong time. I support the contention of Mr. Wright.

The President: I thank you for your remarks and suggestions. I think it is advisable for the Council to consider the matter and report.

Agreed.

RELIEF OF RATES.

Councillor Venter (Cradock): There are many members who would like to know the position in regard to the question of the Relief of Rates. My Council is particularly interested in the subject.

Mr. Eastman: In reply to Councillor Venter's question, the Relief of Rates Sub-Committee has not held a meeting during the year and has not prepared a report for submission at this Convention.

It will be remembered that at the last Convention it appeared that a considerable amount of the opposition to active steps being taken to give effect as far as practicable to what I think the majority of us consider to be the right thing, namely, that contributions towards the relief of rates should, if made at all, be strictly limited in their amounts, was based on the fact that many Municipalities were so hard hit financially through the de-rating Act that assistance from the Electricity Department was considered a vital necessity. It was clear also that if substantial relief from the financial burden of the de-rating Act were made the Municipalities concerned would review their attitude on the question.

Subsequent to the last Convention the Government announced that it was prepared to discuss the question of financial relations between it and Municipalities but soon after the outbreak of hostilities it was made known that these discussions were to be postponed, and accordingly I, as Convenor of the Special Committee, had assumed that no useful purpose would be served at the present time by resuscitating the matter at this Convention.

Councillor Robbins (Maritzburg): I certainly do not think that this matter has been buried. There are other things besides interment. I feel that ultimately the question will be settled, but not at the present time. There are many things to be settled between the Government, the Provincial Administrations and the Municipalities, and until we know where we are and until the Government stops shoving responsibilities upon us with one hand and grabbing our revenue with the other we shall not be in a position to deal with this question satisfactorily. There is a tremendous amount of expediency in this matter.

It is impossible to consider the question of the disposal of electricity profits until financial relations between the Union Government, the Provincial Administrations and Municipalities have been satisfactorily settled. The present position reminds one of a train consisting of engine, passenger coach and guard's van, represented by the Union Government, the Provincial Administrations and the Municipalities. The engine moves back quickly, bangs into the passenger coach, and the latter passes the bang on to the guard's van, which alas, like the office boy, has nothing or no person to pass the bang on to. So we are obliged to suffer the mortification of seeing our revenue taken away at the very time when our financial responsibilities are increased. If we were to throw in our hand to-morrow, what would the Government do? The sooner the

Government stops this policy, the better it will be for South Africa, and we can then consider the question from a proper perspective. (Applause.)

Councillor Venter (Cradock): I should like to record our thanks to Mr. Eastman for the explanation, but feel that the Convention should come to grips with a matter of such importance, and in the circumstances move that the same committee remain in office for the ensuing year, so as to prevent the matter being shelved, and I express the hope that they will find it possible to furnish a comprehensive report at our next convention.

The Convention adjourned at 12.50 p.m.

TUESDAY, 21st November, 1939.

The Convention resumed at 9.30 a.m. in the Town Hall, Umtata, with the President in the Chair.

The President: Before we proceed with the ordinary business, Mr. Hugo has a resolution which he wishes to move.

BANKING.

Mr. Hugo: I wish to move the following:

> "That this Convention reaffirms the usual banking resolution in regard to the operation of its banking account with the Standard Bank of South Africa."

Mr. Clinton: I second.

Agreed.

DATE OF NEXT CONVENTION.

Mr. Rodwell: At yesterday's discussion the Council went fully into the question of the date of the next Convention at Salisbury. Realising the difficulties confronting the various municipalities in connection with their annual elections it was decided that the best time to hold the Convention would be between the 16th and the 20th of September next year. That appears to be the most suitable date for those parties concerned. I formally move accordingly.

Councillor Robbins: I beg to second.

Agreed.

APOLOGIES.

The President: There is one thing that was unfortunately overlooked yesterday—to express on behalf of Mr. Castle (Capetown) his regret at being unable to be present at this Convention. So far he has attended every Convention, but this time he was unable to come on account of illness. It is nothing serious; merely a matter of taking a little rest. Mr. Castle wishes the Convention all success. (Applause.)

Councillor Berman: I would like to apologise for the absence of the Electrical Engineer of Capetown, Mr. Swingler, who is quite adequately represented by his colleague, Mr. Eastman.

Councillor Robbins: I also have to convey an apology on behalf of Mr. Ewer, the Electrical Engineer of Maritzburg, who sends his best wishes and hopes you will all have a very good time.

Mr. Rodwell: I have not to apologise for any laxity on the part of any of my Councillor members, but on behalf of the S.A. Electrical Engineers' Institution I have been asked to convey greetings with best wishes for a successful Convention.

The President: I now call upon Mr. Foden to read his paper.

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The Engineer.

His Education, Training & Duty to the Community.

By

A. FODEN, A.M.I.E.E., A.M.I.Mech.E., City Electrical Engineer, East London.

It will be appreciated at the outset that the field covered by the above title is enormous and being so will only be a brief résumé of conditions obtaining at present, and of such a controversial nature that it is sincerely hoped the discussion ensuing will be of greater value than the paper.

According to Chambers' dictionary, the definition of an Engineer is one who directs works or engines. Consulting the same authority it is found that the word engine means a complex and powerful machine, anything used to effect a purpose. Studying these definitions the necessity for Education and Training immediately become apparent.

In case there is doubt regarding the line of demarcation between Education and Training it may be desirable to again quote definitions. According to the above-mentioned authority the definition of Education is the cultivation and strengthening of the powers of body and mind, and Training is described as the practical education in any profession, art, or handicraft.

As responsible engineers we have a duty to the young men who aspire to the positions we now hold, and it behoves us to submit the present

education and training systems to an examination to ascertain whether everything possible is being done to ensure that the education and training of these young men is sufficient to enable them, at a later date to undertake their duties to the community for which their education and training should equip them.

The life of an engineer may form a parallel to the title of this paper inasmuch that it can be divided into three periods, preparation, achievement and usefulness, or the application of all that has been learned during the periods of preparation and achievement.

In case it would appear that the acquisition of all the knowledge that I consider an engineer should possess, would detract from the opportunities for enjoying the pleasures of life in the engineer's early years, I would quote the old Arabian proverb: "They who have not layen on sand cannot enjoy sleeping on silk."

EDUCATION

or

The Cultivation & Strengthening of the Powers of Body and Mind.

Accepting the definition that Education is the cultivation and strengthening of the powers of body and mind it becomes necessary to review the facilities for so doing. In South Africa the advantages of secondary and University education are fully recognised by all responsible bodies, and the availability of such institutions is, generally speaking, not beyond the reach of the average parent who is considering the subject of his son entering the engineering profession.

Assuming for the moment that education beyond the elementary school is out of the question for various reasons and it is necessary that a boy must commence his engineering career at the age of say 16, does this imply that he will not be a

successful engineer in later years? The answer to this question depends on several factors or characteristics of the boy himself. Does he possess primarily the adaptability or aptitude for becoming an engineer, and has he shown reasonable examination results during his school career? Finally, is the boy's physical condition such that in view of the probable arduous duties in later years he will not break down under the strain or otherwise be at a distadvantage?

Should all these questions be answered in the affirmative then the subject of his apprenticeship to the trade can be seriously considered.

I once heard a most interesting simile, i.e., the young mind can be likened to a portmanteau and that education is the process of unpacking and not packing, or in other words education should not be a process of cramming, but a process of showing how the mind can be utilised.

With average intelligence the boy at the age of 13 years will reach Standard VI, and at this stage his educational bent should be apparent for either Academic, Commerce or Engineering. On the assumption that Engineering is predominant, General Education should be continued to train the mind for the reception of Engineering Education and all that it implies. This being accepted it is desirable that the boy now has for his objectives the passing of the Junior Certificate examination at the age of 15 years and then the Matriculation examination at 16½ years.

The Matriculation examination having been passed the boy can be apprenticed at the age of 17. It is required by law that a probationary period of three months be served before the indenture is signed, and it will be appreciated that this probationary period is very necessary from the viewpoints of the employer, the parent or guardian and the prospective apprentice. At the

end of three months the boy commences his further education and elementary training in the profession of Engineering. It is at this stage that the sound elementary education previously mentioned forms the firm foundation upon which the further engineering education is built. During the entire period of apprenticeship attendance at Technical School classes is compulsory.

In so far as the East London Municipality is concerned, one afternoon per week is allowed to apprentices for the purpose of attending classes. This facility is extended throughout the entire period of apprenticeship.

During the three years from the age of 17 to 20 the apprentice should study for the National Technical Certificate, and at the age of 20 should enter and take his Advanced National Technical Certificate.

Two years only remaining before the expiration of his apprenticeship it is desirable that by the time the age of 22 is reached the apprentice is in possession of the Advanced Technical Certificate, Part 2.

At the age of 22 apprenticeship days are over and in possession of the Advanced Technical Certificate, Part 2, the young engineer should then prepare and endeavour to enter for the Graduateship Examinations of either the Institution of Mechanical Engineers or Institution of Electrical Engineers, the previous education and examinations forming excellent groundwork and having the added advantage of being fresh in the mind. It may seem that this continued series of examinations advocated is straining the mental capabilities of the young man, but at this age his mind is more adaptable and retentive than in later years when he may desire to posses the above qualifications but finds that to possess them is beyond his mental ability, having forgotten the excellent groundwork received during his apprenticeship days.

Having passed one of the Graduateship Examinations previously mentioned at the age of, say 23 or 24, the next objective should be the possession of the Union Government Engineer's Certificate of Competency. When this has been obtained the road is open for him to travel along to the objective which, during his apprenticeship years, he aspired to reach.

The question of whether a boy should continue his engineering education by going to a University should receive consideration. Opinions differ as to the value of a University career in connection with an Industrial training, but the practical advantage of possessing the breadth of mind and the higher standard of knowledge that it is the purpose of the University to impart is not in question. Many men, however, have attained eminence without University tuition, and the standard required for success in a number of Industrial occupations does not involve a full-time College course as an economic necessity. On the other hand, for those who aim at becoming engineers in the broader professional sense of the term, the higher standard of general and scientific knowledge that alone enables their services to be employed as required in any direction is very necessary, and it is for those that the Universities and higher Technical Colleges offer direct educational facilities that it would be foolish to ignore.

Assuming that a full-time College course is to be included in a particular scheme of training, opinions differ as to whether it should follow immediately upon the completion of the school period, or whether it should be taken after either the whole or portion of the practical training. Those who favour beginning the practical training as soon as possible do so mainly because it establishes an early association with labour and industrial conditions before the mind is subject to the somewhat specialised influence of University life. Those who disapprove this scheme do so

mainly because of the possibility that organised academic work may be entirely interrupted in those places where suitable educational facilities do not exist, or the student himself is neglectful of this side of his training. A compromise that is in favour in some quarters is the "Sandwich" system. This system, as the title implies, allows of alternating the practical and theoretical work consistent with the College terms, and the facilities extended by the industrial concern in which the student desires to spend his time.

TRAINING

or —

The Practical Education in any Profession, Art or Handicraft.

It is apparent from this definition that training must go hand in hand with education during the period of apprenticeship. Now what is a desirable practical education for the apprentice? Obviously the use of hand tools, machine tools, practical work in the form of wiring, cable jointing, switchgear manufacture, armature winding, fitting and turning. This does not, however, constitute all the training necessary. Character forming is essential during these early days in the embryo engineer's career and this subject should receive careful consideration.

The factors that are involved in character forming are many, but the following should receive serious consideration, ambition, initiative, and resource.

At this stage it may be desirable to deal just for a moment with ambition. Readers of Shakespeare will recollect Wolsey's speech to Cromwell in King Henry VIII, as follows:

> "Cromwell, I charge thee, fling away ambition: By that sin fell the angels; how can man, then, the image of his Maker, hope to win by it?"

Reflecting on the above extract, it may at first glance be considered that ambition is a questionable asset, but I am sure that we all appreciate that Shakespeare meant that one must not go to any lengths to fulfil one's ambition. Therefore, it is the method or means to be adopted in realising one's ambition that requires careful teaching and consideration and not the condemnation of ambition in its entirety.

Initiative and resourcefulness are qualities that must, if possible, be cultivated. In this direction the youth should be encouraged to bring forward any ideas he may have. Many of these ideas may be useless, but apart from any useful ideas which may be submitted the effect will be that he is regarded as definitely a part of the organisation. The team spirit is engendered and all that this stands for, and in later years he will or should appreciate that in the higher position that he may then hold he cannot hope to successfully control the organisation without the assistance of those holding subordinate positions. Training in two further attributes are necessary, these being loyalty and self-reliance. Loyalty in most cases is reciprocal and this loyal spirit can be cultivated by those in charge of the youth by not constantly attaching blame to him for misdemeanours that he may have committed.

Self-reliance is a necessity in the training of the engineer and when he is sufficiently versed in his craft, no hesitation should be entertained with regard to giving the youth a job of work to do which, in the opinion of those in charge, he is competent to carry out without undue supervision or instruction. Actions of this kind very soon beget a sense of responsibility.

It is desirable to take an interest in the boy's work to encourage the asking of questions. Many of us are aware of the boy who, although being quite good at his practical work, has not the

faintest idea of the fundamental principles of, say, the work of steam in a turbine or circulation of water in a boiler.

A most important feature that cannot be over emphasised is the importance of accuracy of measurement. The entire science of good engineering is built up on accuracy, and accuracy means efficiency. As an illustration of this, in 1765 Watt's difficulty for 10 years was to keep a steam piston tight. It is stated that he "wrapped it around with cork, oiled rags, tow, paper and other things, but open spaces were left." This is explained by the trouble experienced by Watt in boring his cyclinders, for he states " that in an 18-inch diameter cyclinder the long diameter exceeded the short by ⅛-inch at the worst place."

In 1774, John Wilkinson, of Bersham, hit upon the idea which had escaped both Smeaton and Watt, of making the boring bar heavier, running it clear through the cylinder and giving it fixed support at the outboard end. This arrangement proved so successful that Wilkinson bored cylinders for Boulton and Watt for many years, and in 1776 Boulton stated that " Mr. Wilkinson has bored several cylinders almost without error, one we have put up at Tipton does not err the thickness of an old shilling in any part."

It has been stated that the Watt engine only became a success due to the Wilkinson boring bar.

I have just disgressed for the moment to show that in those far off days the old engineers to whom we owe so much were constantly striving for accuracy which meant improving the efficiency of their inventions.

Cleanliness is a factor that is desirable. Although we appreciate there are many dirty jobs to do, it is necessary to impress the importance of cleanliness of the work. A clean appearance refelcts on the concern employing the boy.

Discipline is essential and there is no necessity to labour this subject except the requisite degree of discipline. In many cases the necessity for rigid discipline calls for investigation and perhaps a little self-examination. Many youths, in the opinion of some employers, may require rigid discipline but if an appeal to their sense of loyalty and responsibility was made this requirement may not be so evident. May I be permitted to digress from the subject of the apprentice to that of the employer. Many who hold the reins of authority are of opinion that they have a duty only to those above them, whereas it should always be remembered that in addition to this there is a duty to those below them, the ideal motto being "I serve." The personal touch goes a long way in cultivating *esprit de corps* and it is a good example to the youth for those in senior positions to take a personal interest in the welfare of those in subordinate positions. In this manner a senior official shows his efficiency by turning out the work, not by bullying but by the absence of bullying. In other words co-operation by every member of the staff is the object lesson which should be given to the young engineer and as I stated at the termination of a previous paper I gave overseas many years ago "that to achieve this desirable objective the study of the human factor is involved equally with the scientific principles of engineering."

It is appreciated, I am sure that training continues a long time after apprenticeship days are over, and training which is obtained in conjunction with experience is doubly helpful in later years. How can one gain this desirable asset? The answer to this is travel and change of conditions and surroundings when finally the wheat is sifted from the chaff. Change and travel tend to formulate that desirable asset previously mentioned, self-reliance, and in addition that other closely linked asset, initiative. The young man has had the courage to cut adrift from his old surroundings and in going to new pastures has

the opportunity of absorbing fresh ideas, customs, characteristics and perhaps languages, all of which cannot be measured by the pecuniary yard-stick.

The time is rapidly approaching, if not actually arrived, when the engineering industry is becoming more of a commercial undertaking than a technical accomplishment. This being so I would stress the importance of having the knowledge to combine the technical with the commercial factors so that an economically sound engineering proposition is the result.

Daily the modern engineer has to deal with the financial aspect of an engineering proposition, involving frequently the effect of interest and redemption on the capital cost of the scheme.

Whilst on this subject I cannot help quoting an extract from an article I read in the "Electrical Times" some months ago which was as follows:

> "The engineer is greatly concerned with finance. It is his business to do for £1 0s. 0d. what a non-technical man would do for £2 0s. 0d. or perhaps £5 0s. 0d. Why have voltages gone up from 1,000 volts to 132,000 volts? Why have steam pressures risen from 150 lbs. saturated to 1,200 lbs. pressure at 950° temperature? I have discussed these problems with non-technical men and the reply they give is a vague 'Oh, of course progress has to come, you can't stop it and you engineers enjoy experimenting with ratepayers' money.'
>
> "Suggest to your man that the engineer wears himself out for financial reasons, that he gets nothing for it if he succeeds and that he loses everything if he fails, and the answer is, 'I don't agree with you. An engineer doesn't understand finance, that's not his job. He knows about engines and that's that.'"

Reverting to the fact that training continues after apprenticeship and on the assumption that the young engineer aspires to the position of

manager, the necessity for expert understanding of his duties is very evident. Therefore, from the commencement of his career until he finally retires the "student" can never honestly say that he has ceased to learn or has progressed beyond the stage when further knowledge is of any value.

The duties of the manager or chief engineer are multifarious and are no longer confined only to the running and maintenance of plant. Briefly, he must be able to successfully :

(1) Direct the general policy of the business.

(2) Control the finances of the business.

(3) Control accounts with reference to the sale and purchase of materials necessary in the conduct of the business.

(4) Decide upon the efficient production and distribution of the products of the business.

(5) Conduct the business to the requirements of the "Human Element" so that all staff is contented in carrying out their respective duties.

This formidable list of requirements shows that not only has the successful manager to have the technical knowledge but also the administrative and commercial knowledge usually associated with his business.

It is now obvious that the engineer should be educated and trained not only in the science of engineering, but in business management or industrial administration and economics. The reason for this is due to the amalgamations that are taking place not only in the production of electricity but in the engineering industry generally. The conditions are rapidly disappearing when the manager or chief engineer has to understand the intricacies of his plant, and so these duties are usually relegated to one of the

specialists in that branch of engineering science. This condition has been recognised by the Institution of Mechanical Engineers for many years and recently I believe by the Institution of Electrical Engineers, and consequently the subjects of "Fundamentals of Industrial Administration" and "Engineering Organisation," Management and Economics" respectively, are compulsory in the former examination and optional in the latter examination.

While the manager or chief engineer cannot be considered to be an expert in accountancy and law, the advantage of a knowledge of these subjects, together with those referred to above, tends to facilitate the ability to express clearly the viewpoint brought forward, due to the development of ordered thought and expression.

How often is the manager trained purely as an engineer at a disadvantage when engaged with a lawyer or accountant on a controversial subject, or even with the City Treasurer and Council when discussing the vital question of the ultimate destination of the surplus profits of the electricity undertaking. At the risk of labouring the point, the ability to express one's opinion in a concise and convincing manner is a quality, the value of which cannot be overrated.

The engineer is frequently prone to subordinate administrative and financial subjects to the technical and practical aspects of engineering with the result that when he comes forward with a scheme he is on occasions over-ruled due to the effect of external administrative and financial influences. Therefore, is it not important that the engineer's training should so equip him that he can withstand such attacks which may wreck his scheme, purely due to him not being able to show in a convincing manner its desirability or even necessity. This convincing manner is obviously attained by study, training and experience.

The subjects of Education and Training having been briefly considered the question may reasonably be asked, to what do they lead, and the answer may be given in the one word "Skill."

Two definitions of this word are "a familiar knowledge of an art" and "dexterity in practice."

In these modern times of standardisation skilled men are unfortunately grouped together with the result that very frequently they are considered as having equal value, skill being regarded as a standardised commodity.

The fallacy of this assumption is very evident when it is realised that skill depends upon the ability, education, training, experience and characteristics of the individual. A good engineer will not necessarily make a good manager, but given the education and training previously referred to the possibility of his so doing is greater than it would have been should he have been educated and trained in another profession.

Dealing with the good engineer who, due to lack of the characteristics and other assets required in a managerial position, he should be able to satisfy his reasonable ambitions due to recognition in a tangible manner by his employers, without having to resort to resigning his position for another where such assets are recognised. Experience has shown that the frequent changing of staff personnel is a practice that cannot be too greatly deprecated and to all of us here the reasons are obvious. Technical progress is necessary to ensure the industrial future of a country and to provide this the skilled hand and brain is of paramount importance. Financial, administrative, commercial and technical experts occupy their relatively important positions in industry but the skilled man is indispensable.

DUTY TO THE COMMUNITY.

To-day the engineer occupies a prominent position in the community for reasons which to all of us are apparent. Research by scientists and engineers have brought and continue to bring about radical changes in the conditions of life, and in doing so the responsibilities and duties of the engineer to the community have increased tremendously beyond those accepted by him a few years ago. For instance, consider the conditions of to-day in connection with the standard of living, improved transport, lighting and sanitation as compared with those obtaining a few years ago. Speed and still more speed is the order of the day. The public appreciate all these amenities which are the product of the engineer's skill, but how often are the persons responsible for the product appreciated?

The engineer to a very great extent is reticent and does not loom largely in the public eye but nevertheless his public spiritedness and sense of responsibility is no less than that possessed and displayed by members of other professions. Consequently and in all equity he should receive the same consideration, recompense and quota of bouquets when they are being distributed.

Engineers in recent years have been made the target for undesirable criticism, i.e., they are responsible for many of the economic and social evils from which the world suffers to-day and that they are putting into the hands of men powers and instruments which they do not know how to use in a correct manner.

Our profession is prone to such attacks as we occupy a peculiar position in industry inasmuch that we only form part of the industrial concern by which we are employed. The primary object of that concern may be financial profit and not service to the community. The engineer cannot

exercise the same individual control over the services he renders to the community as the doctor or lawyer, and as a consequence he cannot be held responsible for the uses to which his products are put.

Medical men may sit in conference and be quite satisfied that as a result of the progress of their technique the human race will benefit. This happy state does not exist with the engineers. They may make apparatus for the benefit of mankind but the application of the apparatus is not under their control and instead of being for good may be for evil. Whether the results benefit or otherwise the human race, depends on organised society and the moral and intellectual level of those who constitute it. In view of this undesirable state of affairs the time is rapidly approaching when the engineers must take an active part in the world's economic affairs and not be satisfied with only producing improved amenities of life but take part in the control and application of their labours. We are repeatedly told that over production in this or that commodity is the cause of industrial depressions from time to time and the engineer is often blamed for manufacturing machines to bring about this condition. In retaliation I would quote the over production annually of coffee, wheat and sugar, etc., commodities essential to life which are destroyed when thousands of human beings are starving. Surely something is wrong in the world in so far as the distribution of products are concerned.

It may be well asked what has the engineer to do with this, and how would he endeavour to bring about a more satisfactory state of affairs should he be given an opportunity of controlling the distribution of his own and other necessary products for the welfare of the human race. In reply it should be stated that the engineer has to a greater or lesser degree and by virtue of his education and training a knowledge of the laws of nature, of the

physical properties of materials of construction, has learned to think concisely and logically, and last, but not least, **understands cause and effect.**

Reverting to the engineer's place in the economic life of the community, the general structure of the economic and industrial system is of vital importance to him. A defective economic and financial system may retard all efforts to place at the disposal of the community cheap and abundant supplies of the commodity which his labours and technique have made possible. It is also possible that although abundant and cheap supplies are available the social organisation is not adapted to receive them. Comprehensive and beneficial engineering schemes may be planned which would be of benefit to humanity but due to circumstances beyond the control of the engineer these are not given effect to.

Engineers are the specialists on the productive side of industry, and on matters in which their expert knowledge may be of value their advice should be sought, particularly by those who have to decide national questions in connection with the organisation of production.

Mention was made previously of distribution and coupled with this is consumption. Both distribution and consumption should not be left to the mercy of unguided economic and social forces any more than production. As engineers we may be a little proud of solving the problem of production, but we should strive for the opportunity of solving or attempting to solve the problems of distribution and consumption. It is of no use boasting that we can turn out ten articles in place of the one by our predecessors if such production is going to choke the channels of distribution. One would not generate steam efficiently and then waste it on an inefficient turbine.

Reference was made previously to the fact that by reason of his education and training the

engineer must understand "cause and effect." Should he be given the opportunities of collecting data and organising facts in connection with distribution and consumption, no doubt he could help considerably. The engineer's responsibility extends far beyond that of producing goods and amenities of life, he should endeavour increasingly to exercise a directing influence in their distribution and consumption.

Civilisation has now reached the stage when technical progress has passed social and economic progress. Our Universities and Technical Colleges might consider it worth while to allow more of their well trained young engineers to study the problems connected with distribution and consumption. The community look to the engineer for production, so why is he not looked to for the organisation of distribution and consumption. This should be one of the engineer's duties to the community, equally with that of the safety of the public for which we are held responsible when using all the amenities of modern civilisation.

During the present crisis war is being waged between scientists and engineers. We may feel that due to our efforts we have made possible the use of such destructive engines of war as battleships, submarines, tanks, long range artillery and aeroplanes. The mere refusal to supply such terrible instruments of destruction would not prevent war as the fact remains that in the Dark Ages and long before the advancement of science war has always been the nightmare of civilisation. Should this explanation be not accepted and engineers and scientists blamed, their retort should be that, due to the present day organisation of Society, engineers have very little voice in international economic affairs. Engineers must be given responsibility in this direction. Physical science enables us to understand causes and anticipate effects but it cannot alter human desires. It is, therefore, not the fault of the engineer and

scientist if scientific advance is leading moral development. The community must enable the scientific workers to wield a greater influence in industrial and economic affairs or it must relieve them from all blame for the evil results of the diversion of science and invention from its original purpose.

In peace or war engineers to-day are "key" men, whether in national or municipal expansion, communications, transport by land, sea or air, production of power, domestic amenities or in the conduct of war and its consequent implications.

It is doubtful whether any profession has done so much for the material welfare of the community than those of the medical and engineering professions. The community gaze in awe and reverence upon monuments and tombs of statesmen and warriors, yet their achievements for the benefit of mankind appear puny compared with those of the two professions previously mentioned.

The works of Newcomen, Watt, Boulton, Stephenson, Faraday and Parsons are unknown to the average man in the street. Why is this state of affairs brought about? The answer is that the engineer, like all skilled workers, delights in the exercise of his craft and skill is undervalued by the community generally. The Engineer's reward is in the labour, achievement, joy of discovery and progress.

In conclusion, I would say that I shall be well satisfied if some of the youths of to-day entering upon our profession benefit by having the knowledge and being able to utilise such knowledge to a greater degree than his professional predecessors and so benefit or attempt to benefit a greater proportion of mankind.

By doing so it is hoped that in the years to come they will not be called upon to witness or assist in the wholesale destruction of human life,

as in those far off days to come it is also hoped that engineers and scientists will have a more direct control of the world's international and economic affairs.

That their logic and understanding of cause and effect will bring about the Utopian condition of peace between nations throughout the world for all time is the fervent hope of the writer.

The President: We thank Mr. Foden most sincerely for his excellent paper, which is now open for discussion.

DISCUSSION.

Mr. Ritson: I wish to congratulate the author of the paper. He has opened up a very big question. The snag we have in this country is that we have such a small population in such a vast space, consequently the training of an engineer cannot always be carried out in his own town, unless he happens to live in one of the large towns. These large towns can be counted on the fingers of both hands, and the technical training part of engineering can only be taken in these larger towns.

If we take our sons in small towns and wish to train them as engineers they have to go to the larger towns. The difficulty is can a youngster withstand the pitfalls found far away from home? It also means a big expense sending him there. We must admit that a university education is of a portmanteau type. In Germany, America and in England there is a splendid system of trade schools. If trade schools could be easily spread over this country—no doubt this would involve considerable expense to the parent—such expense would be much less than at a university. Then there is the question of bulk supply, as a station

with "Bulk" does not require the number of apprentices a Plant station requires, and these "Bulk" stations are increasing.

Mr. M. M. Smith (Matatiele): This paper is definitely a very interesting one, for which Mr. Foden is entitled to every congratulation.

Another way of imparting self-reliance is to allow the youth to do work for himself and his superior should increase the importance of the work as the youth progresses. Any boy who has his work and progress at heart always wishes to carry some degree of responsibility and desires the trust of his superior in him. This method cannot fail to encourage the boy in his future career and also cultivates within him initiative, self-reliance, responsibility and loyalty. Further, it will give him a chance to prove his worth or otherwise.

The engineering profession in general, is divided and again sub-divided into so many highly specialised branches that it has become an irrevocable necessity for the youth to be trained exclusively in municipal engineering. As municipal engineering may be considered as one of the specialised branches of the engineering profession, it is not to the advantage of the youth to qualify for any of the Government Certificates of Competency as far as the specific requirements of his knowledge in municipal engineering are concerned. Some of the subjects for these Certificates are unnecessary and of no value to the municipal engineer, while many indispensable subjects are not included. The curriculum for a municipal engineer's certificate of competency should embody electrical and mechanical engineering, financial and clerical administration and law relative to machinery and administration. It may, therefore, be considered that the Government Certificates are not in focus with the specific requirements of knowledge for a municipal engineer. As tuition and recognition can be received to-day for electrical, mechanical, civil and

mining engineers to state a few only, there seems to be no reason why municipal engineering cannot be likewise with its own courses of tuition, institute and degrees or titles as the case may be.

Municipal engineering can be divided, without encumbrance and suitably adapted to the various requirements and responsibilities, into three classes of certificates: i.e., municipal engineering (electrical), municipal engineering (steam) and municipal engineering (diesel), each of which includes mechanics. This means that the youth who one day wishes to take charge of a Diesel plant must have the Electrical and Diesel certificates. For the certificates as above, the average youth will have no difficulty in qualifying. Further, if these certificates are given the same legal status as the Government Certificates, then the present cases of incompetent persons taking charge of municipal plants, will be eliminated completely.

In my opinion, the best way by which to train the youth for his career is by commencing his practical and theoretical training at the same time. Practical training should be the major part of the youth's training and thus suitable correspondence courses will suffice. This system will assist the youth, to develop his natural ability as a municipal engineer, where his parental finances are insufficient to provide for University training.

Thus the present system of training, etc., needs revision and modification for the municipal engineer and I appeal to this Association as the most suitable to make the necessary representations to the proper authorities and to form an Institute of Municipal Engineers, not only for the honour, prestige, and advantage of the municipal engineers of to-morrow but also for those of to-day as well as for the benefit and advantage of the community we serve. (Applause.)

Councillor Capell: This subject has interested me for many years. I can only say that I am slightly disappointed at the lack of positiveness in this paper. Mr. Foden has placed before this Convention some of the requirements in the training of engineers, but he has left the impression on my mind that he is indefinite regarding the policy that should be adopted.

There are two methods of training, one being through the University, and the other, which the bulk of apprentices have passed through, that of a common artificer, with the progress that subsequently follows to a superior position. You all realise the disadvantages you have experienced in regard to the need of facilities when you were serving your apprenticeship. These disadvantages still exist.

There are facilities through correspondence schools for obtaining the necessary technical education, and the Government have assisted to a material extent in providing facilities. If you look round you will find that the best men are not necessarily those who have had the advantage of an University training. And so I am disappointed that Mr. Foden has not taken a more definite line, which would be of great advantage to those in charge of our engineering establishments, in that it would assist in laying down a policy for the training of future engineers.

The author also created the impression that it was rather doubtful if an engineer to-day should possess some amount of commercial ability. I contend that engineers and senior technical officers must be technical men beyond reproach. Their business ability must be second to their technical ability. A man of outstanding business ability is apt to overlook cardinal engineering features. It is the function of the Councils to lay down the policy and the duty of the engineer is to carry out that policy.

Twelve months ago you will recollect that I had something to say in respect of the purchasing of German goods. Our engineer was prepared to accept German goods, but the policy of the Council was that we did not want to purchase anything from a country which we thought capable of doing us harm. At the time what I said was pooh-poohed, but history has shown that our policy was correct. Whilst it might happen that an engineer possesses good business ability, such ability must be subordinated to his engineering skill. Matters of finance must be left to financial experts. I hope that at a later stage Mr. Foden will give us something definite regarding this phase of the subject. (Applause.)

The Convention then adjourned for refreshments.

Upon resuming,

Councillor Robbins: I am sure we are greatly indebted to Mr. Foden for his admirable paper. One aspect of the position he does not mention at all, and that is that he has not provided in the education of the engineer that he must be taught to "suffer fools gladly." (Laughter and applause.)

Councillor Berman: Before I proceed to offer a few remarks on this paper, I wish to take this, the first and probably only, opportunity which I may have, of expressing both for myself and for the rest of the delegates present, our thanks to you, Mr. President ,and to His Worship the Mayor, and the Town Council of Umtata, including the indefatigable and ubiquitous Councillor Spikin, and to all the good people of this town, for the very warm reception and kind hospitality they have extended to us. I may not have an opportunity later on of doing this, so I wish to say now that their hospitality was as boundless as their kindness was overwhelming. It was worth travelling 2,000 miles (including one or two bad patches of road) to partake of it.

I wish to pay tribute to Mr. Foden for his paper. I was particularly interested in his remarks about the engineer's duty to the community, and I was very pleased to note how well this part of his paper was received. I could not help thinking of our " cock-eyed " economic system into which the engineer has to fit himself. Mr. Foden draws a picture of the glaring contradictions of the system. On the one side is the engineer who has done so much to improve the conditions under which people live, who has been responsible for the wonderful inventions and improvements in the sphere of production, and on the other side, our inefficient system of distribution, which is lagging so far behind. I am sorry for the engineer who is conscious of the position in which he finds himself. Slow and painful as has been the march of mankind along the path of progress, the results obtained are by no means insignificant, for all of which the community has to thank the engineer. It was not the fault of the engineer that so little use had been made of his valuable efforts, inventive genius, and his readiness to serve the community at all times. It was the fault of the community at large and in a sphere over which he had no control.

We see the engineer at his best on public bodies and in utilities where every effort is based on the spirit of public service and where the only motive is the public welfare, where other considerations such as personal gain, personal profit, cut-throat competition and personal benefit are totally unknown.

It is a great pity that these spheres in which the engineer can work for the public good unhampered by private greed and unrestricted by the rules of our economic jungle are still so limited and so circumscribed. The only field, therefore, in which the engineer can give of his best is in the Municipalities and in the publicly owned utilities.

I disagree, however, with Mr. Foden when he looks to the Universities, particularly to the faculties of Commerce and Economics, for guidance and assistance to the engineer in the sphere where his efforts are frustrated. This is the last place he should go to. Unlike the study of engineering which is based on the exact sciences such as Mathematics, Physics, Chemistry, Hyraulics, etc., the other studies with which he wishes to equip the engineer are merely based on the private political prejudices of the exponents of laissez-faire.

By all means let the engineer stick to his job, that of serving the public; let him keep away from the sphere of the so-called economists, who are merely engaged in finding pseudo-scientific justifications for our absurd economic system, the results of which are almost heart-breaking to every serious student.

Let the engineer rather concentrate on helping to organize further and other spheres of human activity on the lines of public or municipal ownership. There is nothing revolutionary about it. If a sensible, well organised scheme of public ownership and distribution, and public control could be devised for water and electricity, why not apply it to the distribution of milk and bread for the public good?

Now a few words in a less serious vein. Someone told us here that engineers are born and not made. I know a way of becoming an engineer, and quite an easy one at that. I was told by our City Engineer of a young man who wished to become an engineer. So he wrote to a Correspondence School asking them for particulars of their course of engineering, and they wrote back stating that it was a very difficult course indeed and would take many years, and would entail an enormous amount of hard work. But they added that they had an easier course which would yield

him the same result, that was a course in how to become a Town Councillor. (Laughter.) Once he became a Town Councillor he would ipso facto be a Town Engineer.

May I suggest to our young men that if they find engineering in the ordinary way beyond their capacity, or if they find the facilities inadequate, they should take the easier course and become full blown engineers by way of a Municipal election. I picked up all my engineering knowledge and have become a full-blown engineer one morning on my way from my house to the Cape Town City Hall. (Laughter and applause.)

Councillor Deane (Bloemfontein): We must all give our mead of praise to this interesting paper. After listening to the last speaker I began to wonder whether we were discussing the paper by Mr. Foden or whether we were getting another paper from the Capetown delegate. The trend of his remarks was certainly different from that of the paper before us. I would like to say that I whole-heartedly support Councillor Robbins when he says that engineers must learn to "suffer fools gladly." (Hear, hear.) I have been put in the position of chairman of our Electricity Committee, and heaven only knows how my Electrical Engineer friend on my right (Mr. Pirie) puts up with my foolishness sometimes. In his reply I hope Mr. Foden will give us a little more information concerning engineering pupils. It does look very formidable for the young man who wants to take up the profession, and I hope Mr. Foden will say something that will be a little more favourable and which will give them more encouragement to enter. In regard to ambition, that is a very bad thing if one makes it one's "god," or if one takes the view that the means justifies the end. On the other hand, without ambition one gets nowhere. Another part of the paper referred to the fact that the amenities provided by electricity are not appreciated by those who benefit from them.

That is truism. One hears even of Councillors whose first question is, "What is it going to cost? Our rates will go up!" One feels sorry for the Engineer who has to put up with that kind of thing. A further point is that very often there is insufficient co-operation between the heads of departments. I have tried to make it an ideal that wherever possible the heads of departments shall meet once a week to discuss their various difficulties. (Applause.)

Mr. Val Davies (Visitor): I have only one word of criticism. I think Mr. Foden has attempted too much. The real motive for the writing of the paper is, I think, the training of the young engineer. This subject has been discussed for quite forty years. When I was an apprentice it was the subject of international disputes. At that time there were outstanding men in England and elsewhere who expressed views which to-day have proved correct.

During the last twelve years I have been interviewed by at least 200 parents who have brought their sons and asked my advice regarding their training. They perhaps had heard of a distant cousin or of someone else who had made a success of engineering, and had decided that their boys should be engineers. The boys, as a rule, had passed the matric; the parents think that all that is required is that the boy should enter a University. Because of the indiscriminate acceptance of bad "material" 90 per cent. of such boys are useless for the training. I will give you my experience in this regard.

Of 100 students accepted in the first year for an engineering course, no less than 50 failed in the first year. These are figures from a South African University, and they will give you some indication of what the position is. Thus we are left with 50 per cent., and in the final year only five of the original 100 were left. Such figures

are deplorable, and they support my point that there should be some psychological or practical method of eliminating unsuitable candidates who have not the proper mental make-up or background. They are not suitable, and it is tragic to think of the really good material that may be overlooked. (Applause.)

Mr. Sparks (Pietersburg): We all thank Mr. Foden for his paper and for the very useful information it contains. In everything, especially machinery, a little bit of grit can interfere with the working of the whole system.

In the training of engineers there is a certain amount of grit in the works. One bit of grit, in my opinion, is the small pay we give apprentices. I have always felt that the scale of pay is far too small. Its effects are very bad indeed. We talk about the status of the electrical engineer, and it has been mentioned that we suffer from an inferiority complex. The small pay of apprentices has a tendency to develop this inferiority complex; they are not earning what they should.

A point emphasised by Mr. Foden was that the question of economics is becoming more and more important in the training of the engineer. Our job is to tackle the things which we know are going to benefit the public, but the question of the low pay of apprentices is contrary to the development of economics, for the boy who goes to college has to rely upon his father for the monthly cheque. If he were paid more he would become more self-reliant.

Mr. Milton: The problem of training engineers is one with which I have come in close personal contact for many years. There are, therefore, certain opinions which Mr. Foden has expressed which I feel should be endorsed, and there are also several points in connection with which Mr. Foden's views would be appreciated.

In his paper, the author has dealt with the training of the engineer from its inception to the point where the engineer is required to do his duty to the community he serves, when he reaches a senior administrative position. All those who set out to follow this course, however, do not reach this objective, and I feel that the author's views in connection with the stages at which many fall out on the way would serve as encouragement to youths (and their parents or guardians), who have selected engineering as their chosen profession.

It must be admitted that all who decide to follow the profession are not suitable for the highest posts which it offers, but nevertheless are very suitable to fill certain important positions in the field of employment that engineering offers, and, therefore, failure at various stages to progress further, does not mean that the time spent in training to such a stage is wasted.

The knowledge of accounting, which the author specifies, cannot be over-emphasised, as it is very essential that the engineer should engineer his projects economically, and that he should be in a position to understand the views of the experts in the fields of accountancy and economics, and what is more important, should be in a position to convey his views and ideas to those experts in a way which they themselves are able to appreciate.

Not only does the engineer contact such experts, but he is also required to deal with all and sundry. To do so satisfactorily, is it not necessary at a fairly early stage in his progress that the young engineer should possess a sound knowledge of the psychology of people? Such knowledge should prove useful to him not only in dealing with the external contacts of his organisation, but also with the staff.

I would be pleased to learn the author's views in regard to the advisability of the senior engineer

possessing a sound knowledge of the processes he controls, in order that he may appreciate the difficulties of the junior staff in dealing with their problems and the effort and time which is frequently involved in obtaining solutions to problems, which, once obtained, seem so obvious.

The author refers to the necessity for loyalty as a characteristic of the young engineer. Surely this is not enough. Is it not necessary that from the outset he should be trained to have confidence in his seniors, and to show a willingness to serve the interests of the organisation employing him? It seems to me, therefore, that the young engineer should show that he can appreciate and take part in team work at a very early stage in his training. Further, in order to foster a feeling of loyalty and confidence, it seems to me to be essential that the training of the engineer must be complete in detail and that no "short-cuts" should be taken.

The author, by inference, has indicated that a study of the qualifications and attributes of those at the head of the profession to-day provides a criterion of what is required of the student, and is a guide to the direction in which he should be trained. In view of the rapid development of the profession and its relative youth, it seems to me that considerable care should be exercised in this study. After all, in the field of electrical engineering particularly, the competition for the senior posts has not been so great in the past as it will be in the future, and aspirants for the posts at the head of the profession will probably require more extensive and intensive training than those at present holding them have received.

The author is to be congratulated on the manner in which he has dealt with his subject, and for the enhanced value of his paper arising from the manner in which he has shown the necessity for education and training by his indication of the duty of the engineer to the community.

Councillor Olley (Salisbury): I should like to reply to the remarks of the councillor delegates from Durban and Cape Town. The gentleman from Cape Town says, " You keep to your job, and we will keep to ours." But do Councillors really know their job? Whilst the paramount training in electrical engineering must be technique, the engineer must likewise be in a position to say not only how to instal a plant, but to state how long it will last — its economic life and in what sense it can be a paying proposition. He must be able to supply details both in regard to the plant itself and the running of the undertaking. He must be able to assist Councillors. Remember this: a man has an idea that he can perform some public service. So he joins a Town Council; but what does he know? Nothing! I admit that in Durban and Cape Town and other big towns there may be a few shreddies. In Rhodesia we call them sharks. (Laughter.) Generally, Councillors are not conversant with all Municipal matters, hence, the necessity for the Electrical Engineers having knowledge in addition to Engineering technique.

Now, we have reached a position when things are becoming standardised, and I am beginning to wonder whether we have not reached that state in regard to matters electrical. There is a striking example in the Electricity Supply Commission, which supply the current direct to municipalities, and all the latter do is simply to distribute the ready-made article, as it were. In my opinion standardisation will undermine all small undertakings in from twenty to twenty-five years. That is how it appears to me. We have it in Rhodesia and you have it here. With regard to pay of apprentices, I suggest that the paramount thing is in their training and their gaining of knowledge, and not just how much pay they should get. Pay should be secondary.

Mr. Stevens (Ladysmith): I would like to express my appreciation of Mr. Foden's paper. In

the selection of apprentices it has been my experience that the wrong lad is often given the job. In future, I propose considering a character report from the schoolmaster, an expression of opinion from some of the applicant's fellow scholars, information regarding his behaviour as a whole, how he fills in his spare time, and the impression created at an interview. There can be no doubt that very often sentiment must play an important part. If two youngsters are about equal, the one whose parents are not in a position to assist in his future training should be given the preference. The point raised by Mr. Foden regarding the necessity for an engineer to have experience in accountancy has partly been brought about as a result of the difficulties engineers sometimes experience with the financial expert. I suggest that in municipalities the heads of departments should meet together once a month, which would result in a better understanding.

Mr. Muller (Krugersdorp): The question confronting parents is whether their lads should go to a University first and get their practical training afterwards, or whether practical training should precede the theoretical, as in the case of apprentices attending technical college, and afterwards taking the Engineer's Examination.

In the latter case, my experience as part-time instructor, and later with apprentices in my Council's employ, has forced me to the conclusion that the majority of apprentices leave school with their minds so undeveloped that they cannot appreciate the value of anything being taught at the technical classes, and resent being forced to go to another school.

There is something wrong about this system of compulsory attendance of classes. Lads have got into trouble for not attending classes, but provided they get a certain percentage attendance, they will in five years become journeymen, even if they never got past the first year course.

I think there is much to be said for the removal of this compulsion, so that those with the necessary intelligence and ambition may enjoy vastly improved training facilities, while the "won't works" go their way in peace and arrive at probably a better result than to-day, as their mind finds nothing to rebel against.

Another serious point in connection with such boys is that by refusing to occupy their thoughts with anything useful while at classes, their minds become the incubators for much that is degrading and thereby poison the minds of others.

Coming now to the University method. With all its limitations, I think it is still the best for those who can afford it, as it provides facilities for broadening the outlook, training the mind to think, and acquiring a wider knowledge, which would otherwise have to be laboriously obtained over a much longer period. The drawbacks are firstly, that many young men complete their courses with a fair sized debt to wipe off, or for other reasons get tempted to take a job with good pay, regardless of possibilities of practical training. Then also, having just grown out of boyhood, they find it irksome to be ordered about as a junior, by the foreman or journeyman, because in their newfound manhood it creates a feeling of inferiority.

Councillor Holland (Johannesburg): I do not speak with knowledge of electricity, and I did not intend to participate in this discussion, but I feel that I must congratulate the writer of the paper upon his excellent literary style. It is not often that one finds a technical man able to clothe his thoughts in such lurid and such figurative language. I was delighted with what he said about the real meaning of education. So many people fail to realise that education means "the drawing out of that which is within," and is not a mere process of "cramming." It is sincerely

to be hoped that all who are trained for your profession will be taught on the lines indicated by the speaker, and it is to be hoped that careful selection will be made of those who wish to enter the profession.

In the past there has undoubtedly been a great deal of pushing of square pegs into round holes, but steps are now being taken to prevent this, and in Johannesburg particularly every care is being exercised by the Juvenile Affairs Board to ascertain for what careers lads are suited, and to advise them accordingly. That, I think, will be of great benefit to all concerned.

I was also deeply interested in the speaker's quotation from Shakespeare with reference to ambition. Though in the passage referred to, Shakespeare seems to deprecate ambition, yet I do not wish you to run away with the idea that he habitually discouraged it, since in "Henry V," the king before the battle of Agincourt is made to say:

"But, if it be a sin to covet honour,

I am the most offending soul alive."

As was pointed out by the speaker, "It is the means to be adopted in realising one's ambition that requires careful teaching and consideration and not the condemnation of ambition in its entirety." Provided you do not covet honour by dishonest means, ambition is the finest incentive you can have to progress.

There was another paragraph which made a deep impression upon me. I refer to the passage in which it is said "that the community gazes in awe and reverence upon monuments and tombs of statesmen and warriors, yet their achievements for the benefit of mankind appear puny compared with those of the medical and engineering professions."

I am reminded of a sonnet of Shelley entitled "Ozymandias" which says:

"I met a traveller from an antique land
Who said: Two vast and trunkless legs of stone
Stand in the desert. Near them on the sand,
Half sunk, a shattered visage lies . . . . . .
And on the pedestal these words appear:
My name is Ozymandias, king of kings:
Look on my works, ye Mighty, and despair!
Nothing beside remains. Round the decay
Of that colossal wreck, boundless and bare,
The lone and level sands stretch far away."

The works of that mighty king of Egypt have vanished from the earth, but the inventions of the engineer, such as the locomotive, the telephone, the aeroplane, wireless, etc., will live for ever, and have contributed largely to the progress of civilisation.

As to the question whether a university course for an engineer is wise, or not, I noted that one speaker said that he had had men in his employ with a university training and others without it, and that there was very little difference between them. But I also gathered that it is quite possible that in the future the best engineer will be the man who has been through a university course. In my opinion, the man who has had that training cannot fail to be a better engineer.

Whether that training should come straight after the school course, I am not in a position to state definitely, but I should have thought it would be better to go straight on.

Again I congratulate the author on the high standard of his paper. I came expecting to hear a paper that I should not be able to understand, but it has been a joy for me to listen to it, and the advice it contains cannot fail to be accepted by everyone.

In conclusion, I trust that the author's hope that the present unhappy war will be followed by an era of peace between the nations will be ultimately realised.

Councillor Raftery (Durban): The last speaker has expressed just what my views on this subject are. I hope his words will sink into the minds of all of us. I should like to congratulate Mr. Foden on his paper. I agree with every word of it in regard to the training of engineers and particularly do I agree with him in what he says about grumbling at students when they make mistakes. Such errors should be pointed out to them in a nice way and advice given with a view to the prevention of a recurrence. And I would go further and say that if a young man does his work satisfactorily a word of praise would encourage him to always do his best and to give satisfaction.

Re ambition, I certainly think it is a good and necessary thing to be ambitious. I mean, of course, the right sort of ambition, such as a desire to improve oneself educationally, socially and generally; to better one's position in life; to do big things; to achieve. Once Lord Beaconsfield said, "He who is without ambition is not worth his salt," and I agree with him.

On the question whether an engineer as head of a department should have a knowledge of other subjects I agree with Mr. Foden, that a knowledge of finance, economics and law would be very, very useful.

Councillor Bloe: This paper make a greater appeal to me than any other. I would ask Mr. Foden one or two questions. Does he not consider, as I do, that a little more education in subjects suitable for an electricity career should be given to boys who pass their first year matric in our High Schools? Speaking as a schoolmaster, I do not remember during the whole of

my eighteen years' experience, any boys coming to me and asking about electrical engineering. Some of the subjects taken in our High School curriculum to-day, do not lend themselves to boys taking up this particular branch of engineering. I look upon the High School as the feeding ground for the Technical Colleges and they should, therefore, be encouraged to take up electrical engineering to a greater extent. During the past four years, it has been my lot to assist in chosing apprentices, and only on one occasion did the sub-committee find a lad coming straight from school, who knew what a sub-station or a transformer was. We selected that lad because he showed that he was interested. I regret that Rhodes University College, which is the University of the Eastern Province, has not instituted a Chair of Electrical Engineering, and I think something might be done to get Rhodes University College to consider the matter.

The President: It is too late to continue the discussion further, but before I call upon Mr. Foden to reply I would like to thank him for his very able paper.

Mr. Rodwell: This paper seems to have called forth a great deal of discussion, and I think it would be a pity to close it down at this juncture. It might be continued at some other time. (Hear, hear.)

Clr. Baskerville: I thank Clr. Olley for having put forward my ideas. Apprentices are not so keen upon engineering as we would like. Many of the youngsters now coming forward are merely in search of a job. Another matter that is alarming me is that the engineering side is being neglected and is being replaced by economics. First and foremost we must have competent engineers, and only secondly competent economists.

The President: We will now adjourn until tomorrow, when there can be further discussion and Mr. Foden can give his reply.

The Convention adjourned at 12.40 p.m.

WEDNESDAY, 22nd November, 1939.

The Convention resumed at 9.30 a.m. in the Town Hall, Umtata, the President in the Chair.

NEW MEMBERS.

The President: I have much pleasure in announcing that the Council this morning has admitted the following new members :

Mr. W. H. Milton, as " Associate."
Mr. C. H. Adams, as " Engineer Member."
Middleburg (C.P.) Municipality, as " Councillor Member."

DISCUSSION (Contd.)—MR. FODEN'S PAPER.

We will now continue the discussion on Mr. Foden's paper, and I would ask members to make the discussion as brief as possible by confining their remarks to a period of five minutes, or communicating any further discussion.

COMMUNICATED.

Mr. Rodwell: This Association is the richer by Mr. Foden's contribution to its Proceedings, particularly as the topic he has chosen is of such fundamental significance if engineering as a profession is to achieve the goals it aspires to. That the profession is conscious of this truism is amply witnessed by the time and space devoted to the subject in Britain and America during the past decade.

If one can escape for a brief half-hour from one's own environment and channel of life to

survey this field from a detached height, one is awe-inspired by the avenues, each representing an item falling within the scope of engineering.. A youth intrudes on us in our detachment and says: "Tell me, Engineer, how you will educate one who seeks proficiency, one who cannot tell you which particular avenue he will be allowed to follow by Dame Chance or Opportunity."

The addition of the further legions of "chances" superimposed on this already complicated network is disconcerting, and soon comes the realisation that it is the fortune of few youths setting out to train themselves for a career to be able to say: "My future will definitely lie along that particular tributary." Economic and social forces, coupled with too shallow a conception in the generality prevent deliberate pre-selection in relation to five or ten years in the future, and obligate most youths "to take what is going" subsequent to their preliminary education. This being so, it would seem that a readjustment of our educational outlook is necessary. As the training of the average youth for his career commences about the ages 15-17 and progresses for five to ten years or more before his true niche in life is apparent, the greatest care must be devoted to the avoidance of so particularising his training as to find its value vitiated when the niche appears.

Hence, in educating the youth we must pay chief attention to "leading forth" or educating those aspects of his mentality which will be of most **general** application to the many avenues. I refer to such items as — how to think with unbiased mind and honesty of purpose; breadth of conception and far sightedness as to probable consequences; self-reliance and initiative; leadership and tact in dealing with one's fellows; curiosity and refusal to take other than basic principles for granted; a love for understanding **thoroughly** and of knowledge for its own sake; a sense of responsibility; where and how to find things out for oneself and to use the legacy of knowledge left by

others; the very **basic** principles of sciences, crafts and "taking pains"; unbiased appreciation of another's view points; where possible, the facilities of travel with a receptive mind to broaden outlook; the art of appreciation; leading forth of those many attributes classed as character.

And having so stirred up the minds and souls of youth to an eager appreciation of the broad **basic** principles which are a necessary attribute to genuine success in any field (rather than breaking so many hearts from any interest in learning because of so much particularised cramming of experience and subjects which will fit but a few careers and tastes), we would teach one further thing before launching him into the maze of his engineering career. It would simply be this — "Now you have behind you a general background which is common to all before you. Your education is now **beginning.** Go find the available job which appeals to you most; try to find your right niche, for even iron will rise to the top if in its right medium — mercury. Use the keys you now possess to unlock the doors of particularised knowledge necessary to fit the requirements your job demands. Achieve this knowledge for its own sake and you will love your work."

The youth would then proceed to the more particularised study of a selection of subjects lying directly in his sphere; he would then be of an age and inclination to understand and appreciate. No longer would he be one of thousands of mass-produced articles holding a certificate indicating that he happens to have been sufficiently mentally and physically healthy during a short succession of three-hour periods of a year to illustrate that he has been capable of temporarily cramming his mind with 40% or more of **particularised** knowledge, the bulk of which he has no love for and which is most vaguely pertinent to the direct demands of his tributary of engineering. He would be individual,

therefore valuable. In short, it would augur well for the future if education could be split into two stages — that of **" the fledgling stage "** to the end of apprenticeship, or college or university training, should be on a very broad generally applicable basis, followed by that of **" the career stage "** when a youth has his first glimpse of the tributary of engineering Dame Opportunity will permit him to follow, and educational facilities of a widely selective nature will afford him the opportunity of particularised and eager study in directly useful channels.

Such broad principles are equally applicable (it is only a matter of degree) to the various grades of training, viz., to meet the cases of youths not having opportunity of full secondary school education, those youths that have such opportunity and those who subsequently pass on to University or Technical College.

These principles are partially inherent in a University training which has been properly absorbed and recognised by a student. The training aims at generality of background in technical subjects; free intercourse with others of diverse leanings; freedom of action and self-reliance; curiosity and **how** to utilise the legacies of learning. It does not produce engineers, but men with a **probable capacity** of being engineers, depending on ability to use the background keys to unlock the doors of particularised training. The effect of this new product in our ranks in larger numbers to-day is beginning to illustrate the efficacy of the general **principle.**

The engagement and training of apprentices in the Electricity Undertaking of the City of Johannesburg is carried out and it may be of interest to state the methods employed there which are as follows:

Each year applications are invited through the public Press for the positions of apprentices to be

filled during the ensuing year. The approximate number to be selected is 11 per annum. From the applications received the General Manager selects approximately 30 for interview by a sub-committee consisting of the Chairman and Vice-Chairman of the responsible Committee, together with the General Manager. The selected lads are interviewed, and as a result, the number required to replace the fully-trained apprentices leaving during the year are chosen in the order in which they will enter the service. A few alternates are also chosen to take the place of any lad who may withdraw and not wish to take up an apprenticeship during the year. Those lads who have received two full years' training at a trades school and matriculated lads are usually given preference and the number of lads applying who are so quailfied greatly exceeds the vacancies. The lads who have received two years' training at a Trades School are allowed one year off the five years' apprenticeship. It is the part duty of an officer of the Department to attend to the welfare of all lads throughout their apprenticeship. The training of the apprentices follows schedules laid down which are occasionally varied according to the aptitude of the apprentice for any particular branch of electrical engineering and whether or not he desires to specialise in any particular branch. It is usual for each apprentice to spend six months in each of the following branches of the Department:

Electrical Workshops;
Meter and Instrument Testing Branch;
Illumination and Wiring Branch;
Distribution Test Branch;
Overhead Mains Branch;
Underground Mains Branch;
Sub-stations Branch;
Generating Stations;
System Protection Branch;
Drawing Office.

Upon completion of apprenticeship the young man may remain in the service for a further six months on journeyman's full pay and he is required to take full journeyman's responsibilities; this to give him confidence to carry out jobs unaided under the conditions to which he has been accustomed; to teach him self-reliance and to furnish the wherewithal to start in new surroundings.

On completion of apprenticeship, the young artisan is asked to chose the branch in which he desires to work the six months' improvership as a skilled worker, and as far as possible, his wishes are granted. On completion of the six months improvership the trained artisan must then leave the service and he is not eligible for re-engagement until he has had not less than a total of two years' service elsewhere. The artisans and electrical engineers trained in this undertaking are scattered throughout this and other countries. A good percentage have gained eminence in our profession, and, judging from the correspondence, all are doing extremely well. Arrangements exist for a limited number of both University Students and Trades School Students in equal numbers to spend their vacation leave in the various branches of the Department for training purposes and a number of University Graduates are engaged in the service and are taking up important positions on the technical staffs.

The author deals with his subject in a practical way which is of considerable value to our members and should be an inspiration to achievement for our young engineers.

REPLY BY MR. A. FODEN.

Mr. President and Gentlemen,—Only one or two points raised require direct answers. Replying to Mr. Councillor Capell, of Durban, I think it is most difficult to fix a set method of training

engineers as conditions vary and it is impossible to lay down a definite system. My paper only gives a suggested basis. Mr. Capell also referred to the fact that it is not necessary for an engineer to have a knowledge of the financial conditions of his Department. I am afraid I cannot agree with that. As responsible engineers we are definitely interested in the financial aspects of our work. It would be very easy for us to put forward a scheme, but we would have to consider whether it was a financial proposition. The engineer must always take an interest in the financial aspect of the scheme and look to the Council for direction in the matter of policy.

In regard to the business side, I do not think engineers have any desire to trespass upon the prerogative of the Councils, but we must give the Councils recommendations in regard to managing a Department. I think we should be allowed to formulate our own policy in so far as management is concerned, subject, of course, to the Council's acquiescence.

Councillor Berman, of Capetown, spoke of the somewhat Utopian conditions when we can have exceptionally cheap light and water. I agree that such conditions would be very desirable, and that they would ease the ratepayers' burden considerably, but unfortunately such conditions do not obtain to-day. We have to take cognisance of conditions as they exist, and adapt our methods to suit these conditions. Therefore, it is necessary for engineers to have some knowledge of economics, law and finance.

Councillor Deane, of Bloemfontein, spoke of the possibility of training an engineer in five years. An engineer's training goes on for ever, and I am afraid he could never be fully trained in five years. The science of engineering is changing constantly, and we never know sufficient. We must of necessity keep up-to-date; therefore, we

can never be completely trained. Another point he made was that a boy might be penalised if he had not been matriculated when he attended day classes. It is possible for him to acquire this desirable standard by attending evening classes or to take a correspondence course. This, however, places an added burden upon him. The matriculation examination forms the ground work for subsequent examinations.

Mr. Milton raises a very interesting point, namely, that all young engineers do not reach their objective, and requests my views in connection with the stages at which they fall out, or, I presume, cannot make further progress.

I concur with Mr. Milton that by reason of their training and experience which has been received up to the time that they cannot proceed any further in their profession, then they are better able to fill certain important posts below the higher executive positions. This might be an advantage in later years, as by filling the lower posts for a longer time they will be attaining a thorough grasp of the duties of those who occupy subordinate positions.

In regard to Mr. Milton's point referring to the desirability of the senior engineer having a sound knowledge of the processes he controls, it would appear that Mr. Milton arrives at the solution, inasmuch that the training of the engineer must be complete in detail and no "short cuts" taken. The effect of this thorough training in all branches and processes, in so far as is practicable, is most necessary, and by so doing the engineer who has reached the top of his profession must or should of necessity appreciate the problems and difficulties his junior staff experience as he had at one time during his career passed through the same cycle of conditions.

It will be noticed that my opinion on this particular point raised by Mr. Milton is closely

related to my reply referred to above in connection with the desirability of having knowledge of the processes controlled by the senior executive.

With reference to Mr. Milton's final comments relating to the qualifications and attributes of those engineers of to-day holding higher executive positions, is it not dangerous to prophesy what will be required of the engineer in so far as training and experience in the future is concerned.

The science of engineering is varying daily and it is anticipated that this will do so until the end of time, and in the future those engineers may or may not require the same intensified training or perhaps extensive training as those now occupying positions to which Mr. Milton refers, due to changing conditions.

It would appear that adaptability is a most important attribute in the make-up of an engineer. Many engineers to-day occupying senior executive positions have had an intensive and extensive training in certain branches of their profession, but due to the changing conditions brought about by the advancement of science, the knowledge they derived in earlier days cannot be applied, but due to the thorough knowledge of the principles attaching to their earlier training, plus adaptability, many of these engineers have been able to successfully carry out the duties connected with their positions.

Councillor Olley referred to changing conditions and said that as a result there was not enough scope for engineers. I do not think that this is the correct view. It has been found in Great Britain that although several small Electricity Undertakings have closed down, there are still many openings for engineers, particularly in regard to the distribution and sale of electricity. That is why I draw attention, in my paper, to the

necessity for the engineer to know something about the commercial side of engineering. There is ample scope for the engineer in that direction.

Mr. Stevens spoke of the filtering or segregation of boys as they come along for training. In so far as East London is concerned the Council advertises in the local press stating that an examination will be held for the purpose of appointing apprentices either in the City Engineer's or the City Electrical Engineer's Department. In conjunction with the local Technical College an examination paper is prepared dealing with general knowledge and introducing very elementary engineering problems. At the last examination approximately 100 boys sat for four vacancies. Based on the marked examination papers, 12 boys were selected for interview. Each applicant was asked a set of questions, not of a technical nature, but just general questions such as "What is your hobby?" and "Wny do you want to become an engineer?" The result was surprising. Out of the 12 boys who were asked to state their hobby, only three said that they were interested in wireless. They were also asked what type of literature they read, and their replies were most interesting. The whole process of elimination was very interesting and successful, as the four selected boys have up to now proved most suitable. I put this method of elimination forward as a suggestion, as the most desirable characteristics in a boy can usually be ascertained by a written examination and personal interview.

Mr. Muller wondered if an apprentice would ever become anything better than a Foreman. I think that depends on the boy himself. If there is the right material, i.e., boys with the ability to absorb knowledge, and with the initiative and aptitude for engineering, the rest depends upon themselves. If a boy does not show much interest it would be best to have a confidential talk with him. As

each boy has different characteristics which must be studied closely, the subject of psychology is a factor which should also be studied very carefully. I have also found that interviews with parents have a very good effect, due to the parents' home influence.

Councillor Bloe spoke of the schoolmaster ascertaining the " bent " of a boy. This is highly desirable, but I do not think it desirable to split school classes at the age of 14, as at that age the boy is still learning general principles, and in my opinion he is too young to study the higher technicalities which would be to the detriment of a sound knowledge of the basic principles of engineering.

In reply to Councillor Baskerville I must adhere to my view that the engineer must have some knowledge of law, finance and commerce. Primarily he must be an engineer, but the other knowledge is very helpful and therefore necessary.

I think I have dealt with all the points raised by the various speakers and I have nothing further to say except that I am glad to have had the opportunity of giving this paper, and I am very grateful that it has provoked such an interesting discussion. If it has served no other purpose than to suggest a basis for the successful training of the young engineer, I shall be perfectly satisfied. I wrote the paper with the definite object of providing a basis for discussion, and with the hope that such discussion would prove helpful.

SUPPLY REGULATIONS.

The President: I will now call upon Mr. Harvey to present the report of the special sub-committee on the Supply Regulations.

Report by Sub-Committee on Supply Regulations.

Mr. President and Gentlemen,

As you are aware a Sub-Committee was appointed by the Convention held in Cape Town in 1938, with the object of exploring the various methods by which the uniform Electricity Supply Regulations, drafted by the Safety First Committee, could be adopted and promulgated, substituting throughout the Union of South Africa all the existing by-laws, most of which have become obsolete and in many instances ultra vires.

The results of the Sub-Committee's efforts during the past year are detailed in two circular letters, dated the 2nd August and 9th October, respectively, addressed to all Local Authorities, which will be laid on the table at our Umtata Convention.

The response received to the first circular letter has been very encouraging, approximately one hundred and twenty-five replies having been received unconditionally agreeing to the principle of "group" promulgation. From this letter, it is practically certain that "group" promulgation will be the only feasible method by which the new regulations can be given the force of law, as the Department of Labour and the Chief Inspector of Factories, in spite of sustained negotiations, have not been able to overcome certain legal difficulties, which prevented the regulations being adopted as an amendment to the Factories Act, or particularly as an addendum to the Electrical Wiremen and Contractors' Act.

From the circular of the 9th Octoer, the only serious difficulty encountered with regard to "group" promulgation, is the question of issuing

copies of the regulations to all the Local Authorities, who will have to make them available for inspection in terms of the various Provincial and Local Ordinances. This difficulty has been largely overcome owing to the magnanimous gesture on the part of the Institute of Electrical Engineers who are having the Regulations printed on their own initiative.

In the meantime the Sub-Committee is investigating the procedure to be adopted in the various provinces, as it will be necessary that the representative of the Sub-Committee from each Province will have to be responsible (perhaps with the assistance of his alternate or a provincial subcommittee), for the final steps to be taken in connection with the gazetting of the regulations.

The intention is, therefore, that your Sub-Committee should, in due course, forward all consenting replies to the member concerned for the necessary action, after such action has been decided upon, in consultation with a legal adviser, if necessary.

Your Sub-Committee feels that the stage has now been reached whereby it should be granted power to act, so that whatever action might be necessary in the coming year will not be delayed unnecessarily, especially as it is felt that something concrete can be achieved in the near future.

I, as convener, have received unstinted support from the members of the Sub-Committee, and I wish herewith to place my gratitude on record. My special thanks are also due to the following:—

Mr. Eastman, Cape Town.
Mr. Swingler, City Electrical Engineer, Cape Town.
Mr. Milton, Electricity Supply Commission.
Mr. Joubert, Chief Inspector of Factories.
Mr. Poole, Secretary, the Association of Municipal Electricity Undertakings.

The South African Institute of Electrical Engineers.
The Institution of Certificated Engineers.
Mr. van Huyssteen (Chief Clerk, Springs Electricity Department).

A. Q. HARVEY,
Convener: Sub-Committee
Supply Regulations.

Springs,
14th October, 1939.

Mr. Harvey: Since writing this report for circulation your sub-committee has held another meeting, at which Messrs. Milton and Alexander were asked to be present. At this meeting, which was held on Monday afternoon, Mr. Milton reported to the sub-committee from the Institute of Electrical Engineers, which report was submitted in the form of notes on the question of Wiring Regulations. The chief items in this report being that the Supply Regulations have now been revised by the Safety Precautions Committee and brought into line with the latest 11th edition of the I.E.E. Wiring Regulations of Great Britain. That in the process of revision it was decided to segregate those Regulations, designed entirely for the safety of the public, into one document which is referred to as the "Wiring Regulations." The Supply Regulations portion being a document apart and is known as the "Model Supply Regulations." This now means that only the Supply Regulations portion need be promulgated and this portion is now so arranged that it will meet every Municipal Undertaking, the Model Supply Regulations will then be there for the authority to adopt if they consider it wise to do so. Several visits have been made to Pretoria with the same results of the impracticability of Government promulgation. The Institute of Electrical Engineers and Safety Precautions Committee, likewise paid a visit to the Chief Inspector of Factories, who have also been informed that

promulgation of the Regulations could not be done in terms of the Act. It, however, was suggested at the above interview, that for the purpose of conducting examinations for the licensing of Electricians that a knowledge of Wiring Regulations of the Institute of Electrical Engineers should be considered as one of the requirements. This, I understand, is receiving serious consideration and will be put to the board when properly constituted, and we feel that we should instruct our representatives to push for this end.

The Institute of Electrical Engineers in this same report raise the question of promulgation by reference, in the new Supply Regulations there are numerous references to the British Standard Specifications to site 70 in all. Our attention (that is the sub-committee) was drawn to this fact by a responsible official in the Administrator's office at Pretoria, and it was due to this fact that we decided upon group promulgation the question of references to the British Standard Specifications in the "Wiring Regulations." The decision of the Committee will be given later. Mr. Milton in his notes, goes on to note that we should approach the Provincial Consultative Council to amend the Electrical Wiremen and Contractors' Act of 1939, to permit for promulgations of Wiring Regulations under that Act, or alternately that a Provincial Ordinance be formed to enable each Administration to promulgate Wiring Regulations as Provincial Regulations. This means would naturally ensure the standard and general application of the Regulations, and would apply to all towns as they acquire an electrical undertaking. It has been stated that no municipality can promulgate Regulations controlling any departmental activities in anticipation of the forming of that department. Your Committee has mentioned that this can be done, and is still of the opinion that it can, and we have it in our possession in writing from the Administrator's office to this effect. The Institute of Electrical Engineers is prepared

to publish these Regulations in both official languages and have the Regulations available for all Electricians who wish to study same for their Electrician's Licence, but will only do so if the Board of Examiners agree to accept same as stated earlier. In the meantime, however, the Institute of Electrical Engineers is prepared to duplicate or print a sufficient number of the Standard Regulations in the English medium to enable those concerned to purchase copies for their information, and these copies will be available at 3s. per copy. Your sub-committee has considered all the points raised, and all the difficulties, but are still of the opinion that we should continue with the present policy of group promulgation. We have waited years and years and certain members of this Association who first started these Regulations have already passed away, others are now on pension, we now have a set of first class Regulations printed and ready for application, but every time something is suggested new difficulties rise up, new suggestions come forward. Are we to go on and on until nothing is achieved. We agree to tackle every possible way to make this Union wide, but why not let us get going and have these Regulations as general as we can at present, even if there are still a few points where certain trouble may be experienced? Your Committee, therefore, recommends to the Association that we proceed with group promulgation, and I appeal for your support on this issue.

The President: Thank you, Mr. Harvey. The matter is now open for discussion.

Mr. Eastman: I do not agree with Mr. Milton's contention that our Association is dealing with the question of standardisation of the Electricity Supply Regulations merely from the Municipal standpoint.

Our Association acted from the National standpoint in this matter for the first time in 1920, when it issued model Electricity Supply Regula-

tions which still form the basis of electricity supply regulations throughout the Union. It continued to act with the National ideal before t when it dealt with the question of revising those regulations and I venture to suggest that they would have been standardised by now for general adoption throughout the Union if the matter had remained, as it was then, only in the hands of the Association and the Commission.

The Association indeed approached the Government since the last Convention with the National requirements clearly in mind when—acting under a misapprehension as to the powers under the Act of the department concerned—it suggested that the Government itself promulgate the Regulations for universal adoption.

I believe that such action would have made for greater expedition in achieving the desired end and it is a matter for regret therefore that it is impracticable. One the other hand the facts that the responsible Government Department has intimated that it considers our Wiring Regulations suitable as a standard for adoption throughout the Union and has suggested that electricity suppliers take joint action to have the proposed standard regulations promulgated, should be of great assistance to us in overcoming any further unforeseen difficulties that might arise in this connection.

Our thanks are due to the Chief Inspector of Factories, Mr. F. W. Joubert, who I am glad to see with us at this Convention, for the interest he has taken in this matter and for the willingness he has shown to co-operate with us as far as possible on questions in this connection that have been taken up with him during the past year.

I think that the suggestion that was made during the year to divorce the technical section of the Regulations, namely, that which relates solely to Wiring Work, from the remainder, which are in

the nature of conditions of supply, is a good one from the point of view of simplifying the procedure in getting something done quickly, and the method of doing it is in my opinion to work on the principle of Group Promulgation.

This principle has been adopted in other legislation of common interest to numerous Municipalities so that the necessary machinery exists and has only to be put into motion to produce similar results in regard to the supply of electricity and wiring installations.

I understand that Mr. Alexander has been engaged in revising the Regulations as last considered by the Association in the light of the recently published 11th edition of the Institution of Electrical Engineers Regulations for the Electrical Equipment of Buildings. I am not aware of these revised regulations having been submitted to the Association as yet, and I would like to be assured that no important alterations have been made to them in their present form.

Mr. Foden: For the purpose of discussion I would like to mention a few points.

It is now proposed to have National Supply and Wiring Regulations. Are these Regulations going to conflict in any way with the various Provincial Ordinances? In so far as the Cape Ordinance is concerned it is laid down that a Municipality must promulgate Regulations, and failing this the Government will do so. The East London Municipality has its own Electricity Regulations which have been amended from time to time to suit local conditions.

Up to the present I have not seen the proposed draft Regulations. They may or may not suit local conditions in so far as wiring is concerned.

With regard to Conditions of Supply, this is a subject that vitally affects the finances of the

Undertaking and local requirements and conditions must be considered. At present the whole subject appears to require clarifying and I would like to hear what other Municipal representatives have to say about these proposed draft Regulations.

Mr. Harvey: There is one point I would like to make clear. Mr. Foden referred to East London. These Regulations are based chiefly on the I.E.E. Regulations. Whereas perhaps they do not meet local conditions in certain cases, I understand there will be no difficulty in amending them to bring them into line with the requirements of East London or other Municipalities. The supply conditions are based upon the original ones in principle. Various tariffs are mentioned, but nothing is fixed. You can alter them to suit yourselves.

Mr. Smith (Matatiele): I would like to know what the Committee intend doing in regard to sharing expenses when the Regulations are promulgated?

Mr. Harvey: I would like to say that originally we did not know that in the Cape the Regulations had been circulated free of charge. They will not be asked to share in any expenses for which they are not liable. I believe there is a further way by which they might be accepted universally in the Cape. That point will be decided, and you will be informed fully regarding what is happening. I would like an unanimous vote on this matter. If the members of the Convention have this matter really at heart they will accept the Regulations which have been drawn up by a set of very capable men, and I therefore appeal to engineer members to put the case up very clearly to the Council and stress that we do not want any alteration whatever. One alteration will lead to a lot of correspondence and cause another twelve months' delay. If it goes through it must be accepted. Copies will be on sale at 3s. per copy,

and I will write to each Municipality. I feel that it is only by this means that we will get somewhere next year. (Hear, hear.)

Mr. Milton: If the Convention decides upon group promulgation it can accept a 100 per cent. assurance that there is nothing in the vital section of the Regulations that will be taken out. (Applause.)

Mr. Rodwell: It is clear that we all have the same object in view, and that is to promulgate the Supply Regulations as quickly as possible.

SUPPLY REGULATIONS COMMITTEE.

The President: The next business is the election of the Supply Regulations Committee.

Mr. Foden: I move that the existing Committee be re-elected.

Mr. Bevington: I beg to second.

Agreed.

Mr. Rodwell: I woudl like to pay a tribute to the Safety Precautions Committee and the Supply Regulations Sub-Committee for the good work put in, and I propose that this Convention endorses the actions of the Association Supply Regulations Sub-Committee and give them instructions to proceed with the promulgation of the Regulations.

Mr. Muller (Krugersdorp): I beg to second.

Carried unanimously.

Mr. Kinsman (Durban): I ask your indulgence to read a few notes I have written on a matter which is very pertinent to the safety of the public. It has been felt that occasional fatalities should not be made an opportunity for sensational Press statements, but a Convention of this description cannot shirk its duty by passing over what has happened. I have, therefore, written these few notes which may be of value to councillor members who represent municipalities.

Memorandum re Periodical Tests of Private Installations.

By C. KINSMAN, A.M.I.E.E.

Recent electrocution fatalities resulting from failures of insulation in installations, accompanied by the deterioration or entire absence of earthing, must necessarily be viewed with grave concern by the public generally and by members of this Association particularly.

The Electrical Wiremen and Contractors' Act, 1939, in Clause 19 (1), places on the supply authority the duty of testing installations, or extensions thereto, before their connection to the electricity supply mains. Such a test would ensure that the installation is in a satisfactory condition as regards both the insulation of the current carrying portions and the earthing of those exposed metal portions which, while not normally energised, might inadvertently become charged. It is assumed that the supply authority also endeavours to exercise control over subsequent extensions to the original installation.

Despite such precautions, however, supply authorities are continually faced with unauthorised and potentially dangerous extensions, as well as with the gradual deterioration of the original installation.

The question arises as to the responsibility — moral or legal — of the supply authority, for protecting the public from exposure to such dangerous conditions as might result from either of the two causes referred to. In view of the insistence by the supply authority, upon a high

standard of material and workmanship in the first instance, it is logical that a corresponding insistence should apply in the case of maintenance of the installation. This is the case with certain authorities, who embody in their By-laws or Wiring Regulations some such clause as this:

> "Any installation connected or about to be connected to the supply mains shall be provided and fixed and **maintained** by the consumer at his own cost and expense in accordance with the By-laws and Wiring Regulations, which the Council may from time to time issue."

Even where such By-laws or Regulations exist, it is probable that non-compliance is only brought to light on the unfortunate occurrence of an accident.

Clause 20 of the Act already referred to, lays down that no person, other than a registered Wireman, shall carry out electrical work, and that no person shall cause or permit any wiring work to be done by any person other than a registered Wireman. This clause places certain definite responsibilities on the owner or consumer.

The question then arises as to the duty of the supply authority to insist, as a condition of the continuance of the supply, upon periodical inspections of installations to ensure their satisfactory maintenance.

It is not suggested that such inspections should be at lesser intervals than five years, and it is realised that unauthorised extensions of an installation carried out subsequently to an inspection may be potential sources of danger from the time of their erection. In fact, the two most recent fatalities in Durban, were due to unauthorised wiring which had only been in existence for three and a half years and one and a half years respec-

tively. From time it might be claimed that quinquennial inspections would not have prevented either of the two fatalities.

Against this, it can reasonably be claimed that more frequent inspections would be impracticable, and that in any case the knowledge that regular inspections are made and that prosecutions take place where infringements are discovered, must inevitably lead to a diminution, if not a total cessation, in the carrying out of extensions by unauthorised persons.

It is of interest to note that in the Regulations for the electrical equipment of buildings, issued by the Institution of Electrical Engineers, Regulation No. 1108 requires that a certificate shall be given by the Electrical Contractor on the completion of a wiring installation, in which he shall recommend a period for subsequent re-inspections, this period to be no longer than five years. On the expiry of each of these periods there shall be submitted further certificates signed by a Chartered Electrical Engineer or a Registered Electrical Contractor.

This Regulation places upon the owner or consumer, the onus of ensuring that his installation is in a satisfactory condition, and it is suggested for the consideration of members of this Association that appropriate steps be taken in South Africa to the same end.

Taking into consideration prevailing conditions in this country, it is further suggested that these periodical inspections be carried out by the existing installation inspection staffs at a small charge. This will, no doubt, in some cases entail an appreciable increase in the number of Inspectors employed, but the additional cost will be met by the revenue from fees. The fees need not be high; probably an amount of 5/– will suffice, and a charge of 5/– every five years, or

1d. per month, cannot in any circumstances be called an unreasonable charge upon any consumer, having regard to his responsibility in the matter.

F. W. Joubert (Chief Inspector of Factories): Mr. President and Gentlemen, I wish to congratulate all those gentlemen who have been responsible for drawing up such an excellent set of supply and wiring regulations. I would like to give my whole-hearted support to the group promulgation, on which Mr. Harvey has just reported. This standard set of wiring regulations, if promulgated by all the suppliers of electricity, will certainly tend to increase the safety of your distribution systems.

I have been approached by interested parties to have a set of wiring regulations promulgated under the Electrical Wiremen and Contractors Act. To make the position quite clear, I wish to point out that this Act has been passed for the purpose of making provision for the registration of electrical wiremen. Section 33 provides that regulations may be made as to the procedure at Board Meetings and generally for carrying out of all the provisions of the Act, which are essentially to register wiremen and control the licensing and registration of electrical contractors. This section does not provide for the promulgation of wiring regulations, nor is there any other section of the Act, which provides for this.

In drawing up the Act it was not contemplated to usurp the powers of electricity suppliers by making provision for the conditions under which current shall be supplied to consumers. It is essential that suppliers retain this power. Section 19 of the Act makes it quite clear, because in this section mention is made of the procedure to be followed by a supplier, when it is found that a registered wireman has contravened a by-law made by the supplier.

I appreciate the difficulty of setting an examination paper on wiring for candidates, because at the moment suppliers have no standard wiring by-laws. Under the Act I am a member of the Electrical Wiremen's Registration Board, and I have undertaken, as soon as the Board has been established, to place before it for consideration, the inclusion of the wiring regulations of the Institute of Electrical Engineers, with the subjects to be studied for examination. This is provided for in sub-section (2) of section 10 of the Act. As Mr. Milton has just mentioned these regulations form minimum requirements for safe wiring and there should be no difficulty in all suppliers adopting them. Mr. Milton kindly supplied me with a copy of the wiring regulations a few weeks ago and I find them very comprehensive. I hope it will not be long now before all the suppliers of electricity in the Union have adopted these wiring regulations by means of group promulgation.

Mr. President, I quite agree with Mr. Kinsman that the wiring of consumers' buildings be inspected by suppliers periodically. He suggests one inspection every five years at a fee of 5/- but I consider that more frequent inspections would give greater safety to consumers. In this connection I would like to give you some figures of the electrical accidents which have happened since 1931. As you know I have the administration of the Factories Act under my charge and I wish to thank you for your co-operation and support in carrying out the provisions of this Act, and I hope to have your continued support, especially in the prevention of accidents.

Although there has been a gradual increase in the number of accidents from 1931 to 1939, the accident rate has decreased considerably. These accidents, are those directly caused by electricity. Unfortunately accidents of this nature include a large percentage of deaths. The development and increase in the use of electricity in recent years in

the Union, has been simply marvellous. I wish to congratulate you on this expansion. Had it not been for your constant and untiring efforts, this development could not have taken place. Comparing the horse-power figures of electrical undertakings of 1930 with those of 1937, I find that they have been nearly doubled and I am sure that the expansion up to the present is very much more than double that of 1930. The number of accidents have not increased in the same proportion. From my records I have taken the following figures relating to accidents directly caused by electricity:—

Year.	No. of Accidents	No. of deaths	No. of Accidents to Skilled Workers	High or Low tension system	Percentage of deaths.	
1931	19	11		Mostly L.T.	57.9	
1932	6	2	4	,,	33.3	
1933	15	9	4	,,	60	2 H.T. Accidents.
1934	18	10	4	,,	55.5	2 H.T. Deaths.
1935	24	8	12	,,	33.3	
1936	41	15	16	,,	36.6	
1937	27	12	10	,,	44.4	
1938	24	16		,,	66.6	
1939 Up to end of Oct.	33	17	11	,,	51.5	

From this it will be noticed that, although there are not many accidents caused by electricity, considering the vast number of units sold per annum, the percentage of deaths is very high. The total number of accidents in the Union in 1938 reportable under the Factories Act, was 683 including 73 deaths. This gives a percentage of 10.7 fatalities due to accidents. Most of the accidents caused by electricity, happened on low tension distribution. I am sure that I can rely on your continued co-operation in making and seeing that the distribution systems are as safe as humanly possible. This brings me to another question which has often been discussed and that is the

working on live mains. I only wish to point out the desirability that all such work come under the direct supervision of a senior official. I fully realise that whole sections cannot be isolated, whilst certain work has to be done, but this work on live mains must be performed in the safest possible way. All the matters I have mentioned relate to safety and with your permission, Mr. President, I would like to bring to the notice of the Conference one or two other matters. I wish to point out the necessity of a by-law which makes it compulsory for dealers to notify suppliers of electricity when electrical apparatus such as stoves, refrigerators, washing machines, etc., are sold. I know of an instance where a refrigerator was installed by a dealer and the earth wire of the three-core cable was cut off, instead of being connected to the 3-point plug.

You all have workshops in connection with your distribution systems. I shall be glad if, when ordering machinery of any kind you include in your specifications that all machines must be provided with efficient guards. This is especially necessary with grinding wheels.

At the last conference notes by Mr. Kinsman were read on "The Subject of Earthing in Relation to Low Tension Supplies of Electricity." In connection with these notes, Mr. Swingler stated that "with the object of determining the efficacy of earth leakage protection switches under local conditions, experiments are now being made in Cape Town." I would like to know whether the results of these experiments can be placed before the Conference.

In conclusion, Mr. President, as a visitor, I wish to thank you for your kind invitation to be present at this conference and the Mayor and Council for the splendid reception and entertainment. (Applause.)

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Mr. Wright: I wish to refer to the circular letter issued by the Chief Inspector of Factories, in which he suggested the periodical inspection of installations and also to the fact that some five or six years ago the Government issued regulations under which we were compelled to use an approved type of wire for overhead service connections. These two facts alone show that the Authorities are deeply interested in the prevention of accidents. Personally I think the only real method of preventing accidents is by the installation of some type of earth leakage device, which will automatically cut off the supply immediately a fault occurs. The installation of this device should be made compulsory by law and not left to the discretion of the consumer or the supply authority. I think I am correct in stating that such a law already exists in Australia and in several European Countries.

Councillor Capell: My Council was asked to do something in this matter. It was felt by the Electricity Committee that before embarking upon any scheme it was essential to get an expression of opinion from such a Conference as this. My committee feels that while the number of fatalities have not been very great, there are a number of important points to be taken into consideration. In many cases of fire the outbreak has been attributed to a faulty installation. Councils do not like the origin of fires being laid at the door of their electricity department. The Council should have the power to deal with the matter and to protect their citizens. In many instances installations put in thirty years ago exist to-day. Periodical inspections would definitely do something to improve the position, and that is why Durban has asked its engineer to bring it before this Convention.

Councillor Berman: It is not without a feeling of temerity and a certain amount of trepidation that I risk to speak, as I am only a layman and do

not possess any great knowledge of the subject. But I have a definite mandate from my Corporation to speak and vote against the proposal. To accept it would mean that we would go out of our way to publicise and draw unnecessary attention to the "dangers" of electricity. This, we consider, would be extremely unwise seeing that we are most anxious to popularize the use of electricity. We consider it totally unwarranted and uncalled for.

One half of the accidents mentioned by Mr. Joubert appear to have been sustained not by inexperienced householders, but by qualified wiremen. Again, when the total number of people using electricity is considered, the number of accidents is surprisingly small. On a rough calculation there are 250,000 consumers of electricity in the country. That would give one million individuals coming daily into contact with electrical apparatus, and a total number of 365 millions per annum. If we bear in mind the nineteen annual fatalities from contact with electricity and deduct therefrom the number of skilled wiremen involved, we are left with ten individual cases per annum, that is one in 36 millions. Surely under these circumstances it is unnecessary to emphasise and draw unnecessary attention to the mythical danger of electricity.

In any case your Association is now busily engaged with the drafting of Regulations to improve the position generally.

We in Cape Town are being flooded with cheap electrical equipment, which, we maintain, is the cause of all the trouble. If the sale of cheap and faulty electrical equipment could be prevented and all electrical goods standardized, it would be an excellent thing both for the industry and the country.

We hope this Convention will not hastily embark upon the proposal put forward from Durban.

Mr. Alexander: Unfortunately you have not a draft of the Wiring Regulations. With regard to the periodical testing of installations, it was felt that it would be a rather harsh step to take, and we, therefore, included it in the model conditions of supply which can be provided by a municipality.

Councillor Raftery: Mr. Kinsman's object is to see that whatever regulations are made shall be enforced. People who use electricity should have it brought home to them that nothing must be done that is contrary to the regulations, and that if they do trangress the regulations they will be liable to be punished. Mr. Kinsman's suggestion should receive very deliberate and careful consideration, and I propose that this be done. (Applause.)

Mr. Smith: I second.

Councillor Venter: The low accident rate has been due more to good fortune than to good management.

Councillor Raftery: I move that the proposal put forward by Mr. Kinsman be given effect to.

Mr. Kinsman: I feel that in view of the fact that the Conditions of Supply were going to be separate from the Wiring Regulations, my request was that an opportunity be given for discussion on the subject, so that Councillor members might be guided. I expected a lot of opposition. My point is that the responsibility should be placed upon the consumer of utilising the services of the Municipality at a small fee. I would be quite satisfied with an expression of opinion by the Convention.

Mr. Berry: In the United States the consumer pays a fee for inspection, and in return enjoys a reduced insurance premium. Some such system

might be introduced in this country. I support Mr. Kinsman's contention that it is in the interest of the consumer to protect himself.

Mr. Eastman: When considering the proposal now before us that the carrying out of an inspection and test of an installation every five years be included in the wiring regulations and so be given the force of law when those regulations come into force, we should bear in mind the fact that the rule as quoted in the latest edition of the I.E.E. Rules for the Electrical Equipment of Buildings has not the force of law in Great Britain.

The Electricity Commissioners, the authority which in England issue regulations relating to the control of electricity supplies and to the safety of the public, has not as yet thought it necessary to take the step in that country contemplated by the proposal before us now.

We all realise the possibility of danger arising under certain circumstances in electrical installations—though in practice those circumstances mostly produce nothing more than mere inconvenience to the consumer—and we are all alive to the need for doing everything reasonably within our power to prevent accidents occurring. At the same time we must recognise the fact that one cannot fully protect a person from the results of his own foolishness or wilful disregard of elementary precautions or even prevent him from acting foolishly, neither can we as supply authorities accept any responsibility for the results of such foolishness, disregard of precautions or the misuse of our service.

What would the proposed inspection and test show? Nothing more than that at the time the inspection and test is carried out the inspector is satisfied that as far as he can tell the installation is not in an unsafe condition! The installation might well be in an unsafe condition five minutes

after the inspection has been completed through causes entirely beyond the control of the supply authority, and I venture to suggest that should an accident occur soon after the inspection had taken place the supply authority would be considered to have some degree of legal, if not moral, responsibility in connection with it.

I see no objection to supply authorities voluntarily instituting such an arrangement as a condition of supply if they are prepared to accept the position as I see it regarding the impossibility of guaranteeing that the installation is not unsafe immediately after the inspection and test has been carried out and regarding also the matter of responsibility, but I think it entirely wrong to make the carrying out of this inspection and test at prescribed intervals a legal obligation on supply authorities.

Some undertakings have for many years past carried out insulation tests on complete installations on each occasion when extensions are made to them and also on installations when carrying out tests on meters. These tests are made by the supply authority merely to satisfy itself that there is nothing obviously wrong in the installation, and I believe that such action is all that is necessary within reason.

The primary safeguards against accidents lie in the employment only of properly qualified wiremen to carry out the work, the use of high quality materials and the education of users of electrical apparatus and equipment so that they treat the installation as a whole with respect.

Mr. Rodwell: Mr. Kinsman has put his case so lucidly that there is no need to enlarge upon it from a technical point of view. Our experience in Johannesburg is very much the same as that of Durban. It is obvious that everyone present feels that this question should be thoroughly thrashed

out. It has been before the electrical engineers for years, and demands a great deal of thought. Therefore I suggest that a sub-committee should go more carefully into the matter, and that such committee include Mr. Eastman, Mr. Kinsman, Mr. Hugo and Mr. Wright. I would also like to see Mr. Milton co-opted on that committee.

A Member: And the mover.

Councillor Raftery: With the consent of my seconder, I will withdraw my motion in favour of Mr. Rodwell's proposal. I want the Convention to support the principle.

Councillor Spilkin: I think it would be most unwise to tie the hands of the sub-committee by adopting the principle.

Mr. Rodwell: I propose that the following constitute the sub-committee: Messrs. Eastman (Capetown), Kinsman (Durban), Pirie (Bloemfontein) and the mover.

Agreed.

The President: The Convention will now adjourn until to-morrow.

The Convention adjourned at 12.35 p.m.

Earthing Tests.

COMMUNICATED.

Mr. Swingler (Capetown): It will be recalled that at our last Convention I promised to make available to the Association the results of experiments which were then on the point of being put in hand on earth leakage protective switches by

the City of Capetown Electricity Department in the course of investigations as to the suitability or otherwise for local conditions of the combination of direct earthing with the use of earth leakage protective switches as practised in Australia.

The earth leakage protective switches tested by the Department in the course of the experiments had the following characteristics:—

Item	Rating		Minimum Operating		Impedance
	(Amps.)	(Volts)	Current (Amps.)	Voltage	(Ohms.)
A	25	380	0.053	15.2	287
B	25	415	0.072	10.0	139
C	25	240	0.045	16.2	360
D	25	500	0.049	15.0	306

The primary factors governing the functioning of the proposed method are :

(1) The resistance to earth of the earth electrode to which the protective switch is connected is sufficiently low to permit of the device operating on the occurrence of an earth fault.

(2) The resistance between the earth electrode to which the protective switch is connected and the earthing system to which the installation is "direct earthed" is not less than a certain minimum value.

The Australian authorities concerned have specified that the resistance under item (1) shall not exceed 200 ohms, and shall be not less than 100 ohms, in respect of item (2). As the difficulties to be met were expected to be of the nature of unduly high electrode/earth resistance the experiments were directed principally towards determining whether or not condition (1) could be met in practice in some of the outlying areas of the Capetown reticulation system.

The experiments were carried out in sandy soil with the following results:

For the purpose of this test two electrodes A and C were driven into the ground at a distance of approximately 60 feet apart and an electrode midway between was used as a potential spike, the earth resistances of A and C being calculated from the value of the alternating current passed between A and C, and the potential measured between the potential spike and each electrode.

Test No.	Electrode A.	Resist.	Electrode C.	Resist.	Remarks.
1.	¾" G.I. pipe about 4 ft. in ground.	5333 Ohms	¾" G.I. pipe about 4 ft. in ground.	1600 Ohms.	Ground dry (Summer).
2.	do.	1920 Ohms.	do.	862 Ohms.	Grnd. damp (1st rains).
3.	do.	960 Ohms.	do.	585 Ohms.	Ground wet Heavy rains
4.	1" G.I. pipe about 8 ft. in ground.	134 Ohms.	do.	580 Ohms.	Test made immediately after (3).

These tests show what extraordinary variations in the earth/earth electrode resistance occur with the change in the seasons. It will be seen, moreover, that a ¾" pipe driven to a depth of four feet even in wet ground has an earth resistance far and away in excess of the upper permissible limit of 200 ohms. and although a lower resistance than 200 ohms. was observed when using a 1" diameter pipe driven to a depth of 8 feet in wet ground it is not unlikely that this figure will be exceeded when the soil becomes dry again — tests as to which will be made when this condition obtains.

In short, in localities such as these, earth leakage protective devices cannot be relied upon to give the protection for which they are designed unless permanently damp ground exists in which to bury an earth plate. Pending the results of

further tests on the variation in resistance of earth electrodes to earth with the seasons the City Electricity Department requires the exposed metal work of all installations with unsatisfactory earthing facilities to be " earthed " to the neutral conductor of the distribution network in accordance with the M.E.N. system. Where this is done a label is fixed to the main distribution board marked " Earthed to Neutral."

THURSDAY, 23rd November, 1939.

The Convention resumed at 9.30 a.m. in the Town Hall, Umtata, the President in the Chair.

PAPERS COMMITTEE.

The President: I have to announce that the Council recommends that the following constitute the Papers Committee: Messrs. Eastman, Kinsman, Poole and myself. Is that agreed?

Agreed.

PAPERS FOR NEXT CONVENTION.

The President: I would now like to invite papers for our next Convention. Papers have been promised by Councillor Webb, of Benoni, and Mr. Dawson, the Legal Advisor to the Cape Town Municipality.

Mr. Milton and Mr. Rodwell intimated that they would each give a paper.

Mr. Berry (Visitor): Mr. le Mare, the Publicity Officer of the Electricity Supply Commission, suggests that he might give a paper on Propaganda. I would like to suggest, if it meets with approval, that visitors be invited to contribute

papers. Some of the firms have fine commercial men on their staffs who might give papers on interesting subjects.

Councillor Robbins: May I make a suggestion in regard to papers? We come here and have a very good time, but it seems to me that we do not do enough work. We usually do 2½ hours' work per day. I don't think that is fair. Now we have a very valuable paper by Mr. Milton that is crowded out. I suggest that the Council consider the question of giving us rather more work and rather less play.

The President: Mr. Milton will give a resume of his paper, after which it will be open for discussion. I now call upon Mr. Milton.

Mr. Milton: The procedure I am adopting is one I would like to recommend for application in regard to all papers. Papers are printed and circulated before the Convention, and if members were advised that these papers would be discussed much more work might be done.

Tariffs.

By W. H. MILTON, B.Sc. (Eng.), M.(S.A.)I.E.E.
Electricity Supply Commission.

Many of the problems connected with the operation and maintenance of Municipal electricity undertakings have been dealt with at previous conferences, but very little has been said on the subject of the prices charged for the commodity we sell, except in relation to the prices charged for

water-heating and occasional references to tariffs in force without mention of how they have been derived.

It is an axiom of business that unless the price of the commodity is right the demand is limited and potential users will be debarred from purchase, the barrier being high prices on the one hand and bankruptcy on the other hand if the error lies in uneconomically low prices. If the price is correct, then the business will be satisfactory for both the purchaser and the seller.

In so far as electricity undertakings are concerned, the problem of arriving at a correct price for the commodity, that is, with due regard to its value to the customer and its cost of production, is difficult, the difficulties being increased very considerably by a lack of understanding among many of the parties concerned in the business.

The aim of this paper is to bring about a better understanding of the intricacies of the problem and it is hoped that any points which are not clear and any points which are contentious will give rise to a free discussion, to the benefit of us all.

In previous papers delivered at your conferences it has been stated that the business of electricity generation, distribution and supply requires a highly specialised study. The specialised aspects arise from technical considerations and from the nature of the items of expenditure which make up the ultimate cost of production.

These aspects have a powerful bearing on the problem of costing for the purpose of economic sales, and are reflected in all satisfactory tariffs for supply which are evolved from time to time.

COMMON PRACTICE.

Probably the root of our misunderstanding is planted in the more common experiences of our commercial life, and, therefore, a review of the

conditions leading to common commercial practice is advisable, as it may help to introduce that better understanding of the electricity supply authority's problems which is so desirable.

Certain commodities can be sold on a simple price basis of say so much per lb. or pint, with special discounts for large orders, the prices being arrived at on a satisfactory basis of costing. These simple prices occur in businesses where the manufactured product can be produced at a predetermined steady rate, and stored until absorbed in the market. By this means, fluctuation in the rate of consumption or use of the commodity can be averaged to result in a constant rate of production which produces a total amount of the commodity that is approximately equal to the total amount purchased during the same period. The rate of manufacture in such cases only requires to be modified to meet changes in the average consumption over relatively long periods.

The effect of this "averaging" is that market requirements can be met by a small plant which would be quite inadequate to meet the requirements at those times when the maximum rate of purchase takes place, and in consequence the total capital investment in plant necessary to meet market requirements is minimised, though, of course, warehouse or storage facilities must be provided to enable the rate of manufacture to be averaged.

Incidentally, the amount of the investment in warehouse or storage facilities will depend on the nature and rate of withdrawals for disposal during the most onerous conditions of manufacture.

AVERAGING FOR FIXED PRICES.

Where the process of averaging is possible, and it must be admitted that exceptions are rare, the commodity actually costs the manufacturer a fixed

amount per lb. (or per pint or article) on account of raw materials, labour, overhead costs, and the allowance for profit, etc.

In view of these facts, the commodity can be offered to the public economically at a fixed price. Discounts may be offered for large orders, because the rate of turn-over of capital is increased, and the incidence of interest, overhead charges and warehousing costs, etc., is reduced, the manufactured articles carrying these items of cost for shorter periods in such cases. This aspect is usually emphasised in the case of what are usually termed "snap orders."

A further factor which has an important bearing on the subject of pricing is that, in many commercial enterprises, the price of articles is established on the basis of "value of service" and the quantity put on to the market is controlled to give a maximum return. In general, the quantity of a commodity sold depends on the price of the commodity, though there is always a limit to the quantity which can be absorbed even if the commodity is "given away." In the case of monopolies, this system of pricing is open to serious abuse. As electricity undertakings in this country are virtually monopolies, pricing should be based on the "cost of service" and not on the "value of service."

It must be admitted that the vast majority of the articles purchased by the public do have a fixed price per lb. or pint, no matter what intervals elapse between the purchases made by individuals, and in spite of the fact that the number of lbs. or pints purchased at any one time is subject to considerable variation.

This is because the factors resulting in economic fixed prices (or flat rates) are the most prevalent in our commercial life and, unfortunately, many people come to expect the system of fixed prices or flat rates to be applied universally.

EXCEPTIONS TO FIXED PRICES.

Such people either have no knowledge that there are exceptions to the most prevalent conditions or alternatively entirely lost sight of the foundations on which fixed prices are established.

Electricity supply, except in unusual circumstances, requires the actual application of the basic principles of costing. When this is done and prices are evolved on a sound foundation, it will be found that averaged prices would be unfair in their incidence on the majority of users, and only in special cases would the cost of electricity to the user be a reasonable representation of the supply authority's cost of giving supply.

This subject should be of absorbing interest to all concerned in the business aspect of the production, distribution and sale of electricity. Included in the number so concerned there is a large proportion of persons who understand nothing of the technique of electricity generation and distribution. In the circumstances the treatment of the subject in this paper has been made as non-technical as possible, though technicalities cannot be avoided entirely.

TERMS OFTEN USED.

One of the most prevalent difficulties experienced by laymen is the inability to grasp the significance of certain terms used in agreements for the supply of electricity and in discussions on costs.

As electricity is not measured by the standards of lbs. or pints, etc., with which everyone is so familiar, it seems advisable at this stage to explain, for the benefit of laymen concerned, the nature of the quantities used in the study of the problem of selling this service and the measurement of electricity.

Briefly, the quantities generally used are as follows :—

(1) Kilowatt (kW) or Watt :

This quantity is a measure of the **rate** of supply or receipt and may be likened to, say horse-power, or pints per minute. Being a measure of a rate it does not indicate the total quantity being supplied. For example, a gallon might take an hour to flow from an orifice or it might take a minute, and though the quantity of one gallon only is drawn off, actually the flow would be expressed as a gallon per hour or 60 gallons per hour, respectively, and neither of these **rates** is indicative of the quantity of one gallon supplied. Measurement in " kilowatts " is, therefore, the measurement of the rate at which electricity is supplied.

Whilst the rate at any instant of time may be measured, there are occasions when the average rate over some prearranged period is measured. The average rate is usually accepted as the most satisfactory basis for costing, the averaging being taken over periods of two-minute intervals up to hourly intervals in common practice.

(2) The " Unit " :

This quantity is a measure of total **work** done and, therefore, combines, as a product, the rate of working and the time during which the rate or rates are applied. It may be regarded by the layman in the same way as so many lbs. or pints received in a given period, but without particular regard to the time taken to use the lbs. or pints received. The actual " unit " is a kilowatt hour, the number of units supplied being the product of the average rate in kW during supply and the number of hours over which the supply is taken.

(3) Kilovolt Ampere (kVA) :

This quantity is also a measure of a **rate** and is similar to " kilowatts " but differs in one very important respect. In electrical circuits used for alternating current supplies, much of the apparatus used for power purposes

in addition to taking a useful supply of electricity from the supply authority, also causes electricity to pass to and fro without doing useful work. This latter feature imposes a useless burden on the apparatus, cables and distribution system as well as absorbing some of the capacity of the generating plant in use to supply the consumers. The removal of the useless burden is possible but the process involves expense. Thus electricity supplied for say power purposes, includes not only the **useful portion** utilised in productive work but also a **useless portion** which is passed backwards and forwards between the supplier and the user. In a given circuit, therefore, the total rate measured in kVA exceeds the total rate measured in kW, the two quantities being different by a factor known as the power factor. In brief, the kVA rate is obtained by multiplying the voltage by the amperage, the resulting figure being usually so great that it is expressed as so many thousands (so many kVA). kVA is often the standard adopted for measuring the rate of supply to consumers, because those consumers responsible for a large useless burden without concurrent large power use, should meet the expense the supply authority is put to in providing that plant and equipment which is loaded for no useful purpose by the consumers.

(4) Power Factor :

As indicated above, the " power factor " is the ratio of kW to kVA or, in effect, the ratio of useful work to the total quantity which is the sum of the useful work and the interchanged electricity. Power factor, therefore, can never be greater than one, though the ideal of unity is often very closely approached in cases such as lighting, resistance element heating, etc. Many industrial loads, using induction motors, are responsible for very low power factors and cases where the power factor is as low as 0.5 are not of infrequent occurrences in industry. Where the power factor is 0.5 it means that, among other items of plants, the cables used to supply the user are at least twice the size of the cables which could have been used if the power factor had been corrected to unity.

(5) Power Factor Correction :

Apparatus can be purchased which enables users to restrict the interchange of electricity to the localised area between a load responsible for low power factor and the power factor corrective apparatus. The corrective apparatus is available in two principal forms, namely what are termed static condensers and what are termed synchronous condensers, the latter often being designed to do other work in the form of synchonous motors. Where these appliances are used, it is possible for a user to take a load from the supplier which closely approximates unity power factor at the point of supply, although the power factor of many appliances used by the user may be very low.

(6) Voltage and Amperage :

Reference has been made to volts (kV) and amperes (or amps) and these two terms are often misconstrued by laymen.

Voltage may be likened to the pressure or force which is made available to a user and which is adopted by a supplier for the purpose of passing electricity from the source of generation to the area of use. In view of the magnitude of the figures common in practice, voltage is often quoted as so many thousands of volts (so many kV).

Amperage on the other hand may be likened to a volume-of-flow and is a measure of the current of electricity present in an electrical circuit. Whilst the product of pressure and volume-of-flow is usually a measure of work being done, this is not always the case in electrical circuits, departures from the general rule being due to the fact that a portion of the volume-of-flow may be passing to and fro in the circuit without doing useful work.

The fact was mentioned in the description of "kVA."

(7) Load Factor :

The term load factor is used to cover a very large number of applications and to be intelligible the specific application must be stated in each case. As used by

electricity supply authorities, the principal applications are "station load factor," "plant load factor" and "consumers load factor."

"Station load factor" is usually expressed as the peak demand on the station, multiplied by the period considered, and divided into the number of units sent out from the power station during the same period. The station load factor has a considerable bearing on the average cost of production of electricity.

"Plant load factor" compares the maximum output of which the **running** plant is capable with the actual output from the plant in a given period.

"Consumer's load factor" is the peak demand of the consumer during a given period multiplied by the number of hours in that period and divided into the total number of units used by the consumer in the same period. For example, if a consumer has a maximum demand of 10 kW and uses 7,200 units in a month, then the consumer's load factor would be 100%. If on the other hand the consumer's use for the same demand was only 720 units in a month, the consumer's load factor would be 10%. From this it will be seen that the load factor is the percentage fraction which the actual use of electricity by a consumer represents in relation to the total possible use by maintaining the same demand on the supplier throughout the period.

(8) Storage Battery :

Most laymen use this term freely. The reason for its inclusion here is that a storage battery is not a receptable such as a bottle or can. Electricity is not stored by "pouring" it in. Actually the electrical energy is used to bring about a chemical change which is reversable, i.e., when required, the electrical energy is reproduced by the reverse chemical action which takes place when the electrical circuit is completed. In a way this process is not unlike the process of storage of fat by bears which is absorbed to maintain life during the hibernating period. The principal fact which emerges is

that, two changes take place, one during charge, and the other during discharge. The processes each involve use of energy and, therefore, it is not possible to extract as much energy as was originally apparently "put in." The difference, usually referred to as losses, is relatively high and varies considerably with rates of charge and discharge.

This conception of some of the quantities dealt with in electrical circuits will probably assist laymen to understand the treatment of the problem which is the subject of this paper.

ELECTRICITY STORAGE.

The reference to the benefits of storage and the advantages of a constant rate of production, made earlier in the paper, will probably have called to mind storage batteries and the direct current system.

The direct current system of supply certainly does offer these facilities, because a storage battery can be used. The generating plant can be set to give an approximately constant output (regardless of consumers' immediate requirements) and the battery can then be used, firstly to "store" surplus electricity production when it occurs, and secondly to meet any rate of use by consumers in excess of the rate at which the generator(s) are set to produce electricity. Such an arrangement requires careful designing if the users are to remain satisfied with the service rendered.

In order to give effect to these requirements, it would be necessary to provide a battery of sufficient size to cope with the extremes of difference between the average demand and the maximum and minimum demands likely to occur in practice. Further, it would be necessary to ensure that the use of the battery and generating plant in the above manner would not disturb the

voltage at which the user would receive supply at any time. When provision for these requirements is made, it will be found that the arrangement in almost every case would require the investment of very large capital sums. In addition, the technical difficulties to be overcome in connection with the service which would be demanded of such a storage battery would probably require special supervision.

The facilities afforded by such an installation, therefore, require a careful study of the economics of the proposition and it will usually be found that, apart from technical reasons, the facilities are more apparent than real. There are exceptional cases, however, and, in a modified form this system has an important economic application which the author mentioned when dealing with the subject of "Automatic Plants for Small Municipal Schemes" at a previous Convention.

Such exceptions, however, only come to light when the problem of supply is studied on the basis of cost of production and alternatives are considered with a view to obtaining the most economic solutions. This study calls for the examination of all the items making up the total cost of production.

COST OF PRODUCTION AND BASIS OF CHARGING.

The items of cost which go to make up the total cost of production of a unit of electricity have, in general ,the same form as the items of cost in most processes of manufacture, but, in view of their nature, they cannot be grouped into the same simple final average cost. The items of cost cannot be grouped in the same way, because the rate of production of electricity, except in special cases, must be directly proportional at all times to the rate at which electricity is used and, unless the load supplied from an electrical power station is

of a constant nature, the incidence of the items of cost on the total cost of production per unit is continually varying.

If the charges are to be based on the cost of the service and not on the value of the service to the user ("what the traffic will stand"), it is essential to have regard to analysed itemised costs when framing electricity tariffs to apportion the costs of production reasonably between consumers. Whilst the portion which should be borne by each consumer is the amount it costs to supply his particular requirements, this is so difficult to ascertain that tariffs are designed to approach the ideal within reasonable limits.

In general, the cost of production of electricity may be analysed under two main headings, namely, fixed costs and variable costs.

As the names imply, fixed costs are those which are independent of the number of units generated and variable costs are those which vary, in some proportion, with the number of units generated and sent out for distribution and sale.

EFFICIENCY.

Before proceeding to the allocation of items of cost under these main headings, the effect of efficiency must be borne in mind. Efficiency of production plays an important part in commerce, but "efficiency" unfortunately is a word which can be applied to individual stages of a process as well as the whole process, and in consequence, cases arise where a demand for high efficiency may mislead. What is usually demanded is the production of a satisfactory commodity at a minimum of expenditure and this must not be lost sight of when considering the efficiency of use of fuel or raw materials used to produce a finished article. Very high figures of efficiency of use of fuel can always be attained but such results are

usually brought about by the investment of large sums of capital for the purpose. It is, therefore, important to bear in mind that each stage of increase in efficiency requires correspondingly greater and greater investment of capital, provided, of course, the management and control of plant, etc., is not in question.

We often hear of power stations operating with a very low thermal efficiency, i.e. large quantities of coal are used per unit generated when compared with other power stations operating at higher thermal efficiency. Before such power stations are subjected to adverse criticism, the inter-relation between capital investment to improve efficiency and the gain obtained from improved efficiency should be compared. If it is found that the cost of improving the efficiency of a low efficiency power station exceeds the savings in fuel, etc., then it may be said that the low efficiency station is as well designed and engineered as a high efficiency station if the same criteria apply in both cases. In this way (among others) engineering is the application of economics, in practice, to produce the most efficient overall result with due regard to all items of cost and return. These problems are also considered by manufacturers of plant, and unless plant is to be purchased from stock, the manufacturer should be advised of the return expected on capital investment, cost of fuel and water, wages of maintenance staff and any other item affected by efficiency and factors within the manufacturer's control. When this is done the manufacturer is in a position to offer the purchaser the most satisfactory plant at his disposal.

IMPROVEMENT WITH EXTENSIONS.

A further aspect which affects tariffs is that, as the size of plant in a power station increases, it is usual to find that the capital investment does

not increase in like proportion but at a lower rate. At the same time increments in efficiency are obtainable at lower cost than with the smaller plant and in consequence it is possible to design extensions (and larger plants) for higher generating efficiencies to produce the best economic results as plant extensions take place. Thus, with the development of an electricity undertaking it is usual to find that the cost of production per unit falls. The efficiency of production and changes in efficiency, have an important bearing on the allocation of the items of cost between the two main headings, and their incidence on individual consumers.

COSTING.

The actual allocation of each item of cost between these two headings requires care and judgment, based on sound knowledge because hard and fast rules can only be laid down on general principles. When it comes to details, each case must be treated on its merits. Generally, the principal items of cost are subdivided as follows, though some adjustment in respect of certain details is necessary.

Under the heading of fixed costs, the principal items are:—

(a) Interest and redemption charges on the capital invested in the undertaking (or the return required on capital investment).

(b) Depreciation and/or Reserve Allocations.

(c) Salaries and wages of staff employed to operate the generating station and distribution equipment.

(d) The cost of management of the undertaking including clerical staff and services rendered (such as accounting, audit, etc.).

(e) Those other items of cost which are independent of the rate of generation within the capacity of the installation at any time.

Under the heading of variable costs, the principal items are:—

(a) Fuel.

(b) Water.

(c) Maintenance.

(d) Consumable Stores.

(e) Other items of a like nature.

If an electricity undertaking is developing, it will be clear that additional capital investments will be required from time to time, which would give the impression that capital charges are also variable. Whilst this is true in one sense, the variation in the capital charges and also in the other items of fixed costs occur at intervals, the intervals usually being measured in years, and this section of the costs increases in steps with time. The costs under the heading "variables" change continually throughout the entire development period and undergo seasonal variations in each year and daily variations in each week.

ALLOCATION TO CONSUMERS.

In view of the possible variation in the efficiency of generation, it is important to decide for what purpose an electricity undertaking has been established and the probable extent of variation of the output from the station on a daily and a seasonal basis. When these conditions have been determind it becomes possible to form an opinion as to the reasonable allocation of costs between users. For example, if a small electricity undertaking is primarily established to supply

residents in a town with electricity for lighting purposes, and to provide for the supply of electricity for other uses incidentally, it is reasonable to assume that the undertaking has been established for the supply of electricity between the hours of, say, 6 p.m. and 9 p.m., and that any use outside these hours, being incidental, may be catered for on the basis of the variable costs without necessarily bearing a full share of the fixed costs.

If, however, an attempt is made to allocate the costs between consumers strictly on this basis, it will usually be found that the system of charges evolved will not encourage the use of electricity to that extent which will give the maximum benefit to both user and supplier. This is due to the psychological aspect of the problem of tariffs.

It is, therefore, evident that the mathematical allocation of the costs between consumers cannot always be applied if the best results are to be obtained and it becomes necessary to make certain arbitrary changes in practice. These arbitrary changes, however, must be based on the mathematical analysis in order that the application of the tariffs shall not result in the undertaking operating at a loss or an excessive profit, since in neither case is the maximum benefit to both supplier and user achieved. The analysis of costs of production must, therefore, be carried out correctly before such changes are made as may be found necessary to evolve the tariffs for practical application.

The actual expenditure on certain of the items occurring under variable cost cannot be allocated in toto because the increase in expenditure with increase in output is not directly proportional to the additional number of units generated. For example, the ratio of, say, fuel to units generated is not a constant, but the function is approximately what is termed a "linear function." It,

therefore, follows that a portion of the expenditure on this item is independent of the number of units generated, i.e., it is a constant and this portion of expenditure should be relegated to a heading under "fixed costs." The portion so relegated may vary in practice between 10 and 30 per cent., depending on the nature of the load on the generating plant, particularly when the demands on the station vary during each day to such an extent that the number of generating units in use is varied to suit requirements.

Having allocated the cost of production for the generating station under the two principal headings, it is possible to decide on a reasonable tariff for supply taken at the power station. This tariff usually takes the form of a charge of so much per kVA of the consumer's monthly or yearly maximum demand and so much per unit supplied.

It is only on rare occasions, however, that a user takes his supply at the power station. In almost all cases, the situation of a user's operations is some distance from the power station and consumers are divided into typical groups. These groups usually comprise "large power users," "small power users," and the "domestic consumers," the latter including those making use of electricity for lighting only or for all household applications and also offices, shops, etc. There are exceptional cases which do not fall into these groups, such as street lighting, etc.

In the case of large power users, electricity is sometimes supplied direct from the power station by means of apparatus and equipment installed by the supply authority and used solely for the one user. In such cases the tariff of charges at the power station must be increased to cover the additional fixed and variable costs introduced by such special equipment. In other cases, large power users are supplied from the general net-

work used to supply several other consumers, and this aspect is dealt with later in this paper.

It would appear that the design of the tariff for supply at the power station should have regard to the actual time of peak load on the power station and the extent to which individual consumers contribute to that peak, i.e., each consumer should only be charged for the extent to which he is individually responsible for the peak load (the peak load having established the extent of the plant installation and, therefore, the capital investment, etc.). This might be done effectively if all consumers' loads were of a fixed form as regards their incidence and variation throughout each successive 24 hours. Such cases are very rare in practice, and in consequence, power suppliers usually charge each consumer on the basis of the consumer's actual peak requirements, irrespective of the time or season when the peak occurs.

Where a number of consumers are supplied, the aggregate of the individual peak loads will exceed the actual peak load on the power station. The difference between the aggregate and the actual is referred to as diversity. For convenience of reference and application, diversity is expressed as a number (e.g. 3 or 4) which is arrived at by dividing the aggregate of maxima by the actual maximum at the power station (or sub-station).

COST PER kVA.

If the total of the allocated fixed costs is divided by the actual kVA of peak load expected at the power station and again by the expected diversity figure, a price per kVA is obtained which will ensure that the total payment by all consumers for their peak loads on the basis of this price will be sufficient to meet the fixed costs of the supply authority.

Because the total variable costs, however, depend on the number of units sold to users and are independent of the time of day when the sale occurs, consumers are called upon to pay the actual amount of the variable costs per unit, the price being set at so much per unit,. That is, the question of an allowance for diversity does not arise in connection with this item of costing.

Where several consumers are supplied the equipment connecting consumers to the power station is shared, i.e., each consumer is not connected to the power station independently of the others. Where this is the case, the fixed costs and variable costs introduced by the equipment connecting consumers to the power station should be apportioned between the consumers in the same way as the power station fixed and variable costs are apportioned, i.e., the tariff evolved for supply at the power station is increased in respect of both the kVA and the unit rates with due allowance for diversity, and is then applied to measurements of the supply at the consumer's receiving terminals.

This system of charging ensures that a supply authority will receive from the users, revenue which very closely approximates the actual total cost of production.

It will be realised that this is true only for one aggregate of kVA maximum demands, and any change in this aggregate will result in a difference between total revenue and the actual total cost, because the total of the fixed costs is almost independent of the aggregate maximum demand within the capacity of a plant installation.

Fixed costs, however, will vary in steps with time if an undertaking is developing, and the aim of those responsible for the design of tariffs should be to arrange that the steadily increasing aggregate of demands (which constitutes development)

results in a sufficient surplus on this account to enable additional investments in plant to be made from time to time without requiring an increase in the price charged per kVA even for a temporary period. Arising from development, the usual improvement in efficiency and the reduction in investment cost per kVA of plant installed, frequently make it possible for a supply authority to reduce the charge per kVA and per unit. For reasons mentioned later, however, it is quite possible that the unit rate may remain unchanged and the entire improvement may be reflected in the reduced kVA charge. Further, the improvement in efficiency alone may result in such a small reduction in the variable cost per unit that it cannot be passed on to the user by a reduction in the unit rate in view of the very small fraction of a penny involved. This, of course, does not reasonably apply in the case of users taking a very large number of units each month.

DEPARTURE FROM ACTUAL SUBDIVISION.

Having evolved a tariff of this nature, which is termed a " two part " tariff, it is often found that the resulting figures do not appeal to users. Many users object to a relatively high charge per kVA of demand and not infrequently ask for a flat rate of say ¾d. to 1d. per unit. This is usually due to an inability to estimate the average cost per unit which would be the outcome of applying a two part tariff and seems to arise from a desire to avoid anything in the nature of a service charge or rental which does not vary in proportion to the units used in a month. This attitude is difficult to understand in the light of the number of similar costs accepted by most users as a matter of course, such as rental for premises, wages of permanent staff and the minimum return on capital that is expected, etc.

Cases often arise where a two-part tariff would result in a lower average cost than the flat rate desired by the consumer, yet the consumer will

express a strong preference for the flat rate! It is therefore very necessary that consumers should be assisted to realise that two-part tariffs are designed to provide them with supply on terms, so arranged that no consumer benefits appreciably at the expense of any other consumer.

The fact remains, however, that supply authorities are often compelled—for psychological reasons—to decrease the charge per kVA and increase the charge per unit to compensate for the reduced kVA charge because this action is dictated by the obvious desire of consumers.

Psychological reasons, however, are not the sole cause for departure from the cost basis. Variable costs have, so far, been assumed to have an appreciable significance in relation to the fixed costs. This presupposes the use of some form of fuel to operate the prime movers. In the case of a hydro-electric generating station, however, an analysis of the costs will show that the variable cost is so small in comparison with the fixed cost that it is almost negligible. Whilst at first sight it might appear, therefore, that the tariff for supply from such a station could take the form of a rental based on demand, foresight must be used. It is usual to find that supply of power from such a source is limited to an amount considerably less than the potential demand and that seasonal variation in the quantity of water available severely restricts the output at times. When framing tariffs, it is very necessary that the Supply Authority should have regard for the effect on costs of production likely to be produced by fuel consuming plant required to act, not only as standby, but as permanent plant essential to meet seasonal or even daily requirements. The introduction of such plant may only become necessary after several years of development have taken place. Nevertheless, at that time, such plant will introduce variable costs of appreciable significance and will render desirable the application of a two-

part tariff on the lines so far dealt with. If, therefore, the costing of a hydro-electric station is segregated for tariff purposes, it is advisable to introduce a unit rate based on a reasonable allowance for future variable costs and to credit fixed charges with the "excess" revenue from the variable costs when arriving at the charge per kVA to cover the fixed costs of the hydro-electric station.

Where the unit rate selected exceeds the actual variable costs of supply at consumers terminals, the difference becomes a contribution towards the fixed costs. The actual contribution, having no regard for load factor, will not have the same incidence on each consumer that the portion of the kVA charge it replaces would have, but as the step is taken to meet the wishes of consumers, the latter cannot complain. In order that the total cost to the supply authority may be recovered from the consumers, it becomes necessary to form a satisfactory estimate of the total contribution from revenue at the unit rate towards the fixed costs. The charge per kVA is then reduced by such an amount that the total revenue from this source is less by the amount of the contribution from the variables. The tariff then no longer represents the correct allocation of costs between consumers, but as so few users are conversant with the basis of electricity costs, in deference to their wishes, the inaccuracy must be accepted at the present time. These features must be taken into account when reduction in the tariffs is contemplated as a result of development.

So far, the question of the costs at the power station have been analysed to show their application to large power users, but in municipal schemes it is necessary to evolve a tariff for supply to relatively small users, such as the domestic consumers and small power users.

RETICULATION.

To make supply available to these potential users, it is necessary for the supply authority to invest in a transmission, distribution and reticulation system. The expenses in this connection may also be divided between fixed costs and variable costs, though the latter cost is usually a very small proportion of the total cost of this section of the service. The variable costs of transmission and distribution include the "losses" in the system, arising from the work that must be done by electricity in circulating between the power station and consumers' meters. These losses usually amount to anything from 6 to 12 per cent. in well-designed undertakings, though considerably higher figures are often experienced in practice, sometimes for satisfactory reasons.

In view of the manner in which the distribution wires are interlinked to form a network to supply consumers responsible for a load having a great diversity, it is virtually impossible to arrive at the actual cost involved in giving supply, at all times, to any individual consumer on the system. It is, however, possible to arrive at approximate costs to supply groups of consumers of definite types, but even so, the allocation of costs remains arbitrary. In the circumstances, it is quite reasonable to average the cost of supply from a network and in this way a multiplicity of tariffs is avoided.

ZONES.

In some cases, where a supply authority meets the requirements of a very large area, it may be advisable to divide the area supplied into zones, and costs are then averaged for each zone. Such systems are usually only adopted when it becomes clear that the effect of including one zone in another is to seriously increase the costs to the one without appreciable benefit to the other and where

general averaging becomes unreasonable. In such cases, however, continued development usually enables the supply authority to merge the zones and eventually arrive at the position of a standard tariff throughout the undertaking.

Naturally the averaging of costs must necessarily mean that certain users are charged more than the actual cost of the service, while others are charged less, but as it is not possible to determine who these consumers actually are, this fact must be accepted as unavoidable.

With the exception of cases requiring treatment in zones the expenditure on the general reticulation service of a supply authority is averaged and allocated between consumers regardless of the disance of the area supplied, or the distance of the consumer, from the power station and also regardless as to whether the consumer is situated in a densely or lightly populated area. This average, however, should not be a simple arithmetical average on the basis of the number of consumers served, but should be based on a reasonable allocation of cost proportional to the demand each consumer is likely to impose on the system, because the diversified aggregate of all the consumers' demands is the principal factor that determines the expenditure on the transmission and distribution service.

A two-part tariff similar to that designed for supplies given at the power station can be derived for determining the cost of giving supply to small users. Both the kVA and the unit rates would be increased, not only to allow for the work done in conveying the supply from the power station to the user, which is in proportion to the consumers' use, but also to allow for the additional fixed costs due to the reticulation service provided.

As is the case for supplies direct from the power station, however ,it is difficult to determine the actual contribution of each consumer on a reticulation service to the peak established at the power station. For this reason it is considered satisfactory to aggregate the estimated average demands of individual consumers to determine the diversity of this type of load in order to arrive at a reasonable average charge for the peak load requirements of individual consumers. There are, of course, special cases which arise and which are mentioned later in this paper, but such cases are the exception to the general rule adopted in good practice.

DOMESTIC TARIFFS.

If it were reasonably possible to do so, the two part tariff derived in this way could be used to bill individual consumers. This is not done, because, in addition to the usual metering equipment, it would be necessary to purchase and instal instruments required solely for the purpose of the measurement of the peak load of each individual domestic consumer. The additional capital expenditure alone would have the effect of increasing the cost of electricity to users. Further, the necessity for additional calculation, etc., in connection with the monthly accounts would also add to the cost of supply. Alternative methods of allocating the fixed costs between domestic consumers which avoid increasing the cost of supply are, therefore, adopted for the purpose of framing satisfactory tariffs.

The search for these alternative methods has resulted in several forms of tariff being framed and used, all with the same object in view, viz., sharing the fixed costs reasonably between consumers.

SLIDING SCALE.

One of the earliest forms was the block type tariff which provided for the sale of electricity on

a sliding scale of charges with a fixed number of units in each step of the scale, regardless of the extent or nature of a user's requirements. This form of tariff is subject to adverse criticism, because the average cost of electricity to a consumer on this basis, depends entirely on the total numbers of units used by the consumer in a month (tariffs being applied on a monthly basis), and has no regard whatever to the nature of the consumers' requirements and the magnitude of the peak which the consumer imposes on the system.

It is clear, therefore, that consumers making use of electricity for brief intervals but at a high rate, may conceivably pay less for electricity per unit than consumers making use of electricity continuously for long periods. The former type of consumer, however, should actually be charged more per unit than the latter in view of the relatively large investment costs of the supply authority necessary to meet the large demands of the first consumer in comparison with the relatively small investment costs involved in meeting the small demand of the second consumer.

The "sliding scale" tariff, therefore, only represents a reasonable allocation of cost for one specific case of use for each particular ratio of use to maximum demand, and in all other cases favours some and penalises others, depending upon the consumers' load factor.

GRADED SCALE.

Another form of tariff which has been evolved, provides for the sale of a graded number of units at a high rate, the balance being sold on either a sliding scale or immediately at the lowest economic rate possible for the particular system of supply. The intention of grading the number of high rate units is to recover the fixed costs in proportion to the consumers' probable maximum demand, since the difference between the true unit rate repre-

senting variable cost and the actual high rate adopted, represents the allocation of the fixed costs on a unit basis. The grading of the number of the units sold at the high rates is established by grading the consumers supplied.

"RATEABLE VALUE."

The grading of consumers is sometimes based on the rateable value of the properties where use occurs. This has the objection that the valuation of premises is not necessarily a criterion of the probable average peak load of the premises. Not infrequently users with a low valuation impose a higher demand than users with a high valuation.

It is well known by supply authorities that the maximum demand imposed by a user in relation to the total use of electricity by that user is not dependent on the locality in which the user resides nor on the valuation of the premises he occupies, though cases can be found which show that the valuation of premises is a reasonable indication of the peak imposed by some particular residents. Such cases, however, do not represent a reasonable average.

"ROOMS."

In other cases grading of consumers is based on the number of "living rooms" or equivalent "rooms" in the premises supplied. This system of grading is more satisfactory than the valuation basis, because the number of rooms in premises is a much closer indication of the probable maximum demand likely to be imposed by the occupier of the premises concerned. Briefly, "room" is usually defined as all rooms excluding kitchen, pantry, bathroom and conveniences, but including all outside rooms used as living rooms. There are also cases where kitchens are included in the count for the purpose of the tariff.

The reason for the greater accuracy of this system is due to the fact that the rooms of most premises are similarly lit and the use of electricity for general household purposes or business purposes has a close relation to the number of rooms in the premises supplied.

In order that the actual price of the high rate unit may be fixed, the supply authority must estimate the proportion of high rate units likely to be sold. This is due to the fact that the supply authority never sells the total number of high rate units represented by the total number of "rooms" in the area supplied multiplied by the number of high rate units per room set out in the tariff. In fact, experience has shown that only 70 -- 90 per cent. of the possible number of high rate units which could be sold, are actually sold at this rate, because a number of consumers never make use of the total quota of high rate units. On the other hand possibly some 50 – 60 per cent. make use of a total number of units each month far in excess of their quota of high rate units, and in consequence the total number of units sold by a supply authority far exceeds the possible total of high rate units.

For this reason the actual charge established for the high rate units is in excess of the charge which would be established if all consumers used their total quota of high rate units.

Considering the case of two users who may establish the same demand from identical premises, one user may restrict his use entirely to the peak load period and actually take a lesser number of units than his quota, whereas the other may make use of electricity over longer periods and actually use more than his quota of high rate units. Though the peak load imposed by these two consumers is the same, the one will contribute more towards the fixed costs than the other, and the low load factor consumer will benefit at the

expense of the high load factor consumer, whose requirements are really more valuable to the supply authority and whose responsibility for the supply authority's fixed costs is no greater than the low load factor consumer.

"SERVICE CHARGE."

Another method of applying the room basis, which seems to produce the most equitable form of tariff, is to charge a "service charge" based on the number of rooms supplied, i.e., the tariff takes the form of so much per room (whether or not electricity is taken for use by the occupier) and so much per unit, the latter representing the price fixed to cover variable costs. This system is tantamount to an assessment of the maximum demand likely to be imposed by an occupier of each of the prmises connected to the system of supply and the application thereto of a charge per kVA (for the demand which has been so assessed). Premises not connected to the supply are not included in this assessment.

Whilst this system closely approximates the alternative of metering the demand of each consumer, it may not be a reasonable reflection of the case in some instances. For example, cases arise where relatively large premises are not fully utilised through force of circumstance or choice and many rooms may seldom be used or even entered during the day. Such cases, of course, involve the occupier in some hardship due to grading but surely this hardship is no greater than the obviously accepted hardship of the rental paid (or sacrificed if the owner is the occupier) for rooms which are of little service to the person concerned. If such persons remain occupiers of large premises from choice they do so well knowing that they are paying more than is necessary to meet their essential requirements, and it is not illogical to suppose that such excess payments are made for reasons considered worth-

while. Instances of this type occuring through force of circumstance are a real hardship for which the solution must depend on local conditions.

The service charge system is more harsh than the quota system in its incidence on the occupier of large premises who makes little or no use of the total available number of rooms, but on the other hand the "service charge" establishes a reasonable allocation of the fixed costs between consumers in relation to the demand imposed on the system by the great majority of individual consumers. In practice the number of consumers charged either more or less than the reasonable allocation of costs is far greater when units are sold at so many per room at a high rate, than the number of consumers similarly treated on the service charge basis.

In order to overcome the difficulty of meeting the requirements of consumers who are not likely to impose a demand proportional to the size of premises occupied owing to the nature of the occupancy or the finances of the occupier, it is usual to provide a flat rate as an alternative to the "service charge" rate. Such flat rates provide a not unreasonable return to the supply authority for the service rendered, and bring in revenue which probably benefits the remaining users on the system. The flat rate, however, must necessarily be regarded as an expedient.

The flat rate charge per unit should be so designed that any consumer making normal average use of electricity will pay less on the two-part tariff than on the flat rate, as this ensures that the flat rate is only made use of in those exceptional circumstances it is designed to cater for and does not enable consumers to avoid reasonable responsibility to the supply authority. The service charge system coupled with a suitable alternative flat rate, therefore, deals more fairly with a larger number of consumers than the high rate quota system.

There are other alternative methods of distributing the cost of supply between consumers which are variations of the types described, the latter being those principally used.

SMALL POWER USERS.

In order to allocate the cost of supply to small power users, the difficulty of the metering of maximum demand economically again arises. In the circumstances tariffs have been designed on the lines similar to those applied to domestic users which have been dealt with, and are subject to similar criticism. In view of this, only the most satisfactory system is mentioned, i.e., the basis of charging small power users on a reasonable estimate of the maximum demand they can impose on the supply authority's equipment. This is usually done by establishing some charge per H.P. of appliances installed by the consumer, and the revenue from this source is designed to meet the supply authority's fixed costs with due regard to the contribution thereto from the unit rate charge. All units used by such consumers are then charged for at the unit price established in the same manner as for domestic supplies.

Such a tariff is harsh in its incidence on those consumers making very infrequent use of their installations and also on those users whose installations are in excess of the power required to drive the appliances used. In the first case, the incidence of such charges is no greater than the original purchase price of the plant in relation to the work it was purchased to do, and when a purchaser is deciding on the type of prime mover he requires, he should have regard to both the cost of purchase and the cost of operating the equipment. In the second place the installation of prime movers larger than required usually results in low power factor with its consequent effect on the fixed costs.

Unless a potential consumer is prepared to pay for electricity on the basis of such a tariff, supply to him is not likely to be of any benefit to the supply authority or the other consumers on the supply authority's system.

DIVERSITY.

So far diversity has been dealt with very generally. The extent of diversity and its effect on tariffs varies considerably with the size and nature of the electricity supply authority's undertaking. For example, when dealing with supply for cooking by electricity, the size of the undertaking concerned is very important. If, say, there are only 50 consumers taking supply it is likely that the plant will be relatively small and the fixed costs high in relation to the aggregate maximum demand. Similarly the variable cost of production as applied at consumers' terminals may also be relatively high.

If the tariff designed to meet cost, is, say, 3/- per room and 1d. per unit, it is not unlikely that several consumers will decide to use electricity for cooking. If, say, 10 of these consumers make use of electric stoves, it is probable that the incidence of this load in relation to the actual maximum demand on the power station prior to the installation of the stoves will be high, there being little prospect of diversity in the actual time and period of use of the stoves.

In such circumstances, it may be necessary to consider stoves as power appliances and make some service charge per kilowatt of rating of the stove installed in order that users of stoves should contribute a reasonable amount towards the allocation of fixed costs.

As the size of an undertaking increases, it can be appreciated that, though there may be a proportionatte increase in the number of stoves in use on the undertaking, it is probable that the

times and periods of use of the stoves will result in greater diversity, i.e., though the aggregate capacity of the stoves may be high, the actual amount of the diversified load may be relatively small. Whilst electric stoves in general use, range from 3 kW to 5 kW capacity, or more, it is the experience of the larger undertakings that no more than 1 kW per stove is imposed on the supply authority's source of supply, i.e., the diversity must amount to from 3 to 5 or even more.

In connection with supply to small power users, the same remarks apply, and in the larger undertakings the diversity of this load (which does not fall within the scope of the metered maximum demand tariff), is so great that experience has shown supply to such users to be economical and reasonable at charges equivalent to a price per kVA (or the assessed maximum demand) which is considerably less than the actual demand charge in the two-part tariff, ratios of 1 : 3 being not uncommon although quite economical, i.e., the charge per H.P. (assessed kVA) may be as low as say 3/– where the actual charge per metered kVA is 9/–.

There are other uses of electricity peculiar to municipal electricity undertakings, such as water pumping for domestic use, street lighting, etc.

WATER PUMPING.

Where the water pumping load is under the direct control of the power station staff, and it is possible to pump sufficient water for a town's needs at times when the load from this source does not require the operation of any additional plant at the power station, the actual cost to the supply authority of supplying the load does not include any fixed costs at the power station, though it might be argued some proportion of the overheads is spent on control. At all events there is considerable justification for the supply of electricity for such purposes at special rates.

Care must always be exercised in dealing with these special cases. If the loads are not under the control of the power station staff, certain of them which do not affect the peak when first supplied may later become " on-peak " supplies due to the changing nature of the undertaking with development.

STREET LIGHTING.

As regards the street lighting service the total load from this source is usually imposed at the time of the power station peak. Whilst the load of individual lamps is small, it is reasonable to assess the cost of the service on the basis of the aggregate demand imposed by all street lights. The cost of power supplied can, therefore, be determined by applying the large power users tariff to the load measured at the power station. To the cost so arrived at, should be added the fixed costs arising from the expenditure on the street lighting service and switching wires (the large power users tariff automatically allowing for the use of poles as supports and for feeder mains where these are used). It is necessary to make a further addition to the price for the street lighting service, in respect of the cost of the maintenance of the street lighting fittings and lamp replacements. By making use of these figures, it is possible to arrive at a reasonable charge per lamp per annum for each of the several sizes and types of street lights used. Prices per lamp per annum, however, must have regard to the normal hours of lighting in the year as the cost of lamp replacements and the number of units used is dependent on this period.

On the basis of the points which have been mentioned in this paper it should be possible to deal with almost every case of supply likely to arise in municipal practice.

It is hoped that the importance of designing satisfactory tariffs has been sufficiently emphasised. Anyone who has had the experience

of trying to frame satisfactory tariffs for introduction after unsatisfactory tariffs have been in use, will appreciate the very great handicap arising from supplies having been available to some users at rates which were too low. Tariffs should be on right lines from the outset.

In conclusion, I have to express my thanks to the Electricity Supply Commission for permitting me to express my personal views to you on this subject, and I am grateful to your Association for having given me the opportunity to present this paper.

The President: I am sorry Mr. Milton has had to condense his resumé of his paper, which is now open for discussion.

DISCUSSION.

Mr. Rodwell: Mr. Milton is to be congratulated on his thoughtful paper, the discussion of which must inevitably throw light on many of the obscure problems of costing and charging for electrical supplies. Equitable solution of such problems is the very life's blood of any undertaking. The author has shown that the person responsible for the design of tariffs should be an engineer who has a good knowledge, both of economics and psychology. With these qualities and reliable and up-to-date statistics of his own and other undertakings, he should be able to keep a check of all developments which are occurring in the various spheres of the undertaking and so deduce and advise changes in policy from time to time which would promote the maximum use of electricity for all desirable purposes.

The author has expressed the opinion that electricity undertakings in this country, having a monopoly, should base prices on the "cost of

service" and not on the "value of service." This is a fundamental principle and one upon which I cannot agree entirely. Certain services are of more value to the consumer than others and have a certain degree of "inelasticity," i.e., increased consumption does not follow as a consequence of price reduction; therefore, these services should carry the greater proportion of the total "fixed costs" without materially restricting their use, allowing smaller allocations of "fixed cost" to other services, which are of a competitive nature and are "elastic." Competitive services, particularly industrial and manufacturing, require a lower tariff to promote utilization to an economic maximum. For instance, Johannesburg is primarily a business centre and the demand is of a domestic and business nature. Owing to somewhat high site values the industrial load does not compare favourably. To encourage the industrial load there at low tariff scales is good business. Industries require a large number of employees who reside within the municipal area, contributing to its rates and to its business, and whilst there may be little if any profit for the electricity undertaking, the electrical engineers are broad-minded enough to realise that many other benefits accrue to the supply authorities and to the city as a whole.

However, it is essential that all undertakings should periodically determine, as nearly as possible, the cost of supplying each type of consumer and ascertain whether all are contributing their just proportion of the costs.

The author is to be congratulated on his courage in setting out in a paper to our Association simple explanations of the quantities used in electrical engineering, because, as he states, a very real difficulty is the layman's inability to grasp the significance of certain terms used in agreements for the supply of electricity and in discussions on costs. It would be well if the writer's

simple explanations, which after all ought to be in daily use among Municipal Electrical Engineers and possibly among the Chairmen of Electricity Committees, reached the laymen mentioned who are presumably the consumers.

In the paper it is suggested that large power consumers supplied direct from the power station should receive special consideration and only be charged the costs at the power station, which must mean generation charges plus a slight increase to cover the special equipment necessary to give that consumer only supply. This policy can hardly apply to a large undertaking where the distribution charges must be averaged out over the entire area of supply, and any industrial consumer, whether in an industrial zone or adjacent to the power station, must be charged on a fixed scale. Further, to design a charge based on the actual time of peak load of the consumer may have awkward consequences, as a type of load which may at present be mainly "off peak," if encouraged too rigorously by propaganda and low tariff inducement, may grow to such an extent that the system "peak" may spring up at an entirely different time of the day. While the average total cost of production is being slightly reduced, the incremental cost of production for this particular load may be increasing rapidly, and the load which was formerly welcomed may have to be taken at a loss, without readjustment of its tariff. This has occurred in several of the smaller towns in Britain, the evening lighting peak having been exceeded by the mid-day cooker load. The managers of these undertakings have now to solve this difficult problem.

As you are probably aware the possibility of standardising tariff in Britain is under serious consideration. The diversity and great distances would make this difficult of achievement here.

The author divides the cost of supply into two parts — fixed costs and variable costs. In

arriving at fixed costs, the author has not rendered clear a point which is only of significance when considering domestic and other small consumers; namely, that the cost of meter reading, rendering and collection of accounts and other small items bearing no relation either to demand or energy consumed, must be viewed as a lump sum annual charge separate from the fixed costs per kVA demand.

The writer states that it is often found that consumers, particularly industrialists, object to the relatively high charge per kVA and prefer a flat rate even when the average per unit on the two-part tariff works out less than a possible flat rate charge. This was found the case in Johannesburg when the two-part tariff for manufacturers was introduced a couple of years ago, but all that was necessary was an educational campaign among the industrialists, and to-day, complaints are few, the consumer realising that the current charges are largely in his own hands and that increased efficiency means lower electricity costs.

In speaking of domestic supply, Mr. Milton seems to favour the "room basis" as a more equitable method of charging. This system has been in force in Johannesburg for many years and has given entire satisfaction.

I am unable to agree entirely with the statement that only from 70-90 per cent. of the possible high rate units are consumed by domestic consumers. To-day, with the low cost of household appliances, the primary units are invariably consumed, and the undertakings have to thank the humble electric iron and kettle largely for this fact. The service charge system which may be viewed as an insurance against the "fixed charges" is certainly playing safe as far as the undertaking is concerned and in Johannesburg would possibly create more hardships with consumers than in the coast

centres. Johannesburg consumers having regular annual leave of, say, a month the service charge would operate, whereas on the room basis there is no charge levied during the period when there is no consumption, and the annoying psychologic effect of charging these comparatively small consumers for supply not used, is evaded. I am aware that it may be contended—available service should be paid for, but, a satisfied consumer is an asset of definite value.

The advent of centralised "Ripple Control" to our systems will, in due time, give us a very useful and powerful means of controlling several different types of service, to reduce peak demands, improve voltage regulation and improve the load factor of the system. Controlled services may, of course, be compensated by reduced tariffs if the nature of the load warrants this.

Ripple control being yet in its infancy, it is difficult to predict what alterations in the methods of metering and charging may be evolved. kVA metering may be "rippled" to give demands at certain times and not, as at present, at any time during the 24 hours. Possibly two-rate meters may also be operated by this means. We may anticipate many developments in this sphere within the near future.

Mr. Milton has maintained his reputation for presenting a paper, not only of great interest, but of considerable practical use.

This comprehensive paper describes and summarises the various tariffs in use and will serve as a useful text book and guide to those responsible for the management of electricity undertakings, especially the smaller ones, in approaching the question of framing tariffs and giving effect thereto to suit the particular requirements, and our thanks are due to the author.

in his paper is to be found sound reasons on which to base these charges. To my way of thinking the only method to base your charges on is on the total costs of the scheme.

Compare Umtata with Standerton. The former station supplies practically all its load for lighting and small power but no industries, while the latter supplies 60% of its load for industrial power. It is evident that a tariff to be suitable for these places should be based on the costs of the undertaking.

I think this paper should have gone a little further and coupled tariffs with our old friend Reilef of Rates. In this respect all ground which is not served with electricity and water services is necessarily of lower value to the Municipality than ground which has these services. If, therefore, the value which electricity adds to this ground was immediately recovered as rates it would certainly ease electricity profits being used for this purpose.

Again in fixing tariffs Mr. Milton favours or seems to favour the room charge. This charge can be applied in two ways:

First, as a certain number of units per living room at a higher rate and all units used in excess at a flat rate, such as, say, 5 units per living room at 6d. and the balance at 1d. per unit.

Secondly, a service charge can be made and all units sold at a fixed amount. This service charge would vary for different size houses and could be based on the living rooms. The service charge could be, say, 2/– per living room and all units sold at ¾d.

Comparing these charges the first tariff is straight forward and is not misleading and encourages the use of electricity. All electricity

is charged for and in return for the consumers' money electricity is given. The second tariff charges a service charge for which no electricity is given and all consumed can, therefore, be supplied cheaper than that in the first scale.

Mr. H. A. Eastman: A point to which I would like to draw attention mentioned in Mr. Milton's paper and which was referred to also by Mr. Rodwell, is that in fixing the tariff rates it is necessary to give due consideration to the psychological reactions of existing and prospective consumers to the details of a two-part or all-in rate of charge. When calculated strictly from an analysis of cost to supply a particular service the "high price" section of such a rate may prove to be so great as to frighten away from that service the very consumers whom we wish to encourage to use it, notwithstanding the fact that the "low price" section of the rate may be an exceedingly attractive one and that the average price payable for a given normal consumption is reasonable. The obvious procedure is, of course, whilst giving due consideration to other relevant factors, to reduce the "high price" section of the rate to such a figure as to avoid that objection and to raise the "low price" section to such a figure as to bring the average cost per unit for a normal monthly consumption within the consumers' capacity to pay and to so arrange the two sections as to encourage him to use still more electric energy within his means.

These comments apply particularly to supplies for domestic purposes where there is a wider diversity of types of tariffs than for any other service. Mr. Rodwell, for instance, mentioned that in Johannesburg they preferred in their domestic tariff rate to quote the "high price" section of the rate as a specified number of units per room per month at a relatively high price and to offer all electric energy consumed in excess of that quantity at a very low rate of charge.

Mr. Milton in his paper has mentioned that method of charge as well as that which quotes a charge based only on the number of rooms and a low rate per unit and I would like to draw attention to the fact that either of these methods of charge can readily be converted into the other by merely in the first case crediting the total cost of the specified number of units at the high rate of charge with that number of units at the low rate so arriving at the nett cost per room per month exclusive of electric energy and in the second case by acting in the reverse way.

In the one instance the consumer feels that he is at least getting something for his fixed monthly charges in the shape of a certain number of units and in the other case the supply authority says in effect quite clearly what the consumer should pay as his assessment of the overhead charges on the undertaking irrespective as to the quantity of electric energy he uses. Here again the psychological aspect of tariff rates is clearly seen and opinions differ as to which system is to be preferred. In Capetown we dropped the first-mentioned system in favour of the second some years ago because we felt that the latter would be more popular through the greater simplicity and straightforwardness of expression of the intention of the " high price " section of the tariff rate than applies in the case of the former.

No serious difficulty was met with when the change was made.

The President: As Mr. Milton has mentioned hydro power, I would like to offer a few remarks. We have here a hydro plant and the tariff is much lower by reason of the lower capital cost of the installation. In Umtata we have a very low hot water rate of 1s. per 100 watts. The explanation is that we saw the possibility of creating a new peak load by means of cheap hot water and by dividing it up into three sections. We have to bear in mind the cost per unit sold.

Those familiar with the pitfalls encountered know that a hydro plant must be watched very carefully in order to ensure power. If you reduce your cost and have no more power you will cripple yourselves. If we had no prospects of further hydro power we could not think of reducing our tariff. We run on a 60 per cent. load factor, and I do not see any possibility of going beyond 70 per cent. We are showing a profit now and are building up a reserve for the future. (Applause.)

Mr. Foden: Tariffs and revenue are bound up one with the other. I should like an expression of opinion regarding the desirability of building up a reserve fund and what percentage it should be to the capital expenditure of the Undertaking. What does Mr. Milton consider the most desirable method of financing extensions as this is a subject all of us are faced with from time to time?

At present the two methods usually employed are:

(1) By means of raising a loan.

(2) By means of monies available in the reserve fund.

The former method involves annual capital charges, and over a long period of time is most expensive to the community.

Should not tariffs be so formulated that an adequate reserve fund may be built up and be available for financing capital expenditure? I am sure Mr. Milton's reply will be of interest to all of us.

The President: As time is short Mr. Milton has agreed to communicate his reply through the Secretary for inclusion in the printed Proceedings.

REPLY BY MR. W. H. MILTON
(Communicated).

Mr. Rodwell drew attention to the desirability of considering "value of service" when framing tariffs, and mentioned the benefits to a Municipal undertaking, arising from Electricity Department development, were not to be found in the finances of the Electricity Department alone but in increased revenue to other Departments also.

If Municipal electricity trading was in competition with other electricity traders, then the "value of service" principle, in application, would be subjected to restrictive influences not present where electricity supply is virtually a monopoly. Such influences would restrain variations in price to reasonable limits. As pointed out in my paper, Municipal electricity supplies are virtually monopolies, and therefore the application of the "value service" principle is open to serious abuse. Further, when the "value of service" principle is applied as a general practice, and an undertaking is not working for a profit, it follows that certain users of electricity are actually paying for losses incurred by the supply to other consumers, because profit from some entails loss from others to produce the net results of cost equalling revenue on the whole undertaking.

Exceptional cases do occur when there is every justification for adopting a "value of service" basis. Admitted that the development of an electricity undertaking should, and does, improve the financial position of other Municipal Departments, but this aspect is more appropriate to the question of relief of rates than the framing of tariffs.

Dangerous precedents may be introduced if normal supplies are considered for acceptance on special tariffs based on the benefit of the load to the undertaking, i.e., the effect on revenue and expenditure by the omission or acquisition of one

particular consumer. On the other hand, "off-peak" supplies may be quoted special terms. This, however, is tantamount to considering such loads on the basis of "value of service" but only where the value of service is less than average cost of production. In any case, these terms must be examined with a view to determining whether or not the value of service is such that the load could be supplied with benefit to the supply authority. Further, the time of day during which the peak load occurs is apt to change with the development of an undertaking, and therefore it is necessary that a supply authority, in offering "off-peak" terms, should have full control of the period during which such off-peak supplies are given. It is only in such cases that such supplies can be safely regarded as "off-peak," because they can always be restrained to off-peak periods with changing times of peak load. (For example, certain Municipalities which a few years ago experienced a severe evening peak which established the selection of plant capacity, have since experienced day peaks considerably in excess of their evening peaks and it is now the day peak which decides the magnitude of the plant installation.)

Mr. Rodwell questioned the desirability of analysing the costs of supply at the power station to form a tariff for supply at this point. I intended that this analysis should be a step in the process of tariff making, in order that power station costs may be realised in relation to the final cost of delivery at consumers' terminals on the general network. Further, in order that any large block of load, say to an outlying centre not necessarily within the Municipal area, which is taken straight from the power station busbars, can be costed reasonably, a tariff to meet cost at the power station should be known, because such loads may be taken on with benefit to a supply authority without bearing a proportion of the cost of distribution which is included in the tariffs

designed for application in the supply authority's (Municipal) area. As I pointed out in my paper, it is reasonable to assume, for general purposes, that distribution cost may be averaged amongst the entire community benefiting from the electricity service and no attempt need be made to segregate the costs between small groups or individual consumers. Cases do arise, however, where segregation may become necessary, and this aspect is mentioned in the paper under the subheading "Zoning."

The point has also been raised that certain costs are independent of the maximum demand or units supplied and are, therefore, not properly covered in the two-part tariff recommended. Such costs include expenses in connection with meter reading, rendering of accounts, testing, etc., all of which items of cost do not vary appreciably as between consumers, being much the same regardless of the type and magnitude of a consumer's load on the supply authority's system. These costs, however, are usually small in relation to the total fixed costs of electricity to be apportioned, and in many instances, are absorbed in either the kVA or unit rate. In some instances, however, the tariffs include a meter rental which is intended to cover these special fixed costs, while in other instances, tariffs include a fixed monthly or annual charge (so termed) irrespective of the consumer's requirements. In my paper I have dealt with the subject of tariffs very generally, and there are many such details which would arise in practice which have not been dealt with specifically.

Councillor Venter has raised the question of the recovery of the cost of civil works (and similar irrecoverable costs) in cases where there is a likelihood that an undertaking may be retrogressive. This problem is similar to the problem involved in supply to a consumer who requires electricity only for a limited period. Whilst certain civil works are of a permanent nature, they

may become redundant or obsolete (and therefore valueless) well within their otherwise useful life. Expenditure of this nature should be recovered within the period of useful life of the asset by the establishment of adequate Reserve Funds.

To secure the financial position of an undertaking against the possibility of accident and more rapid obsolescence than originally anticipated, it may be necessary from time to time to alter the rate at which reserves are built up. In so far as the Electricity Supply Commission is concerned, the amounts set aside towards a Reserve Fund to cover obsolescence, betterment and exceptional repairs (not being ordinary maintenance) has been limited to a maximum of 15% of the loans raised.

Should a supply authority determine that its reserves are excessive, the excess could be absorbed in the undertaking during periods of extension from time to time, but the effect of this is to reduce the cost of operating the undertaking below normal for some time thereafter, and there is always a possibility that, either the reduced costs cannot be maintained with continued development, or that large apparent profits are made, i.e., the profit is inflated by the purchase of assets without incurring equivalent annual costs though revenue will probably continue to increase.

Councillor Robbins has drawn attention to the use of the word "unity" in connection with the definition of power factor. This is admittedly a term which has a wide meaning, and in the circumstances I have taken the liberty of deleting it from the paper as it will appear in the Journal, and have used in its place the word "one."

Mr. Berry has submitted arguments in support of the "value of service" basis for the design of tariffs, but, at the same time, presupposes that

profits are aimed at, and evidently assumes that the business of electricity supply is not a monopoly. The points he has raised have been covered largely in my reply to Mr. Rodwell. It is necessary, however, to deal further with Mr. Berry's suggestion of preferential rates, which may benefit the supply authority financially. This system of charging is adopted by the S.A. Railways and Harbour Administration (as will be seen by a study of the railway rate book). Possibly it will be sufficient for my purpose to draw attention to the question which has been discussed at previous Conventions, namely, the railage rate on coal. Low coal railage rates are only possible because high tariff rates are applied to other commodities. For example, supply authorities pay a high rate on machinery, plant and equipment. The high railage tariff for machinery, plant and equipment, in turn often comes in for a modicum of criticism and complaint! I do not intend arguing railway rates problems, and have quoted these items to draw attention to the difficulty of satisfying consumers by applying preferential tariffs. In my opinion, electricity supplies, when offered at differential and preferential rates, are subject to far more criticism than occurs in connection with railway tariffs, as so many more individuals are affected directly on electricity supply systems.

Mr. Gregor has quoted a case where the peak load period has altered from the "evening" to the "day" and has pointed out that his domestic load has become one which might be considered on the basis of variable cost only. The requirements of both sections of the community, however, are not markedly different and neither is negligible in relation to the other, therefore, it seems reasonable to consider costing the supply on the basis of averaging the total costs among the whole number of the consumers on the undertaking. Justification for "off-peak" considerations, even under the conditions of control

mentioned earlier in this reply, only becomes possible when the off-peak load is small in relation to the actual peak, and further, when it can safely be imposed in addition to other existing loading during the "off-peak" period. In Mr. Gregor's case, there is no doubt that he cannot control the load which establishes the day peak in order to move it to some other time, nor can the domestic peak load be so controlled, as it depends largely on the domestic habits of civilization.

The difficulty, introduced by changes in valuation, when the tariffs have been designed on the basis of the valuation of premises, has been mentioned. In some cases, the valuation taken for the purpose of design is the valuation at a given date, and any change in the valuation with the progress of time is specifically excluded from applying to the electricity tariff. Variation of valuation of consumers' property, supplied at the inception of such tariffs, does not then affect the resident's electricity account for that particular property. Whilst, at first sight, this appears to overcome the difficulty, anomalies will arise when new properties are built and also when old properties are rebuilt.

It is common experience that the valuation in a given area of a town changes with time, some areas increasing in value while others decrease in value. Any new properties are valued on the basis of the conditions ruling at the time of valuation. For example, if the valuation of given premises has increased with time after the inauguration of tariffs based on valuations at a fixed date, a neighbouring empty stand may be occupied by exactly similar premises at a much later date, and, when assessed, the tenant may be faced with higher charges than his neighbour due to a higher valuation. If, for the purpose of electricity tariffs, the later valuations are adjusted pro rata to the valuation of similar adjacent premises valued when the tariffs were

introduced, the protests a Municipality is then likely to receive from time to time are easily visualised. In addition to these aspects, other anomalies arising from such tariffs are numerous.

Mr. Eastman has expressed the view that the best form of tariff to apply depends on the merits of each particular undertaking considered. In my own experience, I have not yet dealt with a case in South Africa which required a departure from the service charge basis in order to meet the particular requirements of any given town.

Perhaps Mr. Eastman had in mind that views on electricity costing and tariffs have changed considerably with the development of the electricity supply industry, not the least of which is the attempt being made to operate electricity undertakings at cost and not at a profit. In these circumstances, therefore, many towns have in force, long established tariffs, which differ from those recommended in my paper and, as pointed out therein, a change from one form of tariff to another form of tariff frequently presents such difficulties that the complete change from the one to the other form is impossible at one time. Such changes have been made on a partial basis, however, where those consumers who would not benefit by the change have been allowed to remain on existing tariffs while the remainder have been allowed to transfer to the new tariffs, a reciprocal process not being permitted. A supply authority can reasonably take such a step with the knowledge that, in the course of time, the old tariffs will fall into complete disuse, due to the introduction of lower charges on the new basis (without equivalent changes in the old basis) and also the migration of consumers.

Mr. Eastman, however, has indicated that the room and service charge bases may be regarded as one and the same in their incidence. This is only true where the total number of high rate units (or

quota of high rate units) is actually used by a consumer, or alternatively where the cost of the full quota of high rate units represents the minimum payment to be made by the consumer. In practice, it is usual to find that the total of all the quota of high rate units is not sold, though the majority of consumers exceed their quota. Therefore, it follows that there is a number of consumers who would possibly pay a little more on a service charge basis than on the room quota basis, whereas on the other hand a large number of consumers are paying a little more on the room quota basis than they would on the service charge basis if the two alternative tariffs bring in the same total revenue for the same total number of units supplied in both cases.

Reference has also been made to the fact that certain methods of charging "suit" consumers. This argument has always surprised me, as the principal difficulty met with in explaining tariffs to consumers is that they do not know what their bills are likely to be on tariffs designed to bring in the same total revenue but using different bases. I would go so far as to say that almost all consumers who are used to a service charge basis, if told of an intended change to a room quota basis, would raise as much protest as would be experienced if the reverse were the case. Claims put forward on the plea of producing satisfied consumers should, therefore, be very carefully examined before they are accepted.

Arguments by supply authorities against the introduction of low rate unit charges often include, as an objection, the increase in the use of electricity which is likely to occur. This argument presupposes that more extensive use of electricity by a consumer necessarily involves proportionate increased on-peak use. In my view, this is more likely to be the exception than the general rule, as the increased facility for the use of electricity introduced by lower unit rates, more

generally involves extended hours of lighting and the use of incidental apparatus during off-peak intervals than it does an increase in use during the very short period of the usual peak load experienced by supply authorities dealing with domestic consumers. Looked at from the point of view of lighting, it is not likely that the lighting intensity used by individuals will be increased, having in mind that the differences in the unit rate visualised in this paragraph are necessarily relatively small, though appreciable in their incidence on the monthly bill.

One point, however, is definitely brought to light by this aspect of the discussion, namely that if, in adjusting the demand rate and the unit rate, the unit rate is made too high and the demand rate too low, the incentive to make protracted use of electricity, rather than periodic high rate use, is reduced, and this should be borne in mind when designing the tariffs.

We must thank Mr. Eastman for drawing attention to the fact that copies of the reports of Committees, appointed by the Ministry of Transport, on the standardisation of methods of charge and tariff rates regarding domestic supply, are obtainable from His Majesty's Stationery Office at a price of about 1/– each, as these documents are very valuable to those desirous of further information on the subject of tariffs.

Mr. Nicholas has confirmed the views that I expressed in regard to tariff design where the power is obtained from a hydro electric station, his own case indicating that, with the course of time, it is necessary to operate prime movers using fuel, and therefore involving appreciable variable costs. He has claimed that the use of Diesel engine plant at Umtata results in a saving of £500 per annum. This is apparently the difference between the total annual cost of operating the diesel plant as compared with

capital charges and maintenance costs for an equivalent hydro plant. A further point which emerges from Mr. Nicholas's remarks is that, to be of maximum benefit, hydro plants should be designed for base load purposes, leaving peak loads to be met by less costly generating equipment.

Mr. Foden has also raised the question of the establishment of reserves, but has added the problem of financing extensions from Reserve Funds in preference to financing them from loan funds. If the established reserves have reached such a position that they are in excess of reasonable requirements, then the financing of extensions from reserves certainly provides an outlet for the excess. The idea of the reserve funds, however, is to have available purchasing power to enable a supply authority to meet conditions of accident and obsolescence as they occur. If the funds are invested in their entirety in the supply authority's undertaking, then they are no longer available to finance contingent or obsolescence extensions, and financing such work may present a difficulty, not only from the point of view of increased costs of operation at a stage when there should be no increase, but also in view of the possibility that, at a time of emergency, loan funds may only be available at high rates or, possibly, not at all.

During general discussion, I have been informed that the principal difficulty usually experienced in imposing a service charge rate is that purchasers object to the service charge for which "nothing is received." Examples of costs of this nature, which are accepted without demur in every-day life, are many. From a supply authority's point of view, the example of a consultant or legal counsel retained by a Municipality, offers a parallel case. Such gentlemen are paid a retaining fee which is equivalent to the service charge. The fees they are actually paid by the

day (or by a percentage on the cost of work they carry out) for services rendered, may be likened to the cost per unit of electricity.

Once again, Mr. President, may I thank you for the opportunity your Association has given me to present my views on this subject.

The Convention adjourned for refreshments at 11.10 a.m. and resumed business at 11.30 a.m.

The President: The next paper is by Mr. Mail, which I have pleasure in asking him to read in abstract and to explain to us the various slides he is showing which are referred to in the paper.

Solid Airless Injection Diesel Engines.

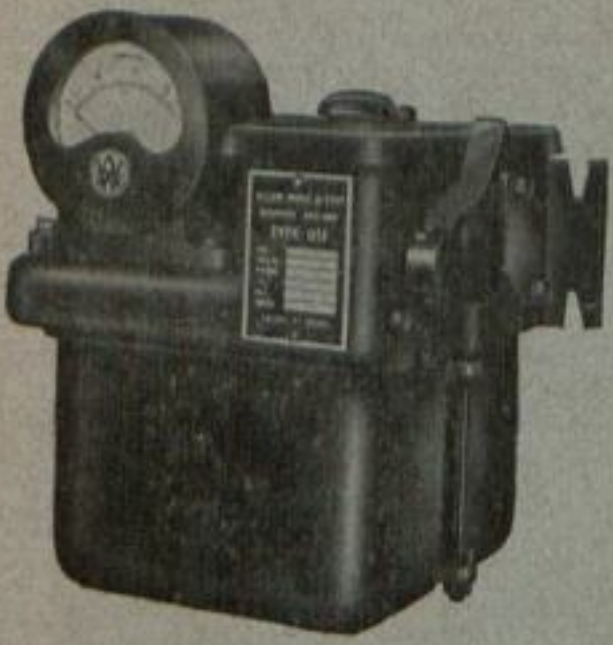
By W. MORTIMER MAIL,
Town Electrical Engineer of Kokstad.

This paper deals with the practical side of my experience of running airless injection engines, crude oil engines, especially 2-stroke engines, and attempts to show that these prime movers can be efficiently and economically used in the production of electricity for a small town.

In the Kokstad Municipal Power Station there are four sets, namely :

57 H.P. 30-kW. 4-stroke engine.
208 H.P. 92-kW. 2-stroke engine.
208 H.P. 92-kW. 2-stroke engine.
250 H.P. 120-kW. super scavenge 2-stroke.

These sets are available for service 24 hours a day continuously ready to carry loads varying from 20 kW. to 150 kW. In order to deal with these



Type "OSI" 20amp. 650v. Circuit Breaker or Direct-on Starter. Contacts are oil immersed and are reversible for long life.

A substantial and robust switch, it is ideal for both large and small consumers.

Other sizes are available up to 750amps.

WE SPECIALISE IN ALL FORMS OF MOTOR CONTROL GEAR AND SWITCHGEAR AND WILL BE PLEASED TO SUPPLY LITERATURE AND QUOTATIONS OR SUGGESTIONS ON REQUEST.

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conditions the engines must be very flexible and they also have to be capable of being started up at any time instantly. They must also be able to take load at once, and having regard to the fact that extremes of temperature are experienced ranging from 20 degrees of frost in the winter to 90 degrees in the shade in the summer, and in view of the fact that the altitude of Kokstad is 4,600 feet above sea level, the arduous conditions under which these machines have to operate will be appreciated.

30-kW. 4-STROKE ENGINE.

The 4-stroke 30-kW. set is now too small to handle the minimum load and is, therefore, used in conjunction with other sets during peak loads. This set is also used as a booster set as explained further on.

This engine has run 36,875 hours in 10¼ years, during which time the following replacements and repairs have been necessary :

At 5,000 hours—New rings.
At 15,000 hours—Oversize rings.
At 23,859 hours—New cylinders, pistons and rings. The engine was completely dismantled and new main bearings and fuel pump parts renewed.
At 35,363 hours—The main shaft had all its journals re-ground 1/16". (This job was done in Durban.) New main bearings, big ends, and force feed were fitted to all exhaust rockers. New rings were also fitted.

During the first 2½ years considerable trouble was experienced with big ends, but since using the present lubricating oil no trouble has been experienced. Previous to this, three well-known brands were tried. That was eight years ago—since which time lubricating oils have all improved.

Another point about this engine is the attention which had to be given to spill valve seats and balls in the fuel pump as these wear and can upset the running of the engine very considerably. This is especially noticeable if two sets are running in parallel. (Sample of spill valve seating and ball submitted.)

Lubrication to this engine is on the force feed principle from the crankcase, but when the overhaul referred to previously was carried out at 35,363 hours a connection was taken from the bottom of the crankcase to an outside tank separator, heater and filter, so that some of the lubricating oil could be drawn off daily and filtered while the engine was running. A priming pump has also been fitted to ensure that all bearings get oil.

This 4-stroke engine has given good service, but entails a considerable amount of maintenance in the cleaning of valves which has to be carried out every 70 to 100 hours.

OPERATING RESULTS DURING 10¼ years :—

Total running time	36,873 hours.
Fuel consumption	0.9lbs. per unit generated.
Lubricating oil consumption	0.02pts. per unit generated.
Total units generated	693,696.

REMARKS : Maintenance costs heavy.

TWO-STROKE ENGINES.

The two 2-stroke engines are three-cylinder Petter atomic solid injection two-stroke crankcase compression Diesel engines, each rated at 208 H.P. at sea level and coupled to 92-kW. British General Electric generators running at 300 revolutions per minute. Each of these machines has been in commission over eight years, during which time the following operating results have been obtained :—

No. 1 Petter:

Total running time	20,813 hours.
Average load	41 kW.
Maximum load	100 kW.
Fuel consumption	0.79lbs. per unit generated.
Lubricating oil consumption	0.03pts. per unit generated.

No. 2 Petter:

Total running time	19,539 hours.
Average load	39 kW.
Maximum load	100 kW.
Fuel consumption	0.8lbs. per unit generated.
Lubricating oil consumption	0.035pts. per unit generated

Lubrication is by outside crankcase calibrator force drip feed, so that on light loads the consumption is heavy, but on heavy loads it is very good. The general average "on load factor" is good.

All lubricating oil is filtered in a Streamline Filter and returned to the engines with 50 per cent. new oil added to it. From the 2-stroke engines there is practically no sludge and the filters are very clean.

Heads have been taken off at intervals of approximately 2,500 hours and pistons are withdrawn, during which period very little carbon is deposited and rings are not gummed up but just become dirty.

Original rings are still in use. Practically no wear has taken place and the compression is as good as when the machines were first installed. Consumption figures also are just as good as when the engines were first started up.

On a few occasions heads have been taken off to replace faulty rubber rings and washers for sealing water joints. Cylinder wear has been negligible.

Fuel oil pumps gave trouble at first due to metal becoming fatigued and cracking. The makers replaced all pumps free of charge, but the

same trouble occurred again. The makers have since improved the design of the pumps which should now eliminate these troubles.

Bearings:

All main bearings are the original ones and have not been touched. Big end bearings also are the orginal ones. Two big ends developed cracks in the white metal. These were spot welded and replaced, since when they have been running satisfactorily.

Crankshaft Alignment:

This is checked approximately every 1,000 hours and has not required any serious attention, the alignment being very satisfactorily maintained.

Fuel Pump:

No seatings have had to be replaced on these engines but the steel balls are changed frequently as it has been found that it is better to make certain of balls being in good condition in order to forestall trouble. The balls are bought by the gross and are inexpensive.

No trouble has been experienced with cooling water or heads, water enters the engine at approximately 110° F. and leaves the outlet at approximately 125° F.

From slides to be shown of the Atomic Diesel Engine the simplicity of its design is to be noted, as well as the removable water jacket and the calibrator drip feed method of lubrication.

Further note should be taken of the removable cover of the cylinder, and the machined combustion chamber, the water passage holes, and the air starting inlet valve.

In the Piston and connecting rod assembly note should be taken of the very large size of the big end bearing, resulting in low bearings pressures; also the small well cut in the bottom half of the

large end bearing which acts as a small reservoir, collecting oil when the engine is stopped and, therefore, ensuring an immediate supply of oil when the engine is started.

Governing is very good on these engines as from no load to severe overloads voltage variation is only 3 per cent.

Atomisers :

At frequent intervals these have to be checked and the needles have to be ground into the cones, for which purpose knife polish and brasso is used.

For testing and checking the Atomisers it is essential to have an Atomiser testing outfit. Such an outfit was made out of a disused fuel pump and a gauge reading to 3,000 lbs., and also a Bosch test set, reading in atmospheres, was procured last year. These two test outfits have proved very useful as it enables not only the Atomiser but also the fuel pump, to be tested on the engine while running.

A section through the calibrator lubricator pump unit shows that all oil pipes are outside the engine except for one feeding the crank, which is fed through the side of the crank case to the oil ring.

Cylinder and Crank Case :

Note the rigid construction, cleaning covers for the water space and large inspection doors for the crank case. The crank case is cleaned approximately every 500 hours, and very little sludge or carbon has been noticed.

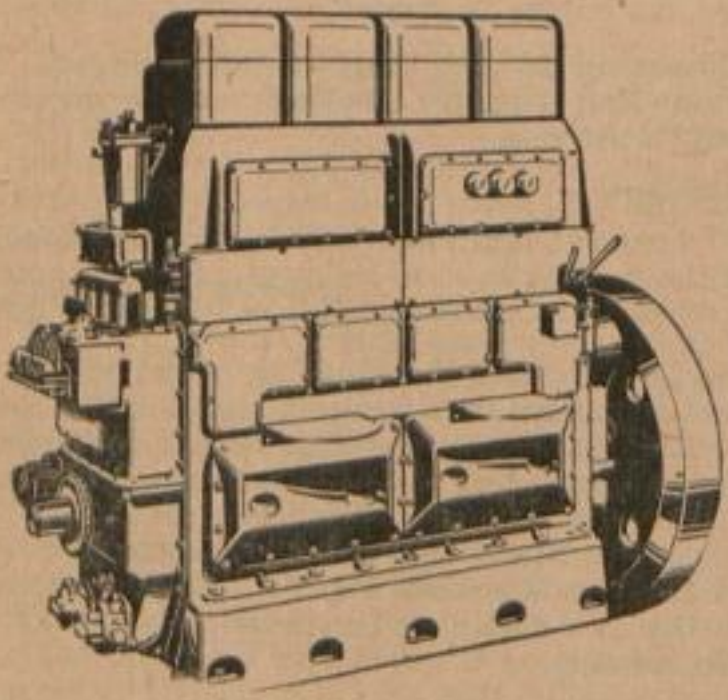
Crank Case Air Plates :

These have had a few extra springs at odd times, but have given very little trouble.

Remarks :

Very satisfactory running, and maintenance is very light.

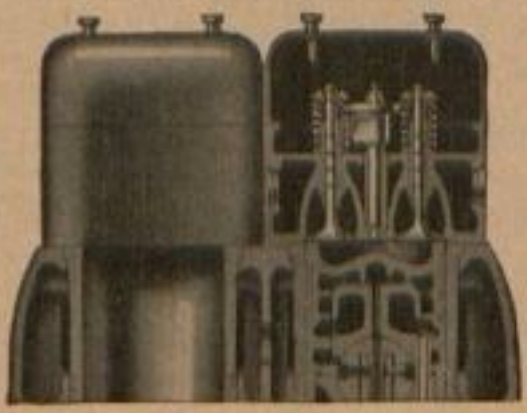
250 H.P. COAST RATING SCAVENGE PETTER UNIFLOW AIRLESS INJECTION ENGINE. INSTALLED JUNE, 1938.



Block of Kokstad Engine.

Four-cylinder engine installed in Kokstad. As this engine is one of the latest designs a short description will be given of it. Since it was one of the first from the factory it has been examined very carefully in the first 500 hours of running as outlined further on.

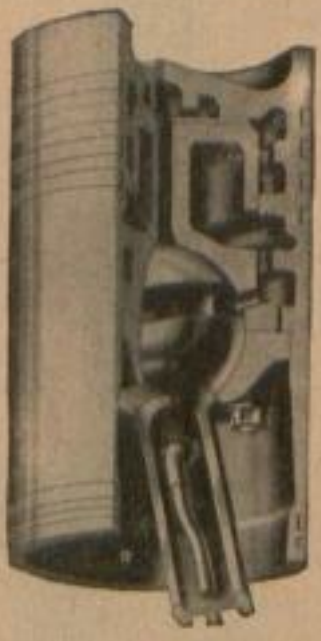
The engine has four cylinders, 8¼ bore and 13-inch stroke, and its rated power is 250 H.P. at 500 R.P.M.



Covers removed showing valve gear, etc.

The cylinder head design gives a flat topped combustion space. In addition to the two exhaust valves each cylinder head is fitted with a relief valve, and two of the heads are fitted with air starting valves. Internal valves are fitted to direct the cooling water to the atomiser and to the space between the exhaust valves.

The fuel pumps and atomisers are of the CAV - BOSCH type. The pumps—one for each cylinder—are placed near their respective cylinders so that the delivery pipes are short and of the same length. There is one atomiser to each cylinder located at the centre of the cylinder head.

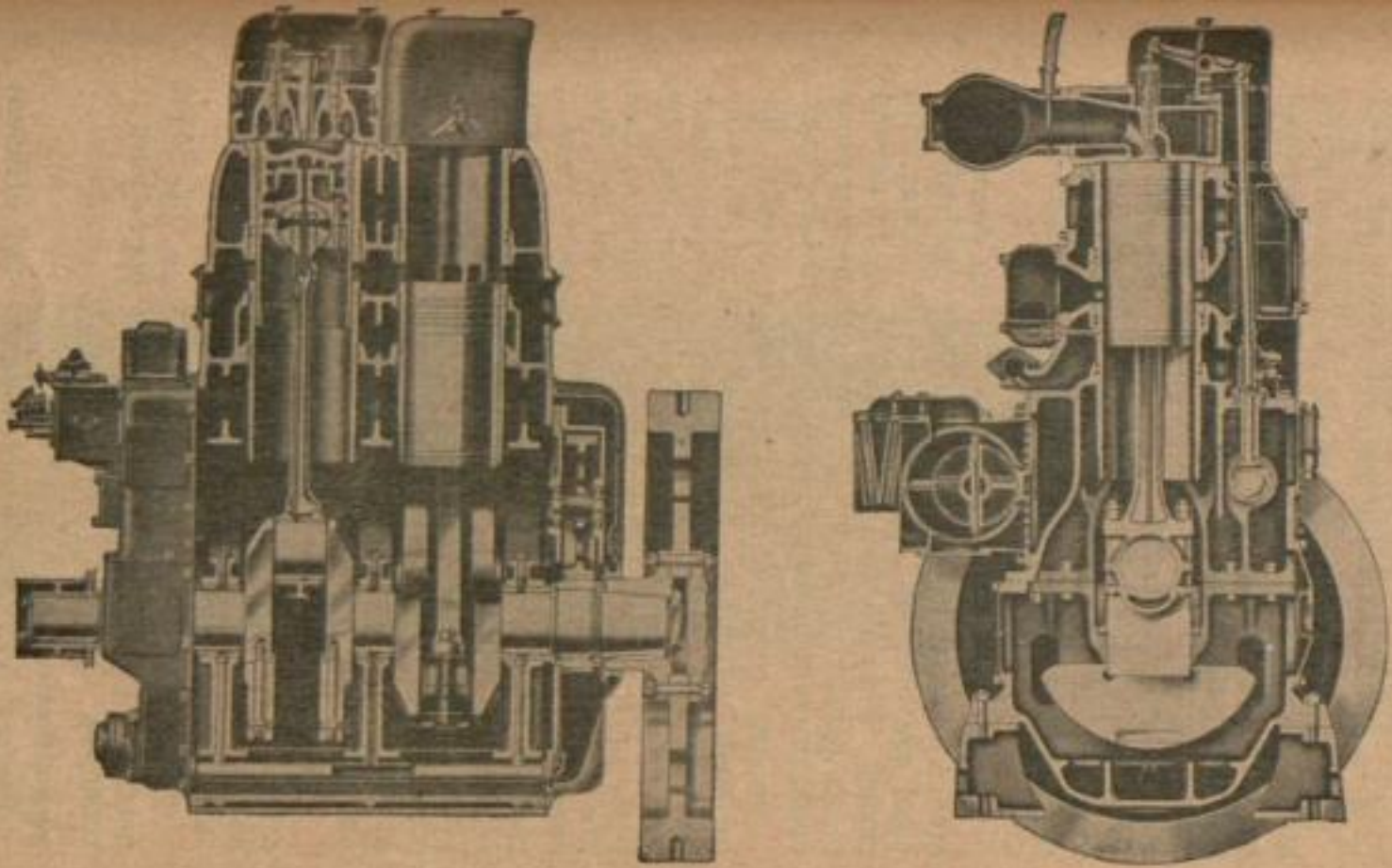


Sectional view of superscavenge piston, showing spherical small end bearing and oil cooling spaces.

The pistons which are oil cooled are of cast iron. The crowns are machined all over and the combustion chambers are of symmetrical form. Each piston has four grooves for compression rings, each groove carrying two rings spigoted together. Two scraper rings are also fitted to each piston.

Piston and Connecting Rod.

The connecting rods are H section and the small end bearings are spherical. The large end bearings are of bronze lined with white metal. External leads are provided for conveying the cooling oil from the lubricating system to the pistons and thence to the crankcase.



Transverse section of superscavenge engine.

THE WORKING CYCLE.

The complete cycle of operations is performed in one revolution of the engine crankshaft.

The piston, on its upward stroke compresses the air in the cylinder to a pressure of about 450 lbs./sq. inch. The fuel oil is injected by the centrally-placed atomiser in a cone-shaped spray. The finely divided oil particles penetrate the turbulent air and intimate mixture results. The resulting combustion is very complete. The atomiser is arranged to deliver the fuel at correct atomising pressure, irrespective of the load and speed of the engine.

As the piston nears the end of its downward stroke, the exhaust valves "C" in the cylinder head are opened, the air ports "A" being still closed. This allows the exhaust gases to expand to atmospheric pressure before the scavenge ports open, preventing any exhaust gases passing back.

On the completion of the power stroke, the exhaust valves "C" are fully open and the remainder of exhaust gas passes into the manifold. The exhaust valves close slightly before the air ports on the upward stroke of the piston, so that the cylinder is completely filled with cool air. The scavenge air is supplied to the cylinders from a gear-driven blower "B" at a pressure of about 1½ lbs./sq. inch into a cored passage in the cylinder block round and between the cylinders to the scavenging ports through which the air flows upwards to the cylinder head, effectively scavenging the exhaust gases.

The patented arrangement of ports in the cylinder are arranged tangentially and radially so as to give the air stream definite swirl and turbulence.

The piston continues to ascend on the compression stroke, and the cycle of operations is repeated.

Perfect Scavenge :

Perfect scavenge is obtained by (a) efficient blower, (b) overhead exhaust valves, (c) patented arrangement of ports.

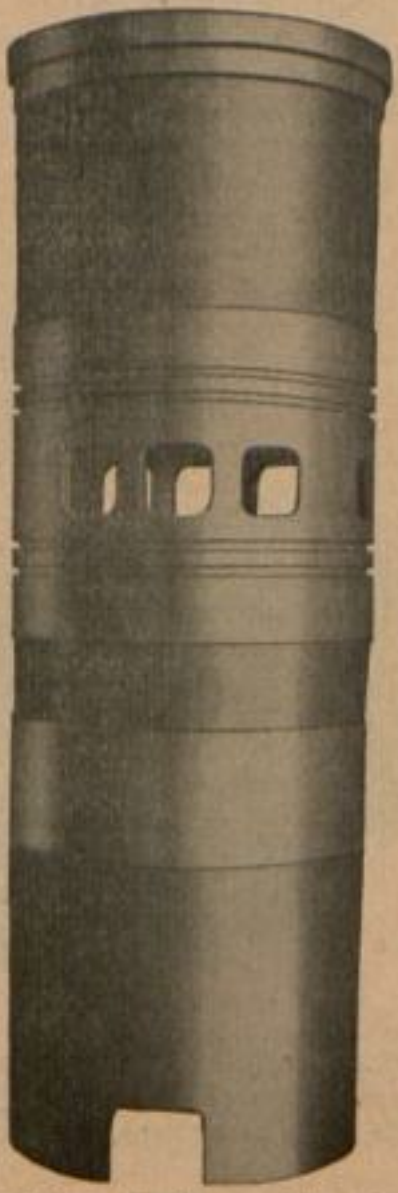
Complete Combustion :

Complete combustion is obtained by specially designed combustion chamber, resulting in invisible exhaust.

Spherical Small End Bearings :

The spherical small end bearings and oil cooled pistons allow for long periods of overload without overheating.

Very moderate exhaust temperature.

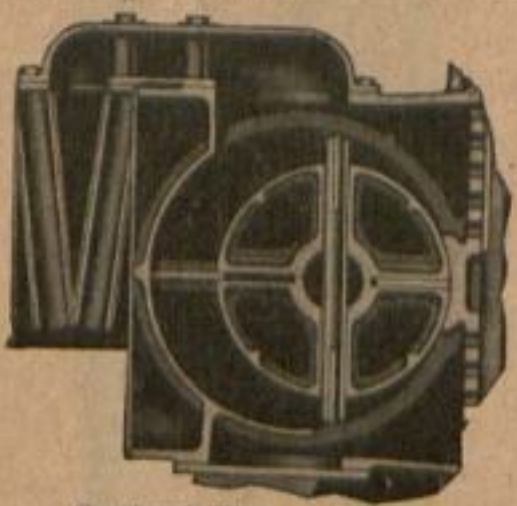


Cylinder Liner, showing position of ports.

The cylinder housing is of monobloc construction with detachable liners. The bedplate is of cast iron deeply ribbed and stiffened both longitudinally and laterally. The cylinder housing is connected to the bedplate by high tensile steel bolts.

Forced lubrication is provided through a cooler before discharge to a separate oil tank, in which a gauze filter is fitted. The oil in the lubricating system is continually filtered, a bleed pipe being taken from the pressure side and delivered to a streamline filter which is incorporated in the engine, and from the filter oil is delivered to the reservoir of the lubricator, which controls the oil supply to the cylinders and blower and the overflow returning to the sump. The lubricating oil pumps are driven from the forward end of the crankshaft by means of a duplex roller chain provided with an adjustable jockey.

The cooling water circulating pump is driven from the forward end of the engine by a laminated leather belt from a V grooved pulley on the crankshaft.

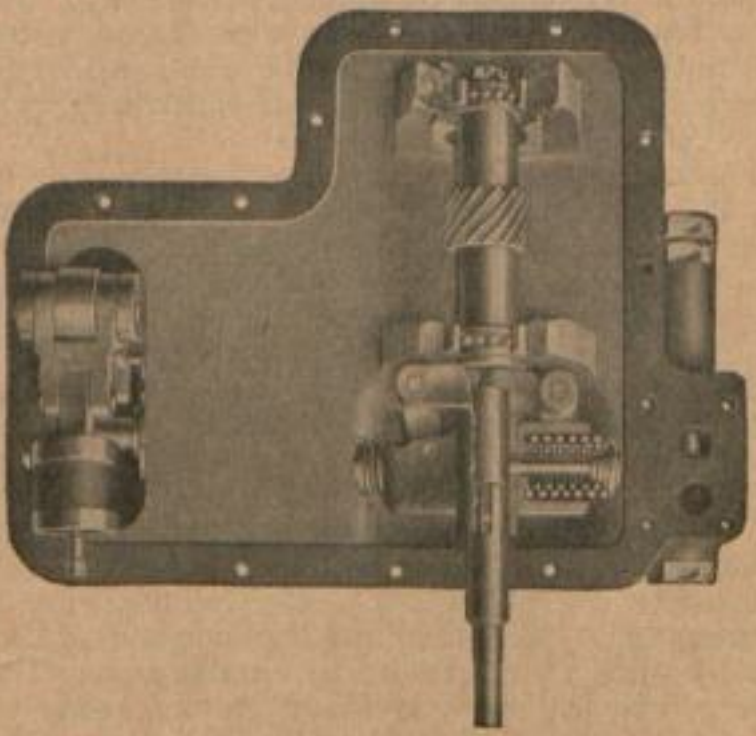


Sectional View of Blower.

Scavenging air is supplied by a rotary blower of the Zoller type. The blower which is driven by a chain of gears from the crankshaft has a displace-

ment volume 1.1 times that swept volume of the engine pistons. Pressure is at 1½ lbs. per square inch.

The governor is of the vertical centrifugal type and the governing is arranged to comply with B.S.I. requirements. There is a hand control for speed adjustments.



Superscavenge Governor Gear, showing details (front cover removed).

Starting is effected by compressed air and the nominal starting air pressure is 350 lbs. per square inch but no difficulty has been experienced in starting with 250 lbs. The air starting valves are operated from the camshaft, the air pipes being led from these valves to non-return valves in the heads of two cylinders.

Any fumes from the crankcase are led to the scavenging blower suction. The engine is very compact and it has a neat and clean appearance. All parts are readily cccessible.

MAINTENANCE AND OPERATING EXPERIENCE.

By the end of September, 1939, the engine had run for a total of 5,506 hours. The engine was examined at 142 hours for alignment, lubrication and general condition. Everything was found to be in excellent condition. At every 100 hours a check was made on the engine and during this period the exhaust valve on No. 4 cylinder was found to be wearing at the end of its stem. This was found to be caused by a wick failing to feed oil to the end of the stem. This was rectified and since then no trouble has been experienced with the valves.

At 1,626 hours one of the blowers gave trouble due to the end bearing nearest the oil cooler running excessively hot on a very hot day (engine room temperature being 120 degrees) and as the clearance on the blower blades was very close it seized on to the barrel of the blower. This was repaired and since then no further trouble has been experienced.

At 1,500 hours the engine was completely dismantled. All parts were examined for wear, including the oil cooled pistons which were all dismantled. The small and big ends and all their parts were found to be in excellent condition. Very little carbon was found on the heads but about 1/32" thickness of carbon had deposited in the exhaust manifold.

At 4,000 hours the engine was again dismantled, including pistons, big ends, small ends, blowers, streamline filter. All parts were found to be in very good condition. Very little carbon had deposited, except in the exhaust manifold where about ¼ inch was found, caused probably by light loads. In the air inlet ports close to the piston opening there was a small quantity of soft carbon due to a small amount of blow back. The Burgess silencer has not been cleaned and seems to be in very good order.

The following is a brief summary of the condition in which the engine was found after 4,000 hours.

Cylinder heads	Slight carbon deposit.
Port covers	Soft carbon deposit.
Crank case	Clean.
Pistons top	Centre clean, slight carbon deposit at outside edge about 1/32" thick.
Oil cooled interior pistons	Very clean—no wear.
Small end (ball)	Very good—no wear.
Cylinder walls	Very good.
Rings	Very good and very clean, all in good order.
Exhaust valves	Seats pitted slightly, stems and guides clean and olly.
All bearings	Very good.
Crankshaft alignment	Zero readings all cranks.
Exhaust manifold and ports	Dirty, ¼" thickness carbon.
Oil filter	Needed cleaning.
Atomisers	Good. These have been attended to four times in 4,000 hours, but checked every 600 hours.
Fuel pumps	Good.
Fuel oil filter	This is cleaned approximately every 300 hours, but fuel oil is very clean.
Engine speed	This varies approximately 20 R.P.M. from no load to full load—adjustment can be made by adjustable governor.
Exhaust on outside silencer	It is impossible to detect any sign of exhaust colour from no load to overload.

Performance figures for this 250 H.P. supers avenge 2-stroke set for for the last six months ending June, 1939, are as follows :—

Fuel oil consumption	0.72 lbs. per unit generated.
Lubricating oil consumption	0.02 pts. per unit generated.
Hours in operation	1,763.
Average load (especial note)	50 kW.
Peak load	130 kW.
Total running hours ending September, 1939	5,506.

It will be noted that the engine has a rating of 250 horse-power which is considerably more than the power required for the 120 kW. generator to which it is coupled and therefore militates against the attainment of better operating results than those given above. Although an engine having the correct margin of power was specified, an alternative tender for a larger and more modern engine, which was offered at no extra cost, was accepted with the intention that when the load increase requires more generating plant capacity, the 120-kW. generator will be replaced by one of 170 k.W. When this day arrives better operating results will be obtained as has already been proved by test runs on the engine during which, with a load of 150 k.W. over a period of one hour, the oil consumption was 0.55 lbs. per unit generated, the units being metered at the switchboard and not on Brake Test.

All fuel oil is metered to each set and the weight of oil is taken at 0.9 lbs. per gallon.

The following data also relates to the performance of these engines:—

Inlet water temperature ..	110 degrees.
Outlet water temperature ..	130 degrees.
Exhaust temperature—	
average on each cylinder	Station full load—450 deg.
	Possible full load—600 deg.
Oil cooler temperature	130 degrees.
Diesel knock	Normal.
Scavenge pressure	1½ lbs.
Noises	(Blower —Slightly noisy.
	(Valves —Slight clatter.
	(Engine noise—Nil.

Diesel fuel oil is procured in bulk in 5,000-gallon rail tank cars and is pumped from the railway to the power station, a distance of 3,500 feet against a head of 100 feet. This is carried out by a 2 H.P. motor and small centrifugal pump through a 1¼" pipe line. This pump can deliver 200 gallons per hour.

Fuel Oil Filters :

Fuel oil is filtered at the power station through three thicknesses of 112 mesh copper gauze in 40-gallon tanks before being metered to each engine and there are also filters on each engine.

Water Supply :

Water is supplied from a dam in the grounds of the power station and is pumped into tanks from which it is supplied to the engines. Stand-by supply is available from the town water mains.

Hot Water Supply for Cylinders :

The hot circulating water is retained in tanks and returned to the engines at approximately 110° F. A separate pipe line is run to each engine interconnected so that the engines that are running, supply hot water to all sets so that the cylinders of any set never get cold. This water is also run to change rooms and shower rooms, so that there is always a plentiful supply of hot water available for the staff.

Booster Plant :

As the Kokstad Undertaking has a 460/230-volt, 3-wire, direct-current system there is a voltage drop on heavy loads to the outskirts of the town, a distance of approximately two miles from the power station. Last year four new underground four-core cables (ready for change over to A.C. at some future date) were laid, and the 30-kW. set in the power station was converted into a Booster set. This was effected by installing another set of busbars with a change-over switch on the main board. These cables can be switched on either to the main busbars or direct on to the booster busbars. When on the latter the voltage can be regulated on the long distance cables to give an increase of 20 volts

if required and so maintain the voltage on the outskirts of the town the same as at the power station or even higher. These cables are interconnected with other feeders from the power station and, therefore, help to maintain the normal voltage of the system generally.

Load Factor :

This is an important point in regard to running costs in fuel and lubricating oil as Kokstad is not an industrial town but purely a health resort with a big farming community. There are a few motors, heating appliances, freezing plants and a few stoves which make the load very variable, especially can this be noticed between summer and winter. In the summer it is a matter of long days, short evenings, small load. In winter, the days are short with long, very cold evenings and heavy loads. This results in a big plant for the number of consumers to meet the winter load and consequently heavy capital charges. There is " no pumping load " as all water for the town supply gravitates from Mount Currie so that this load is not available for improving the load factor and thereby running costs. The day load is comparatively small which does not help to get the best figures from a Diesel plant. Notwithstanding these disadvantages and a white population of 1,700 the revenue is £5,800 per year. The tariff is from 1/- to 1d. per unit and half of the output is sold at from 1½d. to 1d. per unit. Railage is paid on fuel oil as Kokstad is 200 miles by rail from Durban.

PARTICULARS RELATING TO KOKSTAD ELECTRICITY UNDERTAKING.

Town of Kokstad, East Griqualand	4,600 feet above sea level.
System of supply	230/460 volts, 3-wire, direct current.
Number of consumers	349.

Street lighting	All underground with overhead suspension lighting. 170 lamps of 200, 100 and 75 watts capacity controlled from the power station.
White population	1,700.
Total capital cost of plant	£27,522.
Interest & redemption per annum	£1,806.
Depreciation per annum	£400.
Fuel oil cost	£7 5s. 0d. per ton.
Lubricating oil cost	4/– per gallon.
Price of current	1/– to 1d.

FIGURES FOR LAST SIX MONTHS ENDING JUNE, 1939 (HALF-YEAR).

Units generated	218,250
Units sold	185,774
Revenue	£3,051
Losses in Distribution	7%
Used in Station and Workshop	8%

Allocation of units sold :—

1/–	25,724
6d.	16,657
3d.	30,005
2d.	5,609
1½d.	44,244
1d.	35,152
S.L.	30,075

From the above figures it will be observed that during the half-year some 79,396 units were sold from 1½d. to 1d. per unit or just about half the current sold (excluding street lighting).

Fuel oil consumed per unit generated —all sets	0.761 lbs.
Lubricating oil consumed per unit generated—all sets	0.023 pts.
Fuel oil cost per unit generated—all sets	0.63 pence.
Lubricating oil cost per unit generated—all sets	0.13 pence.
Fuel and lubricating oil cost per unit generated	0.76 pence.
Load factor	27%.
Assumed weight of oil	0.9 lbs. per gal.

These figures are given to show that Diesel plant can give very satisfactory service when working twenty-four hours a day continuously over a period of years, and the paper as a whole is intended to be of service to an undertaking that is contemplating installing Diesel plant, or to any that are not getting the best results from their existing plant.

The President: We are all very grateful to Mr. Mail for his most interesting paper, which is now open for discussion. There is not much time, and I would, therefore, ask members to keep their comments as short as possible.

DISCUSSION.

Mr. Mocke (Piet Retief): I wish to congratulate Mr. Mail upon his extremely valuable and interesting paper, which is of especial interest to engineers in charge of Diesel power stations, and can be readily used by them as a basis for the efficient operating of their plants, the figures and data given being taken from actual experiences under normal operation and test by the author.

It will, however, be interesting to know what actually persuaded Mr. Mail to recommend the installation of such large plant in June, 1938, in view of his already heavy Capital Charges. Would not a 70 or 80 kilowatt plant have given him more flexibility in his station, and also improved the general efficiency of the plant?

Mr. Mail now has this comparatively large unit in a town where, he informs us, there are no industries, therefore a peak load of relative short duration. With a 70 kilowatt set operating in parallel with any one of the other units he would immediately improve the efficiency of his plant by improving the load-factor. (Hear, hear.)

Mr. Ritson (Stellenbosch): From the figures of units sold for the half-year there appeared to be a loss of 15%, and it will be of interest to know how this loss is accounted for.

Mr. Runtzler (Port Shepstone): I wish to associate myself with previous speakers in thanking Mr. Mail for his very interesting paper, but must admit that I have a certain amount of criticism to offer. What struck me most, as it did the first speaker in this discussion, was the extreme inflexibility of the plant, it being necessary to run a 92 k.w. set as soon as the small 30 k.w. set is overloaded. Then again there seems to be an unnecessary high ratio between the rated h.p. of the engines and the k.w. rating of the generators. This in itself tends to uneconomical running of the plant, borne out by the fact that the average load given in no case reaches 50 per cent., and goes down to 33⅓ per cent., in one instance, of the full load available.

Taking all this into consideration it is no wonder that the fuel consumption is high, for I think a consumption of .9 and .8 lbs. per k.w. is very high, in fact, .72 lbs. is high as well for a new and modern engine, I have been able to maintain a consumption of .745 and .742 lbs. respectively for the last two financial years, and our new 150 k.w. set only consumes .65 lbs. per k.w. running at from two-thirds to full load. This consumption includes all losses due to water, sludge, etc., which gets removed by centrifuge. It must be borne in mind that our plant is very flexible indeed, enabling us to run nearly always between two-thirds and full load. I may state though that this flexibility is due to the advice given by the Consulting Engineer who was responsible for the installation of the original plant, Mr. R. S. Scott.

Turning to the lubricating oil consumption, I consider that also very high. I certainly do not believe in starving an engine of oil, but I do not like to waste it. Against the consumtpions quoted

in Mr. Mail's paper of .035, .03 and .02 pints per k.w. respectively, our average consumption for the last two financial years, embracing the whole plant, was .0065 and .0062 pints respectively, and with our new engine alone since its installation in October last year the consumption was .0039 pints. I have carried out a test of over two years' duration with a new oil, sending samples to be tested each time the oil in the chamber was changed after 1,800 and 2,100 running hours, and in every instance the verdict was that after filtration the oil was quite fit to be used for another term. Had I not used this filtered oil, or at least most of it, at our water works, our consumption would have been lower than that I have mentioned. I attribute this result, apart from the excellent quality of the oil, to the installation of stream-line filters and Serck coolers. Needless to say, our engines are in excellent condition, and only in two instances, after 20,000 and 17,000 running hours respectively, have I fitted oversize piston rings. (Applause.)

COMMUNICATED.

Mr. H. R. Bevington: My discussion is more in the nature of a comparison between 2-stroke Diesel Engines, chiefly dealt with in Mr. Mail's paper, and 4-stroke Diesel Engines. We have a Belliss & Morcom 4-stroke Engine of similar capacity to the large 2-stroke Petter described in the paper, and shows .76 lbs. of Fuel Oil per Unit, and .014 pints of Lubricating Oil per Unit, which is 1½ times less than the 2-stroke Petter. A good 4-stroke Engine would, therefore, give approximately the same result in lbs. of Fuel Oil, but 1½ times better in Lubricating Oil (which is an expensive item), also, there is no oil cooling to pistons, no scavenge-blower, and no crankcase breather plates, all possible sources of trouble and wear, which shows that a 4-stroke will give as good, if not better, results than a 2-stroke with less sources of trouble, and wear, consequently with less running cost.

The Load Factor on our Belliss & Morcom 4-stroke is much less than with Mr. Mail's 2-stroke Petter, with the higher load factor, as at Kokstad, our 4-stroke would show still better results.

What does Mr. Mail call a moderate exhaust temperature? Our 4-stroke shows 420°F. at less than ½ load. Is his lower than this?

The following analysis of our 4-stroke abstracted from a Log Sheet at random, may be of interest:—

Running Analysis B. & M. 7-Cylinder, 200 kVA Set on Evening Load:

Average P.F.	Average Load.	% Full Load.	Total lbs. Fuel Oil.
.93	58.1 K.W.	31.2%	166.5

Average Load in H.P.	Lbs. Fuel Oil Per Hour.	Lbs. Fuel Oil Per B.H.P. Hour.
77.9	44.5	.286

Peak Load.	% Peak Load of Full Load.	Time.
72 K.W.	38.6%	3hrs. 45mins.

Lbs. Fuel Oil per Unit.

0.76 = 11.5 Units per Gallon of Fuel Oil.

Average Exhaust Temp. at Peak Load.	Cooling Water Temperatures.	
420°F.	Inlet 100°F.	Outlet 110°F.

An impartial comparison of the two types of Oil Engine reveals the following facts:—

1. The 4-stroke engine gives a consistently lower fuel consumption than all but the largest 2-stroke engines. As this saving is often in the neighbourhood of 10% to 20% on what is by far the heaviest item in the cost of running an engine, the power user cannot afford to ignore such an important item in his annual bill for power, for it must be remembered that this saving carries on year after year throughout the life of the engine.

The 4-stroke engine is so much more economical than the 2-stroke because of its more effective scavenging of the cylinder and consequent more perfect combustion. It obtains the utmost power from the fuel, burning the whole of the oil. The 2-stroke engine further loses a considerable part of its power owing to the necessity for fully opening the exhaust port early so as to allow as much as possible of the burnt gases to escape in the short time available. In the 4-stroke engine the exhaust valve only opens near the end of the power stroke and the burnt gases are positively driven out of the cylinder by the returning piston.

2. The 4-stroke engine is very much more economical in lubricating oil. The imperfect cooling of the crank chamber of a 2-stroke engine which has compression under the pistons and a firing stroke per revolution per cylinder, results in excessive heating and rapid carbonization of the lubricating oil. Much of the lubricating oil from the large end bearing is splashed off into the crank chamber, swept up by the scavenge air and passed into the cylinders. These two features, which are inseparable in crankcase compression 2-stroke engines, are the main cause of the excessive lubricating oil consumption of this class of prime mover.

3. The loss of oil splashed off from the large end bearing (referred to above) prohibits the use of fully forced lubrication to this bearing. Despite the continuous loading, without relief, which this bearing sustains on the 2-stroke engine, it is necessary to limit the amount of oil to the minimum possible, far below the quantity which would be supplied by a fully forced system, and consequently it is usual to fit crank case compression 2-stroke engines with only banjo lubricators supplied by a mechanical feed lubricator which will measure out the oil drop by drop.

In the 4-stroke engine there is a direct reversal of load on the large end bearing at every stroke

bearings are continuously lubricated by a copious supply of oil under a continuous pressure. Owing to the absence of scavenge from the crankcase chamber this oil is not wasted as it would be in a 2-stroke engine. Further, there is no fear, as in some designs of 2-stroke engines, of particles of carbon being dropped from the ports or piston crown into the banjo thereby obstructing the oil passage and running out the large end bearing.

4. Two-stroke crankcase compression necessitates sealing rings to prevent compression being lost through the main bearings, and what is worse, the oil being blown out. This means extra friction and heating of bearings, often necessitating water cooling with all its disadvantages of water pipes, possible leakages, inaccessibility, etc. This last is rendered considerably worse by the restricted space in the crankcase due to its being used as a compression chamber.

5. It is frequently stated that the 2-stroke is a valveless engine. This is far from being the case since the 2-stroke has a number of automatic air inlet valves, any one of which may cease to function owing to a small piece of dirt getting on the seating, resulting in complete loss of compression and failure of the engine to operate. In the 4-stroke engine the two valves are mechanically operated, and experience shows that when properly designed and manufactured they give no trouble and will function for long periods without any attention whatsoever. "Spring Injection" 4-stroke engines have run continuously night and day for twelve months and even longer.

6. Contrary to the general assumption, the 2-stroke crankcase compression engine does not offer an economy in weight or size of cylinder.

7. The 4-stroke engine has all working parts easy of access. Ample space is provided for overhauling main bearings, big ends, etc.

8. There are no ports in the cylinder of a 4-stroke engine, whilst the ports of a 2-stroke engine are bound to cause distortion owing to the admission of cool air on one side with constant hot gases on the other. This distortion frequently arises in the joints between the ports and the water jacket, when there is a risk of water getting into the crank chamber.

Some designs of 2-stroke engines are not even provided with liners. The cylinders are cast in one piece, rendering them liable to considerable mechanical stresses due to the variations in temperature of the different parts. In addition they are far more expensive to replace, and cylinders constructed in one piece cannot be cast with the same special material as separate liners.

9. The fuel is completely consumed in a 4-stroke engine, due to its full scavenging and excellent turbulence. There is little carbon deposit either in the combustion chamber or exhaust piping and silencer.

10. There is less risk of the exhaust pipes and silencers of a 4-stroke engine catching fire.

11. With the 4-stroke engine there is no risk of back-firing or explosions in the exhaust.

12. There is not much difficulty in silencing the 4-stroke engine, there being no fear of slight back pressure disturbing its efficiency. In the 2-stroke engine it must be remembered that the exhaust port and air inlet port are both open at the same time, and that the scavenge pressure is normally only a few pounds above the pressure in the cylinder. Only a slight back pressure in the exhaust will, therefore, upset the operations of the engine.

13. **To Conclude:** It has been constantly demonstrated in actual practice that the 4-stroke engine:—

(a) Is permanently the more economical to run.

(b) Is more reliable.

(c) Is better lubricated.

(d) Costs much less to maintain.

Mr. Milton (communicated): As the majority of the members of this Association have to deal daily with Diesel engines, Mr. Mortimer Mail's paper is a very valuable record of achievement with even more valuable indications of the methods which have led to his success.

The ratings of the engines mentioned in the paper are those at sea level, and must be considerably reduced in view of the altitude of Kokstad, namely 4,600 feet. Without this qualification it might at first appear that the prime movers are over-rated in their relation to the generators they drive. A further interesting factor is that the results the author has achieved with the direct current system of supply (and not the more usual alternating current) show that the direct current is not the dodo it is often claimed to be.

I was particularly interested in the fuel consumption figures, because the actual results of operation show that the engines, over periods of 20,800 and 19,500 hours (for the older plant) and 1,763 hours are still giving service within original guarantees. On the basis of the method of arriving at fuel consumption and cost of operation, mentioned in a previous paper of mine (The Engineering of Small Municipal Electricity Undertakings) presented at one of your Conferences, the author's actual results represent 90% to 92.5% of what I would have regarded as reasonable figures. In the circumstances, I would be pleased to know whether the author's figures of fuel consumption allow for wastage due to cleaning fuel received, and losses due to leakage during storage,

etc., i.e., does the total fuel consumption arrived at from the author's data represent the total fuel purchased from the Oil Companies or are the figures obtained from measured quantities of fuel drawn from each engine's service tanks without adjustment for the difference between the totals so arrived at and the totals purchased. The performance of Mr. Mortimer Mail's plant, nevertheless, reflects great credit on his care and management.

Mr. Mail's figures of the life of cylinders, pistons and rings are very interesting, but would be more valuable if comparative figures were mentioned in connection with the 4-stroke engine. Further, valuable advice is contained in the author's remarks on testing and checking of atomisers, grinding of atomiser needles, etc.

Mention, however, is made of cracks which developed in the big end caps, but beyond saying that the new caps have not shown a similar defect, no comment has been offered regarding the possible cause of the trouble. If some indication of the cause of the failure were given, it should be valuable to many of us.

The trouble experienced with the blower seems to indicate the extreme importance of making available the fullest information concerning local conditions and impressing on suppliers the necessity for paying close attention to such details.

The author mentions that his circulating system is so arranged that engines that are running supply hot water to all sets, thus preventing the cylinders of any set from getting cold. This is an excellent feature and overcomes one of the difficulties sometimes encountered with crude oil engine plant, namely the danger of imposing high loads on a cold engine. This danger is not so great with small sets, but is of increasing importance as the size of the unit increases. On the other hand, it would appear that the author

is fortunate in regard to the quality of his cooling water, as no mention is made of softening plant. All too frequently it is assumed that all that is required for cooling is "water," and that, as the water is not boiled, the problem of hardness can be neglected.

The author makes no mention of the question of scale in the cylinder heads and in the cylinder jackets. It would be interesting to learn his experiences in this connection.

In connection with circulating water, the author mentions that the pumps are operated from the engine crank shaft. The author's views in connection with this method of ensuring circulation of water as compared with the use of separate motor-driven pumps, would enhance the value of his paper.

In concluding my remarks, I would draw attention to the fact that the average fuel consumption of 0.8 lbs. per unit generated, with fuel costing approximately ¾d. per lb., indicates that a lower rate could be introduced into the tariffs than the lowest at present used, namely 1d. per unit. Perhaps the author might be in a position to explain why this has not been done.

Mr. Rodwell (communicated): It is always of interest and no small value to listen to papers describing the operating and running of the plant of the smaller undertakings, more particularly perhaps those employing Diesel engines, and I would at the outset congratulate Mr. Mortimer Mail on the very excellent results which he was able to submit in his paper. One very quickly discovers that the results obtained are entirely due to the meticulous care which the plant has been subjected to. I would like to mention one or two points which may be of general interest and form a useful comparison to the figures submitted by the author.

Fuel Consumption:

The author quotes as fuel consumed per unit generated—all sets—0.761 lbs. and a load factor of 27%. This figure must be considered very satisfactory when keeping in mind that as late as 1933 a census of oil engine stations in Great Britain, where load factors very much better than 27% can be expected, showed an average fuel consumption of .9 lbs. per unit generated. This figure was for stations generating between 250,000 and 500,000 units per annum.

It may be of interest to mention that for engines of the largest sizes working on full load consumption figures as low as .44 lbs. per kW hour have been recorded.

Lubricating Oil Consumption:

The consumption of lubricating oil for engines of the Diesel variety should range between .02 and .01 of the fuel consumption at full load. Taking into consideration the variable loads to which the engines must be subjected at 27% load factor the author's figure of .023 pints per unit for all sets is commendable.

Comparative Figures:

The following figures are working costs for the Ashford Undertaking, Great Britain, comprising 3,500 kW (six engines) working on load factor 23.5%. The figures are indicative of the adverse conditions created in this country where freight charges raise the cost of fuel.

	Pence per unit.	
Repairs & Maintenance	.084	* Taken on one year's working.
Fuel	0.171	
Lubricating Oil	.023	
Wages	.047	
Water & Stores	.013	
	0.338	

Effect of Altitude and High Temperatures:

A fair estimate for loss of power due to altitude and high temperature can be taken as 3% per 1,000 feet and 1% for every 6°F. above 60°F. Thus a 250 h.p. engine (coast rating) could only be considered as a 200 h.p. when working under conditions similar to those at Kokstad.

General:

It is interesting to reflect on some of the larger oil engines used for electrical power generation. For instance, the set installed at Copenhagen delivering 15,000 kW. The engine is of eight cylinders, double acting, 33ins. cylinder diameter and a stroke of 59". At 115 r.p.m. this engine has a maximum capacity of 22,500 B.H.P.

It is understood that the firm responsible for the construction of this engine has prepared designs for a further 12 cyl. engine capable of 40,000 B.H.P.

It would appear that there is a lot of room for improvement and standardisation of design for Diesel engines. Let us consider, for instance, the weight to power ratio, which ranges from 53lbs./B.H.P. in large engines to as low as 2.26lbs./B.H.P. in aero designs. This is a very wide range and it is only reasonable to assume that in the near future the weight per B.H.P. for stationary engines will be improved without any appreciable reduction in the reliability. For electric power generation, however, the important point is cyclic variation in angular velocity, which is reflected in the distribution system as a voltage ripple.

Maintenance:

With reference to the author's remarks on maintenance, it would appear that he is enjoying a comparatively "' trouble free " period, which is the reward of constant vigilance and regular inspection. It would, however, be interesting to

have the author's views on the cause of his very frequent cleaning of valves in the case of the four-stroke engine.

With regard to the cyl. wear being negligible in the case of the two 208 h.p. engines, one would wonder if this condition is the result of liberal lubricating oil supply.

Ricardo has written some interesting articles in which he attributes cyl. wear not so much to the abrasive action caused by dust in the air intake as to the destructive chemical action which takes place during the combustion period. Consequently, he suggests that cyl. lubricating oil besides acting as a lubricant and cooling medium, should be of such a nature as to withstand the explosion and remain as a film on the cyl. wall to protect it from the chemical bombardment of the high temperature gases.

Bearing in mind these points, and the fact that the two engines in question have done 20,000 hours' running without showing appreciable cyl. wear, one has ample proof that a liberal oil supply, although appearing as a heavy running cost, is bound to have a favourable reflection in the maintenance figures.

The President: I am sorry that time has shortened the discussion on Mr. Mail's paper and it is hoped those who have not taken part will send their contributions along to the secretary for submission to Mr. Mail, who will communicate his reply to all the discussions for publication in the Proceedings.

REPLY BY MR. W. M. MAIL.

(Communicated).

In reply to Mr. Bevington I would point out that he does not seem to have grasped the idea of my paper which shows the comparison between

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modern two-stroke engines and two-stroke engines of eight and a half years ago. If he will refer to my paper he will find that the figures given of the old engines compare very favourably with his figures, especially as he does not state how long his sets have been running. The old engines installed in Kokstad are in splendid condition having had no replacements of rings or bearings and there has been no trouble with air ports in crankcase sealing rings or crankcase compression, and after all these years of running the fuel and lubricating oil figures are as good as when the engines were new. He has taken at random one shift from his log book, while my figures are taken over a period of years.

If he will refer to my paper again he will see that the Super Scavenge two-stroke set installed in June, 1938, had a consumption figure of .72 lbs. per unit generated with an average load of 50 kW. during a six months' period and a lubricating oil consumption of .02 pints per kW. Taking the month of September, 1939, the fuel consumption for all sets worked out at .719 lbs. per unit generated during which period 3,202 gallons were used to generate 40,048 units at the rate of 12½ units per gallon of fuel.

Mr. Bevington mentions about exhaust temperatures quoting 420 degrees F. with a load of 72 kW. while my experience with the Super Scavenge two-stroke set gives temperatures of from 350 degrees at half-load to 510 degrees at approximately full load and 650 degrees at maximum overload. If he refers again to my paper he will note that on a load of 150 kW. with this engine, .55 lbs. per unit generated was attained on a test of one hour and this was recorded on switchboard readings — not on brake test.

Referring to his remarks as to design of four-stroke engines versus two-stroke, I have not found this in practice over a number of years. He states that there is a difficulty of lubricating big

end bearings on the two-stroke type, but I have experienced no trouble in this regard, the lubrication being force feed to banjo ring.

The crankcase opening for air can be called an inlet valve as it is made up of a number of flat springs, these have given no trouble and no grinding is required; they are cleaned approximately every 2,000 hours.

The two-stroke sets are easier to dismantle, if necessary, than the four-stroke one installed in the Power Station and maintenance on the two-stroke is practically nil.

As to the ports in the two-stroke engines getting distorted, this fault has not been experienced on any of the sets.

The 250 h.p. Super Scavenge engine has detachable liners and no crankcase compression, as it is a blower engine, force feed lubrication to all bearings, and oil cooled piston, and it also filters the lubricating oil while running.

Regarding combustion, a visit to the Kokstad Power Station will convince anyone how perfect the combustion is, there being no sign of exhaust from no load to overloads.

Silencing the Super Scavenge set is attained with a Burgess Silencer which is very effective, as residences are within 500 feet of the Power Station.

From my experience with Diesel engines I prefer the two-stroke as being more reliable, requiring fewer spare parts, and cheap in repairs and maintenance over a number of years of running. Particularly is this noticeable in the latest design of the Blower Super Scavenge two-stroke type.

If Mr. Bevington will refer to the Diesel Press and Papers he will find that there are numbers of the best known firms making and selling two-stroke engines, whereas a few years ago they could be counted on one hand.

Replying to Mr. Mocke: The reason for deciding on the size of the Plant was that when the change-over to Diesel Plant was made the Plant consisted of two sets of 40kW. steam prime movers, which made a total of 80kW. and with a view to future loading, two Diesel sets of 92kW. were installed and the steam plant discarded.

This policy has worked out very well, as up to now there has always been one set in reserve as during the four months of the winter, loads are heavy over longer periods as mentioned at the end of my paper. Unfortunately the heavy Capital Charges are due to the wrong type of plant being ordered prior to my appointment which obsolete plant charges have to be carried by the present plant.

Replying to Mr. Runtzler: Most of his questions are answered in replies to previous speakers. Lubricating oil has not been stinted or wasted as it has been my policy to be liberal with lubricating oil as this item does not constitute a large amount on running expenses, especially when wear and tear are taken into consideration. I note at the end of his remarks that he has had to replace piston rings (oversize) at 20,000 hours and 17,000 hours, at which period of running the rings in the two-stroke sets in the Kokstad Station are in splendid condition.

Replying to Mr. Milton: The figures for Fuel Consumption, i.e., 20,813 and 19,539 hours on the old sets, and 5,506 hours on the New Super Scavenge two-stroke set are given so as to arrive at the consumption figures, but the cost per unit

generated is based on the price paid to the oil companies, plus railage, as well as losses on fuel oil and lubricating oil.

Regarding cracks in the big ends, my reference under "Bearings" mentioned that two big ends had developed cracks in the white metal, which were spot welded and replaced. It would be hard to say what had caused these cracks as they only happened after 16,000 hours of running and were not very serious as they were discovered in time.

Water is of first-class quality, no treatment being necessary and so far, no scale or deposit has been experienced. Referring to pumps for circulating water, I have had each engine fitted with its own pump, and no trouble has been experienced. Easy adjustment can be obtained with this arrangement, especially in conjunction with the lay-out of the water piping and hot water circulation available. Each engine draws water from one set of cooling tanks and returns the water on its own pipe to these tanks. (All return pipes are inter-connected through valves in the engine room so as to supply each engine with hot water.)

There are two electrically driven pumps connected with a dam and these cooling tanks, to supply any water lost through evaporation or for adjusting temperatures. These tanks are also connected to the Town Mains through a ball valve.

With regard to the reduction of tariffs — a reduction was contemplated but when the Council was considering this reduction, fuel oil advanced a penny a gallon and lubricating oil three pence per gallon, increasing running exepnses to approximately £200 per annum, and as a reduction has been made on the Street Lighting vote of £100 per annum for next year, cheaper tariffs have been left in abeyance for the present, but as soon as the position is normal, reductions will be made, especially will this be possible if loads continue to

increase as the figure of .8 lbs. per unit generated will be improved this year (1939) to .75 lbs., due to heavier loads.

In reply to Mr. Rodwell: Under the comparative figures of the Ashford Undertaking he does not state the price paid for fuel oil and lubricating oil. These items are very much cheaper in England. The frequent cleaning of valves is due to the four-stroke engine being of old type and design of combustion head. Valves in any four-stroke engines have to receive frequent attention.

As to cylinder wear being negligible, this I attribute to the liberal amount of lubricating oil, as well as the particular brand of oil used. A certain amount of credit is also due, I think, to the engines always being kept hot.

In reply to Mr. Ritson: The losses he refers to under the figures for units sold approximate 7 per cent. for distribution, while units used in Power Station and Municipal workshop is approximately 8 per cent.

The President: As time is getting short we will now consider any matter under "General."

CONCLUSION.

Councillor Spilkin: I just want to say a few words of personal thanks to those who supported me at Capetown in my efforts to get the Convention to come to Umtata. I feel sure that what I promised you all at Capetown has been amply fulfilled. It has been a pleasure to everyone in Umtata to have you here, and there have been many expressions of the wish to have you here again. I hope you will take back with you the happiest recollections of Umtata and that you will pay us a return visit at some future time. We are very sorry to see you depart. (Applause.)

Clr. Starkey: At Capetown it was my privilege to second the motion that the Convention should be held in Umtata. As representing East London and the Border territory, I have no hesitation in saying that this has been one of the most successful conferences ever held by the Association. It has had the advantage in comparison with the larger centres in this respect, that delegates have been unable to attend to other things, and as a result their atention has been centred upon the Convention.

It is my pleasure and privilege to move a cordial vote of thanks to the Mayor and Mayoress, and to the town councillors of Umtata for the wonderful hospitality that has been accorded us, and which has been far in excess of what we thought possible. I have known his Worship the Mayor for many years, going back long before the days of motor cars. The Mayor throws himself whole-heartedly into anything he undertakes, and he and the Mayoress have been indefatigable in their efforts to entertain us. I am quite sure I voice the unanimous opinion of this Convention in thanking the Mayor, the Mayoress and the town councillors of Umtata for the outstanding time they have given us.

If propaganda has anything to do with the work of this Convention I hope Umtata will reap the benefit, that it will become the successful city its people wish it to be, and a place we desire to again visit.

In regard to the splendid organisation and work of the Mayor and Mayoress, I must refer to the work of the Town Clerk, Councillor Spikin and all the other officials of the town. They have every reason to be gratified with the success that has attended their efforts. (Applause.)

Councillor Venter: It affords me great pleasure to second the vote of thanks so ably proposed by Councillor Starkey, and I would like to refer to

the useful work accomplished by the Association, which work becomes increasingly useful each year. I refer more particularly to the standardisation and group promulgation of the Supply Regulations, which is a great step forward. In time to come many benefits not now apparent but accruing as a result of the functioning of this Association will be recognised and credited to the Association.

I feel also that the occasion is opportune to mention that it would probably be beneficial to have one paper dealing with Finance at each Convention, which is, after all, the chief consideration in all electrical undertakings. Mr. Milton's paper at this Convention has been of considerable value and interest in this connection.

The unbounded hospitality which has been showered upon us has been such that we feel like one Umtata family. Far more useful work is performed in a town like Umtata where we keep very closely together.

While the capital of the Transkei has been honoured by the presence of the Convention, may I express the hope that the capital of the district I represent, namely Cradock, the capital of the Midlands, will be similarly honoured. We can assure you that if you do come to Cradock we shall extend to you the most generous and sincere hospitality. In this expression of thanks I would like to include the ladies and citizens of Umtata, who have come forward so willingly and well, and made our stay a very happy one indeed. (Applause.)

Councillor Bloe: I would like to associate myself with the remarks of the previous speakers. As far as Port Elizabeth is concerned, my good lady and myself have enjoyed ourselves thoroughly, and I am sure I echo the feelings of all when I say

we have had an excellent time. I appreciate the work the Mayor has done in connection with this conference along with Councillor Spilkin.

I had hoped for a longer discussion on Mr. Milton's paper. In Port Elizabeth we are considering the erection of a large new Power Station, and it follows that the question of tariffs will probably have to be dealt with when that station is operating.

I would like to take this opportunity of thanking the Mayor and Mayoress who have done so much for us, and to say that we look forward to the time when Port Elizabeth will be able to reciprocate the great kindness that has been extended to us. (Applause.)

Councillor Webb: All good things have to come to an end, and all that remains is to thank the Mayor and the people of Umtata for the way in which they have received us. The discussions have been most interesting, and I feel that the engineers are definitely working in the interests of progress. I am sure you will all agree with me when I congratulate our President upon the way in which he has conducted the business of the Convention. (Applause.)

Mr. Milton: I would like to extend the thanks and appreciation of the Electricity Supply Commission for the invitation to the Convention, and to congratulate the gentlemen already mentioned upon the wonderful time we have had. Mr. Nicholas has been a good scout in looking after the business side of the Convention, while Councillor Spikin is to be congratulated upon the arrangements made for our pleasure and entertainment. I think special mention should be made of the citizens of Umtata, who have gone out of their way to make us comfortable. (Applause.)

Councillor Holland: On behalf of Johannesburg, I would like to add my quota of praise for and appreciation of what Umtata has done for us.

I am quite sure that most of us looked forward with pleasurable anticipations to coming down here. Our anticipations have been more than realised. We have had an extraordinary variety of entertainment which could not, I think, have been bettered in Johannesburg.

I should like to pay a special tribute to your President. As Shakespeare says, "Each man in his time plays many parts," and your President has borne out the truth of that statement. When we arrived we found him acting the chauffeur between the hotel and the station. Since then he has been guide, philosopher and friend to us all, and has presided with dignity and aplomb over our sessions. May I also pay a tribute to his staff who have worked so willingly in the background, who have borne the heat and burden of the day in order that their chief might be able to fulfil his many duties here with us.

In conclusion, I want to say how heartily I agree with the mover of the vote of thanks when he said that Umtata will benefit greatly by this Convention. I, with all my colleagues here, shall tell my friends that if they want a really enjoyable holiday they must come here. Heil Umtata!

Mr. Berry: I wish to thank the President for the invitation extended to the visitors. Holding the Convention was more or less of an experiment in regard to having it in a small place, and I think that experiment might well be repeated. A small place, by offering less in the way of distractions, enables delegates to meet together more frequently, thereby creating an atmosphere of friendship. I can only endorse what previous speakers have said, but I must add a special word regarding the work of the Secretary of the Association, Mr.

Poole, who has put in a tremendous amount of work. (Applause.) Permit me to add that Mr. Dalton, of the South African Railways, who was called away last night, has asked to be associated with the vote of thanks. (Applause.)

Mr. Rodwell: The views of the Convention have been so adequately expressed that there is little to add. One must, however, simply and sincerely thank the Mayor for the great kindness extended to us all. I would also like to express the sincere hope that our President will have a pleasant and successful year of office. (Applause.)

The President: I have little to say, but I would like to thank all those who have loaned their cars and those members who have read papers. I must also ask the Mayor and the Mayoress to accept my personal thanks for what they have done. (Applause.)

The Mayor: I wish to thank my old friend, Councillor Starkey, for moving this motion, and Councillor Venter for seconding it. It will be a great pleasure to convey to the Town Council and the citizens of Umtata your appreciation of what has been done to entertain the Convention. I realise fully that what has been said are not empty words, but that they are real and sincere. We shall ever retain pleasant recollections of this Convention, which is the second large gathering we have had in Umtata in recent years. Last year we had the Law Society's conference here. Umtata is going from strength to strength, and I hope and trust that we shall have the pleasure of welcoming many other Conventions here. This Convention has resulted in closer contact between engineers and citizens of the town. Here you do not get lost in the byways as in larger towns and cities. I thank you very much for your words of appreciation and shall always retain very happy memories of your visit to Umtata. (Applause.)

Mr. Rodwell: I call for three cheers for the Mayor, the Mayoress, the Town Councillors and citizens of Umtata.

These were given to the accompaniment of musical honours.

The President: Is there any further business before we close? There being nothing further, I declare the Convention closed.

The proceedings then terminated.

Association of Municipal Electricity Undertakings.

of South Africa and Rhodesia.

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as at December, 1939.

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