PROCEEDINGS

of the

Twenty-Fifth Convention

of the

Association of Municipal Electricity Undertakings

OF SOUTHERN AFRICA

(Founded 1915)

MUNICIPALITY OF

CAPE TOWN

held at

CAPE TOWN

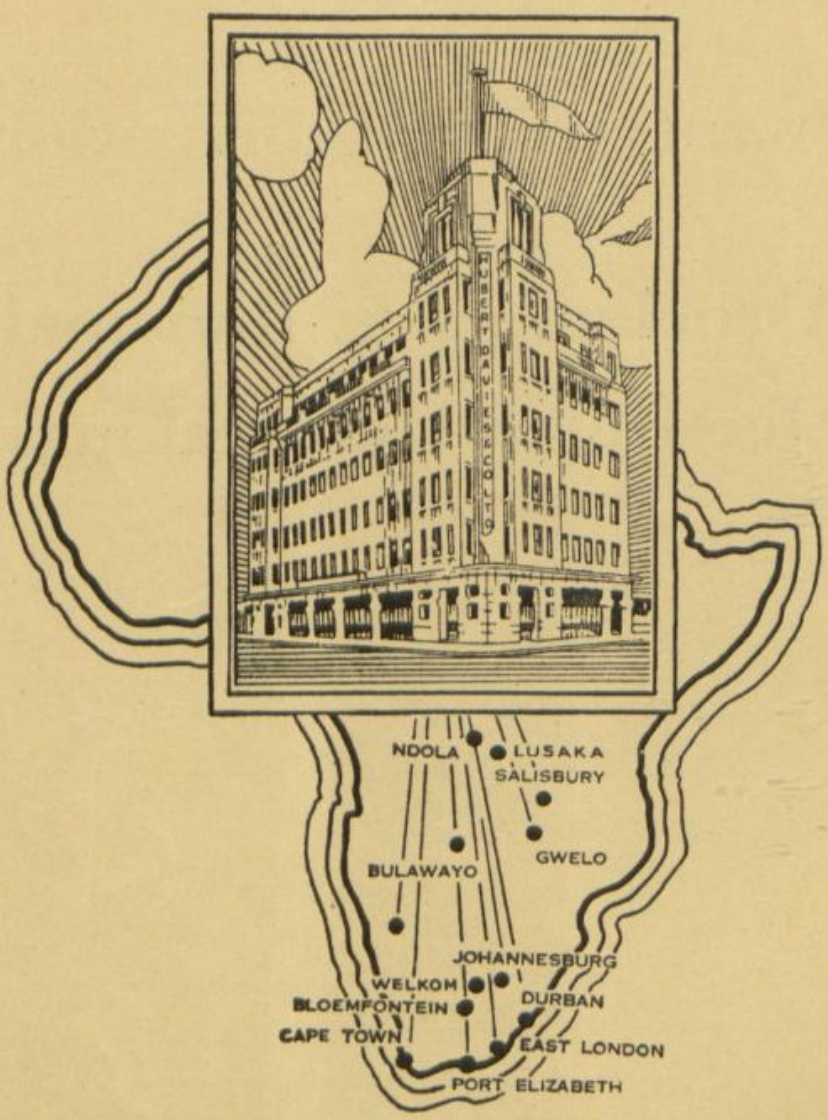
From Tuesday, May 8th, to

Friday, May 11th,

1951

PRICE FIFTEEN SHILLINGS

HUDACO HOUSE



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ELECTRIC EQUIPMENT FOR INDUSTRY

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ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA

FOUNDED 1915

EXECUTIVE COUNCIL, 1951/52

President:

J. C. Downey (Springs)

Vice-President:

A. R. Sibson (Bulawayo)

Past Presidents:

C. R. Hallé (Pietermaritzburg)
D. A. Bradley (Port Elizabeth)

Councillor Members:

Pretoria	Springs	Krugersdorp	Durban
East London	Cape Town	Bulawayo	Johannesburg

NOTE.—The Town is elected and not the individual Councillors.

Other Members:

A. Foden (East London)
J. C. Fraser (Johannesburg)
D. J. Hugo (Pretoria)
C. G. Downie (Cape Town)
C. Kinsman (Durban)
J. L. van der Walt (Krugersdorp)

Secretary and Treasurer:

A. T. Taylor, P.O. Box 7462, Johannesburg.

Sub-Committees:

S.A. Standards Institution	J. C. Downey Alternate: D. J. Hugo
S.A. Bureau of Standards: Safety Codes and other Committees	J. L. van der Walt Alternate: J. C. Downey
Safety Precautions	J. C. Downey Alternate: J. C. Fraser
Registration of Electrical Wiring Contractors	C. G. Downie (Convenor), D. A. Bradley and A. Foden
Coal Supplies	D. A. Bradley (Convenor), C. G. Downie, J. C. Fraser and D. J. Hugo
Import Control	J. C. Fraser, D. J. Hugo, J. C. Downey Alternates: C. G. Downie, C. Kinsman, J. L. van der Walt

It was agreed that members of the Import Control Committee be authorised to deal with the question of copper if there was any need for it.

Representatives:

World Power Conference (Local Committee)	J. C. Fraser
Electrical Wiremen's Registration Board	J. C. Fraser
C.I.G.R.E.	J. C. Fraser Alternate: A. Foden

Safety Precautions Committee to deal with the Promulgation of the Wiring Regulations:

The following members were appointed:

G. J. Muller; C. Kinsman; J. C. Fraser; J. C. Downey; Convenor C. G. Downie and A. R. Sibson.

PAST OFFICERS AND MEMBERS OF COUNCIL

	Past Presidents:	Secretary and Treasurer:
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. Macauley, Bloemfontein	E. Poole
1931–33	L. L. Horrell, Pretoria	E. Poole
1933–34	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, Cape Town	E. Poole
1939–44	I. J. Nicholas, Umtata	E. Poole until Dec., 1940 L. L. Horrell, Jan., 1941
1944–45	A. Rodwell, Johannesburg	L. L. Horrell
1945–46	J. S. Clinton, Salisbury J. W. Phillips, Bulawayo	L. L. Horrell to Nov., 1945 A. T. Taylor, December, 1945
1946–47	G. J. Muller, Bloemfontein	A. T. Taylor
1947–48	C. Kinsman, Durban	A. T. Taylor
1948–49	A. Foden, East London	A. T. Taylor
1949–50	D. A. Bradley, Port Elizabeth	A. T. Taylor
1950–51	C. R. Hallé, Pietermaritzburg	A. T. Taylor

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
1921–24	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

Note.—At the Thirteenth Convention the Rules and Constitution were amended to permit of Councils becoming members of the Association and to be represented on the Executive Council by two Councillor Members, hence the new layout of members of the Executive.

Councillors:	Alternate Councillors:	Engineers:
	1935–36:	
T. P. Gray, Johannesburg J. McLean, Port Elizabeth	H. W. Dely, Pretoria	G. H. Swingler, Cape Town J. H. Gyles, Durban T. Millar, Harrismith E. A. Behrens, Port Elizabeth
	1936–37	G. H. Swingler, Cape Town
H. Middlebrook, Durban T. P. Gray, Johannesburg	F. Morrell, Cape Town J. McLean, Port Elizabeth	T. Jagger, Ladysmith E. A. Behrens, Port Elizabeth G. M. Pirie, Bloemfontein
	1937–38:	L. L. Horrell, Pretoria
H. G. Capell, Durban W. James, Cape Town	H. Middlebrook, Durban L. Hofmeyr, Stellenbosch	J. S. Clinton, Salisbury A. Q. Harvey, Springs G. M. Pirie, Bloemfontein
	1938–39:	D. J. Hugo, Pretoria
E. Spilkin, Umtata W. James, Cape Town	G. C. Starkey, East London W. Fowkes, Cape Town	J. S. Clinton, Salisbury A. Q. Harvey, Springs. G. M. Pirie, Bloemfontein
	1939–44:	D. J. Hugo, Pretoria
E. Spilkin, Umtata C. Olley, Salisbury	G. C. Starkey, East London W. Fowkes, Cape Town	C. Kinsman, Durban A. Q. Harvey, Springs G. M. Pirie, Bloemfontein W. N. Powell, Bloemfontein
	1944–45:	D. J. Hugo, Pretoria
H. H. Verity, Johannesburg C. Olley, Salisbury	H. E. Gearing, Cape Town R. M. Thomas, Durban	C. Kinsman, Durban J. C. Fraser, Johannesburg G. R. E. Wright, Benoni
	1945–46:	D. J. Hugo, Pretoria
J. Ohlsen, Bulawayo J. W. du Plessis, Bloemfontein	M. Jaffray, Salisbury E. Boylan, M.P.C., Johannesburg	C. Kinsman, Durban J. C. Fraser, Johannesburg G. R. E. Wright, Benoni
	1946–47:	D. J. Hugo, Pretoria
P. J. C. du Plessis, M.P.C. (Bloemfontein) Major J. Raftery, J.P., M.P.C. (Durban)	A. Immink, Johannesburg A. Z. Berman, Cape Town	J. C. Fraser, Johannesburg J. C. Downey, Springs D. A. Bradley, Port Elizabeth
	1947–48:	D. J. Hugo, Pretoria
Major J. Raftery, J.P., M.P.C. (Durban) E. H. Tiddy, East London	J. M. Preller, Pretoria C. G. Thompson, Johannesburg	J. C. Fraser, Johannesburg J. C. Downey, Springs H. A. Eastman, Cape Town
	1948–49	D. J. Hugo, Pretoria
E. H. Tiddy, East London J. C. K. Erasmus, J.P., Port Elizabeth	C. G. Thompson, Johannesburg J. Johnston, Durban	J. C. Fraser, Johannesburg J. C. Downey, Springs H. A. Eastman, Cape Town
	1949–50:	J. C. Fraser, Johannesburg
J. C. K. Erasmus, J.P., Port Elizabeth C. E. (Sax) Young, Pietermaritzburg	W. F. du Plessis, Bloemfontein S. H. Millar, Bulawayo	J. C. Downey, Springs H. A. Eastman, Cape Town G. J. Muller, Bloemfontein A. R. Sibson, Bulawayo J. L. van der Walt, Krugersdorp

1950–51:

Note.—At the Twenty-Fourth Convention the Rules and Constitution were amended to permit of eight Councillor Members being elected to the Executive and that these Councillor Members shall be the Councillors of those towns whose Engineer Members (other than the two Past-Presidents) have been elected to the Executive Council.

As a result of this amendment the undermentioned constituted the Executive Council:—

Councils:		Engineers:
Pietermaritzburg	(Councillor C. E. Young)	C. R. Hallé
Springs	(Councillor L. P. Davies)	J. C. Downey
Bulawayo	(Councillor J. J. Wrathall)	A. R. Sibson
Bloemfontein	(Councillor W. F. du Plessis)	G. J. Muller
Cape Town	(Councillor J. Muller)	H. A. Eastman
Durban	(Councillor G. Hayward)	C. Kinsman
Krugersdorp	(Councillor E. B. Neill)	L. J. van der Walt
Johannesburg	(Councillor L. M. Weiner)	J. C. Fraser
		D. A. Bradley
		A. Foden

RULES AND CONSTITUTION

ASSOCIATION OF

Municipal Electricity Undertakings

OF SOUTHERN AFRICA

1. TITLE

The name of the Association shall be "The Association of Municipal Electricity Undertakings of Southern Africa."

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 together.

(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 Undertakings.

3. MEMBERSHIP

The Association shall consist of:—

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

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

4. QUALIFICATIONS

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

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

(b) **Councillor Members.** The Member whose Chief Electrical Engineer shall have qualifications acceptable to the Council shall be the Committee appointed by the Municipality or Local Authority to have control over its Electricity Undertakings 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. After 1st June, 1947, one only duly qualified assistant 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 an Authorised Electricity Undertaker other than a Local Authority who is engaged in the supply of electricity to consumers in the area of jurisdiction of a Local Authority.

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 Municipal 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 March 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:

SCALE OF CONTRIBUTIONS

Up to	½	million units	...	4	guineas
½ ,,	1	,, ,,	...	6	,,
1 ,,	10	,, ,,	...	8	,,
10 ,,	50	,, ,,	...	12	,,
50 ,,	100	,, ,,	...	14	,,
100 ,,	200	,, ,,	...	16	,,
200 ,,	300	,, ,,	...	18	,,
Over	300	,, ,,	...	20	,,

(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 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 publication 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 the Council. The Council shall consist of a President, Vice-President, two immediate Past-Presidents, all of whom shall be Engineer Members, six other Engineer Members and eight Councillor Members.

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

Election of Council. The officers (other than the Secretary and Treasurer) and the Engineer Members 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. The Councillor Members shall be the Councillors of those towns whose Engineer Members (other than the two Past-Presidents) have been elected to the Executive Council.

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

Election of Secretary and Treasurer. The Council shall appoint and from time to time determine the remuneration (if any) and prescribe the duties of the Secretary and 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 five 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 and 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 meetings 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.

MEMBERS, DELEGATES AND VISITORS ATTENDING THE 25th CONVENTION

COUNCILLORS AND ENGINEERS

ALIWAL NORTH
K. G. Robson

ALBERTON
Cr. J. J. Schoeman
C. E. Gregor

BARBERTON
P. C. Asselbergs

BEAUFORT WEST
J. P. Mostert

BENONI
Cr. N. C. Korsman
R. Tarran

BETHLEHEM
K. M. Fisher

BLOEMFONTEIN
Cr. W. F. du Plessis
C. Lombard

BOKSBURG
Cr. J. H. de Bruin
E. L. Smith

BRANDFORT
D. v. S. Dreyer

BULAWAYO
Cr. C. M. Newman
A. R. Sibson

BOTHAVILLE
Cr. J. J. Reynders
J. D. Hattingh

BRAKPAN
Cr. B. S. Gericke
P. L. Vergottini

CAPE TOWN
Cr. Major J. W. O. Billingham
C. G. Downie

CRADOCK
A. Rossler

DURBAN
Cr. F. E. Cheek
C. Kinsman

EAST LONDON
Cr. F. T. Fox
A. Foden

EDENVALE
Cr. H. J. Seymour

FORT BEAUFORT
J. H. Rogers

FICKSBURG
G. Aalbers

GEORGE
Cr. Dr. G. J. Lamprecht
P. H. Newcombe

GRAHAMSTOWN
J. Iverach

GREYTOWN
J. S. Craig

GWELO
Cr. L. G. Doley
A. W. K. Hadfield

GRAAFF-REINET
Cr. E. B. Conway
D. S. van der Merwe

HARRISMITH
P. Bechler

HEIDELBERG
J. F. Lategan

JOHANNESBURG
Cr. L. M. Weiner
J. C. Fraser

KIMBERLEY
Cr. E. O. Davis
C. R. Burton

KLERKSDORP
Cr. J. G. Dawkins
J. M. Gericke

KOKSTAD
W. G. Thackwray

KROONSTAD
Cr. Dr. F. van Reenen
W. Rossler

KRUGERSDORP
Cr. Major H. Pannall
J. L. van der Walt

LADYSMITH
Cr. F. O. Rapson
F. Stevens

LADYBRAND
C. Fletterman

LOUIS TRICHARDT
Cr. D. J. Coetzee
E. L. Buchanan

LIVINGSTONE
K. B. Barlow

MAFEKING
Cr. C. J. Truscott
G. E. H. Jones

N'DOLA
J. H. White

NELSPRUIT
R. R. Lyall

NEWCASTLE
Cr. D. R. Hughes
B. W. Cowley

NIGEL
Cr. D. F. J. MacRae
B. T. Janas

OUDTSHOORN
C. H. Adams

ODENDAALSRUS
N. Ferreira

PIETERSBURG
Cr. R. J. K. Baker
J. I. Inglis

PIETERMARITZBURG
Cr. C. E. K. Young
C. R. Hallé

PORT ELIZABETH
Cr. H. Parker
D. A. Bradley

POTCHEFSTROOM
Cr. P. J. Raubenheimer
Cr. C. J. Fourie
T. Kramer

PRETORIA
Cr. C. W. Sinclair
D. J. Hugo

RANDFONTEIN
Cr. S. Gidley
J. R. Cherry

ROODEPOORT-MARAISBURG
Cr. P. S. Schoeman
D. D. Brown

RUSTENBURG
P. A. Meintjies

SALISBURY
Cr. C. Olley
Cr. A. M. Jaffray
J. E. Mitchell

SOMERSET EAST
W. Atteridge

SOMERSET WEST
F. P. W. Hall

SPRINGS
Cr. L. P. Davies
Cr. R. H. Tainton
J. C. Downey
A. P. Burger (Town Clerk's Dept.)

STANDERTON
Cr. E. J. Smith
C. R. Sprighton

STELLENBOSCH
Cr. G. P. Blake
J. W. du Toit

THE STRAND
Cr. G. Sinclair
C. N. Sims

UITENHAGE
Cr. H. J. Ofsowitz
J. A. Mathews

UMTALI
H. T. Turner

VEREENIGING
A. F. Turnbull

VREDE
Cr. C. P. du Toit
D. R. Verschoor

VRYHEID
W. Rush

VENTERSDORP
H. Bahr

VENTERSPOST
Cr. M. C. P. Bekker
Cr. J. P. Marais
L. Dreyer

WINDHOEK
V. E. Williams

WORCESTER
Cr. E. Traub
Cr. W. P. Burger
W. C. Theron

OTHER MEMBERS

W. M. Andrew, King William's Town (Associate)
J. W. Barton, Welkom, O.F.S. (Associate)
A. R. Campbell, Johannesburg (Associate)
J. S. Clinton, Johannesburg (Associate)
P. J. R. Conradie, Ficksburg (Associate)
H. A. Eastman, Cape Town (Honorary Member)
H. M. S. Muller, Kakamas (Associate)
A. Rodwell, Johannesburg (Honorary Member)
P. D. Kruyt, Allanridge (Associate)
B. Marchand, Witbank (Associate)

DELEGATES
GOVERNMENT DEPARTMENTS

Electricity Supply Commission:

W. H. Milton, Johannesburg.
H. H. Jagger, Cape Town.
E. L. Damant, Durban.
R. C. Jordan, Johannesburg.
C. G. Davidson, Cape Town.
J. M. Macowan, Southern Rhodesia.

Other Departments:

G. A. Dalton, Chief Electrical Engineer, S.A.R. & H., Johannesburg.
C. N. Larkin, Electrical Engineer, S.A.R. & H., Cape Town.
J. A. F. Michell, Chief Engineer, G.P.O., Pretoria.
R. N. F. Smit, Chief Inspector of Factories, Pretoria.
J. E. Shaw, Inspector of Factories, Cape Town.
C. Mullins, Electricity Control Board.

OTHER REPRESENTATIVES

E. Vivian Perrow, Chairman, Safety Precautions Committee.
J. W. Swardt, S.A. Bureau of Standards.
O. J. Alexander, S.A. Bureau of Standards.
J. T. Williams, S.A. Bureau of Standards.
D. J. C. Baxter, North Cape Regional Electrification Board.
A. E. Robinson, Johannesburg Chamber of Commerce.

VISITORS

Prof. R. W. Guelke, University of Cape Town.
S. G. Redman, Merz & McLellan, Johannesburg.
T. R. J. Bishop, Merz & McLellan, Johannesburg.
J. E. Stone, Salisbury.
C. E. Scott, Cape Town.
G. Drewett, Johannesburg.
J. England, Port Elizabeth.
T. D. Pratt, Johannesburg
E. G. Ivey, Deputy City Electrical Engineer, Cape Town.
A. C. T. Frantz, Chief Technical Officer, Cape Town Electricity Department.

REPRESENTATIVES—ENGINEERING COMPANIES

Aberdare Cables (S.A.) Ltd.	R. J. Bates, G. R. Usher, S. Probert, H. Seabrooke, G. Yuill.
African Cables Ltd.	V. H. Woods, W. N. Randall.
Arthur Trevor Williams (Pty.) Ltd.	A. T. Williams.
Aycliffe Industries Ltd.	C. A. Rist, R. C. Walker, H. A. Wright, T. C. Usher.
Bartle & Co.	J. W. Hunter.
British Thompson-Houston Co. (S.A.) (Pty.) Ltd.	L. G. Axe, N. R. Yorke.
Babcock & Wilcox of Africa Ltd.	J. C. Callie, A. K. Tait.
British Insulated Cables (S.A.) Ltd.	A. L. Sanders, A. W. Allen.
Brush S.A. (Pty.) Ltd.	J. White, P. D. Jeffson, J. M. Georgala.
British General Electric Co. Ltd.	S. G. Mortimer, H. Littlewood.
Caltex (Africa) Ltd.	H. V. Earl, W. H. Schrages.
Chloride Electrical Storage Co. S.A. (Pty.) Ltd.	A. C. Tilley.
Contactor (Pty.) Ltd.	R. J. Lloyd, J. C. Royce.
Cooper & de Beer (Pty.) Ltd.	C. L. de Beer.
Dowson & Dobson Ltd.	K. Lewis.
Enfield Cables (S.A.) (Pty.) Ltd.	J. P. Thomas, A. Paice, A. E. Torrance.
General Motors (S.A.) Ltd.	R. T. Park.
Glamco Ltd.	J. McD. Hodgson, N. Gold.
H. R. C. Fuse Gear (Pty.) Ltd.	H. H. Aston.
Hubert Davies & Co. Ltd.	F. D. Opperman.
James Howden & Co. Ltd.	W. Downie.
International Combustion S.A. (Pty.) Ltd. ...	Sir George Usher.
Johnson & Phillips S.A. (Pty.) Ltd.	F. H. Tyler.
Kent, George (S.A.) Ltd.	H. B. Hichens.
H. Marthinusen (Pty.) Ltd.	G. Roeske.
Metropolitan-Vickers, S.A. (Pty.) Ltd. ...	T. Riley.
McKechnie Bros. S.A. (Pty.) Ltd.	E. J. McKechnie.
Patrick Murray (Pty.) Ltd.	W. H. Walsh.
Parsons, C. A. & Coy. (S.A.) (Pty.) Ltd. ...	H. M. Rochester, T. R. Strawson.
Power Engineers (Pty.) Ltd.	A. Singer, J. A. Young.
Reunert & Lenz Ltd.	A. Morcom.
A. Reyrolle & Co. S.A. (Pty.) Ltd.	W. J. Gibbons, C. R. J. Pilcher.
Rice & Diethelm Ltd.	T. F. Suttie, E. T. Norris.
Samuel Osborne (S.A.) Ltd.	V. A. Bright.
Scottish Cables (S.A.) Ltd.	D. G. Sutherland, A. C. Grant.
S.A. Electrical Review	O. W. L. Speight.
S.A. Cable Makers Association	E. R. J. Smith.
S.A. General Electric Co. Ltd.	E. P. Kuttel, L. New.
Stamcor (Pty.) Ltd.	J. M. Taylor.
Shell Co. of S.A. Ltd.	J. F. Price, G. Phillips.
Wilson & Herd Ltd.	W. Herd.
Yarrow (Africa) (Pty.) Ltd.	H. D. T. Harris.

LADIES

Mrs. W. M. Andrew, King William's Town.
Mrs. P. C. Asselbergs, Barberton.
Mrs. L. G. Axe, Johannesburg.
Mrs. R. G. Baker, Pietersburg.
Mrs. K. B. Barlow, Livingstone.
Mrs. R. W. Barton, Welkom, O.F.S.
Mrs. D. A. Bradley, Port Elizabeth.
Mrs. E. L. Buchanan, Louis Trichardt.
Mrs. C. R. Burton, Kimberley.
Mrs. J. C. Callie, Johannesburg.
Mrs. A. R. Campbell, Johannesburg.
Mrs. D. J. R. Conradie, Ficksburg.
Mrs. E. B. Conway, Graaff-Reinet.
Mrs. B. W. Cowley, Newcastle.
Mrs. J. S. Craig, Greytown.
Mrs. E. L. Damant, Durban.
Mrs. E. O. Davis, Kimberley.
Mrs. L. G. Doley, Gwelo.
Mrs. J. C. Downey, Springs.
Mrs. W. F. du Plessis, Bloemfontein.
Mrs. H. A. Eastman, Cape Town.
Mrs. K. M. Fisher, Bethlehem.
Mrs. C. Fletterman, Ladybrand.
Mrs. A. Foden, East London.
Mrs. C. J. Fourie, Potchefstroom.
Mrs. F. T. Fox, East London.
Mrs. J. C. Fraser, Johannesburg.
Mrs. J. M. Gericke, Klerksdorp.
Mrs. A. C. Grant, Johannesburg.
Mrs. A. W. K. Hadfield, Gwelo.
Mrs. H. D. T. Harris, Johannesburg.
Mrs. J. I. Inglis, Pietersburg.
Mrs. H. H. Jagger, Cape Town.
Mrs. G. E. H. Jones, Mafeking.
Mrs. C. Kinsman, Durban.
Mrs. T. Kramer, Potchefstroom.
Mrs. J. F. Lategan, Heidelberg.
Mrs. B. Marchand, Witbank.
Mrs. J. A. Mathews, Uitenhage.
Mrs. H. M. S. Muller, Kakamas.
Mrs. P. H. Newcombe, George.
Mrs. C. M. Newman, Bulawayo.
Mrs. E. T. Norris, England.
Mrs. C. Olley, Salisbury.
Mrs. H. J. Ofsowitz, Uitenhage.
Mrs. F. D. Opperman, Cape Town.
Mrs. H. Parker, Port Elizabeth.
Mrs. E. V. Perrow, Johannesburg.
Mrs. P. J. Raubenheimer, Potchefstroom.
Mrs. K. G. Robson, Aliwal North.
Mrs. A. Rodwell, Johannesburg.
Mrs. J. Rogers, Fort Beaufort.
Mrs. A. Rossler, Cradock.
Mrs. W. Rossler, Kroonstad.
Mrs. W. Rush, Vryheid.
Mrs. J. J. Schoeman, Alberton.
Mrs. H. J. Seymour, Edenvale.
Mrs. A. R. Sibson, Bulawayo.
Miss S. Sibson, Bulawayo.
Mrs. C. W. Sinclair, Pretoria.
Mrs. C. N. Sims, The Strand.
Mrs. R. N. F. Smit, Pretoria.
Mrs. C. R. Sprighton, Standerton.
Mrs. J. E. Stone, Salisbury.
Mrs. D. G. Sutherland, Johannesburg.
Mrs. R. H. Tainton, Springs.
Mrs. R. Tarran, Benoni.
Mrs. A. T. Taylor, Johannesburg.
Mrs. W. C. Theron, Worcester.
Mrs. C. J. Truscott, Mafeking.
Mrs. P. L. Vergottini, Brakpan.
Mrs. D. R. Verschoor, Vrede.
Mrs. L. M. Weiner, Johannesburg.
Mrs. V. E. Williams, Windhoek.
Mrs. N. R. Yorke, Cape Town.

LIST OF MEMBERS AS AT 31st MAY, 1951

HONORARY MEMBERS

Dobson, Dr. J. H., 35 Central Avenue, Illovo, Johannesburg.
Eastman, H. A., Torwood, Parel Vallei, Somerset West, C.P.
Horrell, L. L., 139 Brook Street, Brooklyn, Pretoria.
Poole, E., 3 Musgrave Mansions, 690 Musgrave Road, Durban.
Rodwell, A. T., "Miranda", Oxford Road, Parktown, Johannesburg.

COUNCIL MEMBERS

Adelaide, C.P., Municipality, P.O. Box 38.
Aliwal North, C.P., Municipality, P.O. Box 46.
Alberton, Tvl., Municipality, P.O. Box 4.

Barberton, Tvl., Municipality, P.O. Box 33.
Beaufort West, C.P., Municipality, P.O. Box 9.
Benoni, Tvl., Municipality, P.O. Box 45.
Bethal, Tvl., Municipality, P.O. Box 3
Bethlehem, O.F.S., Municipality, P.O. Box 130.
Bloemfontein, O.F.S., City Council, P.O. Box 288.
Boksburg, Tvl.. Town Council, P.O. Box 215.
Brandfort, O.F.S., Municipality, P.O. Box 13.
Bulawayo, S.R., City Council, P.O. Box 591.
Butterworth, Transkei, Municipality, P.O. Box 36.
Brakpan, Tvl., Town Council, P.O. Box 15.
Brits, Tvl., Town Council, P.O. Box 106.
Bothaville, O.F.S., Municipality, P.O. Box 12.

Cape Town, C.P., City Council, P.O. Box 655.
Cradock, C.P., Municipality, P.O. Box 24.
Ceres, C.P., Municipality, P.O. Box 44.

Delmas, Tvl., Municipality, P.O. Box 6.
Durban, Natal, City Council, P.O. Box 147.

East London, C.P., City Council, P.O. Box 134.
Elliot, C.P., Municipality, P.O. Box 21.
Ermelo, Tvl., Municipality, P.O. Box 48.
Eshowe, Zululand, Town Board, P.O. Box 37.
Edenvale, Tvl., Town Council, P.O. Box 25.

Fort Beaufort, C.P., Municipality, P.O. Box 36.
Ficksburg, O.F.S., Municipality, P.O. Box 116.

Gatooma, S.R., Municipality, P.O. Box 114.
George, C.P., Municipality, P.O. Box 28.
Grahamstown, C.P., City Council, P.O. Box 176.
Greytown, Natal, Borough, P.O. Box 71.
Gwelo, S.R., Municipality, P.O. Box 278.
Graaff-Reinet, C.P., Municipality, P.O. Box 71.

Harrismith, O.F.S., Municipality, P.O. Box 43.
Heidelberg, Tvl., Municipality, P.O. Box 201.

Johannesburg, Tvl., City Council, P.O. Box 1049.

Kimberley, C.P., City Council.
Klerksdorp, Tvl., Municipality, P.O. Box 160.
Kokstad, E. G., Municipality, P.O. Box 8.
Kroonstad, O.F.S., Municipality, P.O. Box 302.
Krugersdorp, Tvl., Municipality, P.O. Box 94.
Komgha, C.P., Municipality, P.O. Box 21.

Ladysmith, Natal, Borough, P.O. Box 29.
Louis Trichardt, Tvl., Municipality, P.O. Box 96.
Livingstone, N.R., Municipality, P.O. Box 29.

Mafeking, Bech'd., Municipality, P.O. Box 42.
Matatiele, E.G., Municipality, P.O. Box 35.
Middelburg, C.P., Municipality, P.O. Box 55.
Middelburg, Tvl., Municipality, P.O. Box 14.

Nelspruit, Tvl., Municipality, P.O. Box 45.
Newcastle, Natal, Borough, P.O. Box 21.
N'Dola, N.R., Municipality, P.O. Box 197.
Nigel, Tvl., Municipality, P.O. Box 23.

Oudtshoorn, C.P., Municipality, P.O. Box 132.
Odendaalsrus, O.F.S., Municipality.

Paarl, C.P., Municipality, P.O. Box 12.
Pietersburg, Tvl., Municipality, P.O. Box 111.
Pietermaritzburg, Natal, City Council, P.O. Box 321.
Piet Retief, Tvl., Municipality, P.O. Box 23.
Port Alfred, C.P., Municipality.
Port Elizabeth, C.P., City Council, P.O. Box 116.
Port Shepstone, Natal, Borough, P.O. Box 5.
Potchefstroom, Tvl., Municipality, P.O. Box 113.
Potgietersrust, Tvl., Municipality, P.O. Box 34.
Pretoria, Tvl., City Council, P.O. Box 440.

Queenstown, C.P., Municipality, P.O. Box 113.
Que Que, S.R., Municipality, P.O. Box 15.

Randfontein, Tvl., Municipality, P.O. Box 139.
Robertson, C.P., Municipality, P.O. Box 52.
Roodepoort-Maraisburg, Tvl., Municipality, P.O. Box 217, Roodepoort.
Rustenburg, Tvl., Municipality, P.O. Box 16.

Salisbury, S.R., City Council, P.O. Box 990.
Somerset East, C.P., Municipality, P.O. Box 21.
Springs, Tvl., Municipality, P.O. Box 45.
Springfontein, O.F.S., Municipality, P.O. Box 10.
Stanger, Natal, Borough, P.O. Box 72.
Stellenbosch, C.P., Municipality.
Somerset West, C.P., Municipality, P.O. Box 19.
Standerton, Tvl., Municipality, P.O. Box 66.

The Strand, C.P., Municipality, P.O. Box 3.
Theunissen, O.F.S., Municipality, P.O. Box 8.

Uitenhage, C.P., Municipality, P.O. Box 45.
Umtata, Transkei, Municipality, P.O. Box 57.
Umtali, S.R., Municipality, P.O. Box 121.
Upington, C.P., Municipality, P.O. Box 17.

Vereeniging, Tvl., Municipality, P.O. Box 35.
Vrede, O.F.S., Municipality, P.O. Box 155.
Vryburg, Bechuanaland, Municipality.
Vryheid, Natal, Borough, P.O. Box 57.
Ventersdorp, Tvl., Municipality, P.O. Box 15.
Venterspost, Tvl., Municipality, P.O. Box 19.

Walmer, C.P., Municipality, Town Hall, Walmer.
Winburg, O.F.S., Municipality, P.O. Box 26.
Windhoek, S.W.A., Municipality, P.O. Box 59.
Willowmore, C.P., Municipality, P.O. Box 15.
Worcester, C.P., Municipality, P.O. Box 37.
Wepener, O.F.S., Municipality, P.O. Box 31.

ENGINEER MEMBERS

Aalbers, G., Municipal Electrical Engineer, P.O. Box 116, Ficksburg, O.F.S.
Adams, C. H., Municipal Electrical Engineer, P.O. Box 132, Oudtshoorn, C.P.
Anderson, F., Municipal Electrical Engineer, Port Alfred, C.P.
Ashley, T. P., Municipal Electrical Engineer, P.O. Box 113, Queenstown, C.P.
Asselbergs, P. C., Town Electrical Engineer, P.O. Box 33, Barberton, Transvaal.
Atteridge, W. H., Municipal Electrical Engineer, P.O. Box 21, Somerset East, C.P.
Bahr, H., Municipal Electrical and Waterworks Engineer, P.O. Box 15, Ventersdorp, Tvl.
Barlow, K. B., Town Electrical Engineer, P.O. Box 109, Livingstone, N.R.
Bradley, D. A., City Electrical Engineer, P.O. Box 369, Port Elizabeth, C.P.
Brown, D. D., Municipal Electrical Engineer, P. O. Box 217, Roodepoort, Tvl.
Burton, C. R., City Electrical Engineer, Kimberley.
Buchanan, E. L., Town Electrical Engineer, P.O. Box 96, Louis Trichardt, Tvl.
Cherry, J. R., Municipal Electrical Engineer, P.O. Box 139, Randfontein, Tvl.
Coetzee, F. J., Town and Electrical Engineer, P.O. Box 21, Komgha, C.P.
Cowley, B. W., Borough Electrical Engineer, P.O. Box 21, Newcastle, Natal.
Craig, J. S., Borough Electrical Engineer, P.O. Box 71, Greytown, Natal.
Delport, G. C., Municipal Electrical Engineer, P.O. Box 6, Delmas, Tvl.
de Wet, D. P., Municipal Electrical Engineer, P.O. Box 15, Willowmore, C.P.
de Wit, T., Engineer-in-Charge, Municipality of Brits, P.O. Box 106, Brits, Tvl.
Downey, J. C., Town Electrical Engineer, P.O. Box 45, Springs, Tvl.
Downie, C. G., City Electrical Engineer, P.O. Box 82, Cape Town, C.P.
Dreyer, D. v. s., Town Electrical Engineer, P.O. Box 13, Brandfort, O.F.S.
Dreyer, L., Municipal Electrical Engineer, P.O. Box 19, Venterspost, Tvl.
Dwyer, C. H., Borough Electrical Engineer, P.O. Box 72, Stanger, Natal.
du Toit, A. A., Municipal Electrical Engineer, P.O. Box 44, Ceres, C.P.
Erikson, J. G. F., Borough Electrical Engineer, P.O. Box 15, Estcourt, Natal.
Ferreira, N., Town and Electrical Engineer, Odendaalsrus, O.F.S.
Fisher, K. M., Municipal Electrical Engineer, P.O. Box 130, Bethlehem, O.F.S.
Foden, A., City Electrical Engineer, P.O. Box 529, East London, C.P.
Fraser, J. C., General Manager, Electricity Department, P.O. Box 699, Johannesburg, Tvl.
Gericke, J. M., Municipal Electrical Engineer, P.O. Box 99, Klerksdorp.
Giles, P. A., Assistant City Electrical Engineer, P.O. Box 529, East London, C.P.
Grandin, P. C., Town and Electrical Engineer, Vryburg Municipality, Bechuanaland.
Gregor, C. E., Town Engineer, P.O. Box 4, Alberton, Tvl.
Gripper, H. J., Assistant City Electrical Engineer, P.O. Box 369, Port Elizabeth, C.P.
Hadfield, A. W. K., Town and Electrical Engineer, P.O. Box 278, Gwelo, S.R.
Halliday, K. W. J., Municipal Electrical Engineer, P.O. Box 5, Port Shepstone, Natal.
Hallé, C. R., City Electrical Engineer, P.O. Box 399, Pietermaritzburg, Natal.
Hall, F. P. W., Municipal Electrical Engineer, P.O. Box 19, Somerset West, C.P.
Hattingh, J. D., Municipal Electrical Engineer, P.O. Box 12, Bothaville, O.F.S.
Heese, J. F., Municipal Electrical Engineer, P.O. Box 17, Upington, C.P.
Hugo, D. J., City Electrical Engineer, P.O. Box 423, Pretoria, Tvl.
Inglis, J. I., Town Electrical and Water Engineer, P.O. Box 111, Pietersburg, Tvl.

ENGINEER MEMBERS—(Continued)

Iverach, J., City Electrical Engineer, P.O. Box 176, Grahamstown, C.P.
Janas, B. T., Municipal Electrical Engineer, P.O. Box 23, Nigel, Tvl.
Jones, G. E. H., Municipal Electrical Engineer, P.O. Box 42, Mafeking, Bechuanaland.
— Kane, R. W., Assistant General Manager, Electricity Department, P.O. Box 699, Jo'burg.
Kinsman, C., City Electrical Engineer, P.O. Box 147, Durban, Natal.
Kramer, T., Municipal Electrical Engineer, P.O. Box 113, Potchefstroom, Tvl.
Kirberger, M. N., Town Engineer, P.O. Box 3, Bethal, Tvl.
Kruger, M. J. C., Municipal Electrical Engineer, P.O. Box 10, Butterworth, Transkei.
— Leishman, R., Chief Engineering Assistant, Electricity Department, P.O. Box 699, Jo'burg.
Lategan, J. F., Town Electrical Engineer, P.O. Box 201, Heidelberg, Tvl.
— Lombard, C., Assistant City Electrical Engineer, P.O. Box 288, Bloemfontein.
Lotter, G. A., Town Engineer, P.O. Box 48, Ermelo, Tvl.
Lyall, R. R., Municipal Electrical Engineer, P.O. Box 45, Nelspruit, Tvl.
Mathews, J. A., Municipal Electrical Engineer, P.O. Box 45, Uitenhage, C.P.
— McDonald, F. G., Assistant City Electrical Engineer, P.O. Box 399, Pietermaritzburg, Natal.
Meintjies, P. A., Municipal Electrical Engineer, P.O. Box 16, Rustenburg, Tvl.
Mitchell, J. E., City Electrical Engineer, P.O. Box 73, Salisbury, S.R.
Mitchell, E. W. O., Municipal Electrical Engineer, P.O. Box 114, Gatooma, S.R.
Mocke, T. M., Town and Electrical Engineer, P.O. Box 23, Piet Retief, Tvl.
Muller, G. J., City Electrical Engineer, P.O. Box 288, Bloemfontein, O.F.S.
Newcombe, P. H., Municipal Electrical Engineer, P.O. Box 28, George, C.P.
Nicholas, I. J., Municipal Electrical Engineer, P.O. Box 57, Umtata, Transkei.
Prevost, H. A., Municipal Electrical Engineer, P.O. Box 21, Somerset East, C.P.
— Redman, R. H., Assistant City Electrical Engineer, P.O. Box 1803, Bulawayo.
Relihan, H. J., Municipal Electrical Engineer, P.O. Box 12, Paarl, C.P.
Reyeneke, G. M., Town Electrical Engineer, P.O. Box 10, Springfontein, O.F.S.
Roberts, L. J., Municipal Electrical Engineer, P.O. Box 35, Matatiele, E.G.
Rogers, J., Municipal Electrical Engineer, P.O. Box 36, Fort Beaufort, C.P.
Roode, L., Town and Electrical Engineer, P.O. Box 34, Potgietersrust, Tvl.
Rossler, A., Municipal Electrical Engineer, P.O. Box 24, Cradock, C.P.
Rossler, W., Town Electrical Engineer, P.O. Box 302, Kroonstad, O.F.S.
Rush, W., Borough Engineer, P.O. Box 57, Vryheid, Natal.
Robson, K. G., Town Electrical and Waterworks Engineer, P.O. Box 46, Aliwal North, C.P.
Rozendal, D., Municipal Electrical Engineer, P.O. Box 31, Wepener, O.F.S.
Sibson, A. R., City Electrical Engineer, P.O. Box 1803, Bulawayo, S.R.
Sims, C. N., Municipal Electrical Engineer, P.O. Box 3, The Strand, C.P.
Smith, E. L., Municipal Electrical Engineer, P.O. Box 215, Boksburg, Tvl.
Smith, M. M., Municipal Electrical Engineer, P.O. Box 38, Adelaide, C.P.
Stevens, F., Borough Electrical Engineer, P.O. Box 56, Ladysmith, Natal.
Sprighton, C. R., Town and Electrical Engineer, P.O. Box 66, Standerton, Tvl.
Tarran, R., Municipal Electrical Engineer, P.O. Box 45, Benoni, Tvl.
Thackwray, W. G., Town Electrical Engineer, P.O. Box 8, Kokstad, E.G.
Theron, W. C., Municipal Electrical Engineer, P.O. Box 37, Worcester, C.P.

ENGINEER MEMBERS—(Continued)

Turner, H. T., Town and Electrical Engineer, P.O. Box 121, Umtali, S.R.
Turnbull, A. F., Town Electrical Engineer, P.O. Box 35, Vereeniging, Tvl.
Van der Walt, J. L., Town Electrical Engineer, P.O. Box 94, Krugersdorp, Tvl.
Vergottini, P. L., Municipal Electrical Engineer, P.O. Box 15, Brakpan, Tvl.
Van der Merwe, D. S., Town Electrical Engineer, P.O. Box 71, Graaff-Reinet, C.P.
Verschoor, D. R., Town and Electrical Engineer, P.O. Box 155, Vrede, O.F.S.
White, J. H., Municipal Electrical Engineer, P.O. Box 197, N'Dola, N.R.
Williams, V. E., Town Electrical Engineer, P.O. Box 59, Windhoek, S.W.A.
Wilson, J., Assistant City Electrical Engineer, P.O. Box 423, Pretoria, Tvl.
Woolridge, W. E. L., Town Electrical Engineer, P.O. Box 24, Harding, Natal.

ASSOCIATES

Andrew, W. M., 15 Chamberlain Street, King William's Town, C.P.
Barratt, V. E. O., Assistant Electrical Engineer, P.O. Box 113, Queenstown, C.P.
Barton, R. W., P.O. Welkom, O.F.S.
Bevington, H. R., Municipal Electrical Engineer, P.O. Box 113, Burgersdorp, C.P.
Campbell, A. R., P.O. Box 584, Johannesburg.
Clinton, J. S., P.O. Box 4648, Johannesburg.
Coulthard, R. D., c/o W. H. Walsh, 171 Trematon Drive, Durban, Natal.
Conradie, D. J. R., P.O. Box 18, Ficksburg, O.F.S.
Dalton, G. A., 111 Eckstein Street, Observatory Extension, Johannesburg, Tvl.
Dawson, C., Electricity Supply Commission, P.O. Box 2408, Durban.
Ewer, Col. G. G., 174 Edmonds Road, Durban, Natal.
Foley, C. B., c/o Electrical Engineer, P.O. Box 35, Vereeniging, Tvl.
Fainsinger, G. S., Assistant Electrical Engineer, P.O. Box 59, Windhoek, S.W.A.
Gyles, J. H., P.O. Gilletts, Natal.
Harvey, A. Q., c/o A.E.G. Engineering, Ltd., P.O. Box 4554, Johannesburg.
Heasman, G. G., P.O. Box 77, Fort Victoria, S.R.
Lloyd, R. K., Poste Restante, Dar es Salaam, Tanganyika.
Lutsch, W. J. F. S., c/o Faculty of Engineering, University of Stellenbosch, C.P.
Mail, W. Mortimer, P.O. Box 164, Kokstad, E.G.
Marchand, B., P.O. Box 223, Witbank, Tvl.
McIntyre, H. A., Assistant Electrical Engineer, P.O. Box 35, Vereeniging, Tvl.
Mercier, G., P.O. Box 377, Salisbury, S.R.
Milton, W. H., P.O. Box 1091, Johannesburg.
Mole, E. W., P.O. Box 428, Port Elizabeth.
Muller, H. M. S., Engineer, Kakamas, C.P.
Powell, W. N., P.O. Box 1386, Johannesburg.
Phillips, J. W., P.O. Box 592, Bulawayo, S.R.
Simpson, H. G., Engineering Department, Searles Ltd., Great Brak River, C.P.
Theron, G. C., P.O. Box 1, Vanderbijl Park, Transvaal.
Tubb, B. H. T., P.O. Box 1699, Salisbury, S.R.
West, J. A., "Edgerton," P.O. Box 24, St. Michael's, South Coast, Natal.
Wright, G. R. E., P.O. Box 465, Benoni, Tvl.
Williams, J. T., c/o S.A. Bureau of Standards, Private Bag 191, Pretoria, Tvl.

AGENDA AND PROGRAMME

Twenty-Fifth Convention held in the Sea Point Town Hall, Cape Town from 8th to 11th May, 1951

AGENDA

1. Election of President.
2. Retiring President's Valedictory Address.
3. Presidential Address.
4. Annual Report of Secretary and Treasurer.
5. Venue of next Convention.
6. Election of Officers:—
   (*a*) Vice-President.
   (*b*) Executive Committee.
   (*c*) Sub-Committees and Representatives.
7. Reports of Sub-Committees and Representatives:—
   (i) World Power Conference.
   (ii) Electrical Wiremen's Registration Board.
   (iii) Registration of Electrical Wiring Contractors.
   (iv) S.A. Bureau of Standards—Safety Codes and other Committees.
   (v) Safety Precautions Committee.
   (vi) S.A. Standards Institution.
   (vii) International Conference on Large Electrical Networks (C.I.G.R.E.).
   (viii) Import Control.
   (ix) Coal Supplies.
8. Right of Supply—Electricity Supply Commission.
9. Papers for next Convention.
10. Auditors—Appointment of.
11. Amendments to Rules and Constitution.
12. Expenses Executive Council Members when attending Executive Meetings.
13. General.

RETIRING OFFICERS

President: C. R. HALLÉ, Pietermaritzburg.

Vice-President: J. C. DOWNEY, Springs.

Past-Presidents: A. FODEN, East London; D. A. BRADLEY, Port Elizabeth.

Councillor Members: One representative each of Pietermaritzburg, Springs, Krugersdorp, Durban, Bloemfontein, Cape Town, Bulawayo and Johannesburg.

Engineer Members: C. KINSMAN, Durban; G. J. MULLER, Bloemfontein; H. A. EASTMAN, Cape Town; J. C. FRASER, Johannesburg; A. R. SIBSON, Bulawayo; J. L. VAN DER WALT, Krugersdorp.

MEMBERS OF SUB-COMMITTEES AND REPRESENTATIVES

Sub-Committees:—

S.A. Standards Institution: J. C. DOWNEY. Alternate: D. J. HUGO.

S.A. Bureau of Standards: Safety Codes and other Committees: J. L. VAN DER WALT. Alternate: J. C. DOWNEY.

Safety Precautions: J. C. DOWNEY. Alternate: J. C. FRASER.

Representatives:—

World Power Conference (Local Comittee): H. A. EASTMAN.

Electrical Wiremen's Registration Board: J. C. FRASER.

Registration of Electrical Wiring Contractors: J. C. FRASER.

Coal Supplies: H. A. EASTMAN (Convener), A. FODEN, D. A. BRADLEY, G. J. MULLER.

C.I.G.R.E.: J. C. FRASER. Alternate: A. FODEN.

Import Control: J. C. FRASER, D. J. HUGO, J. C. DOWNEY. Alternates: H. A. EASTMAN, C. KINSMAN, G. J. MULLER.

PROGRAMME

Monday, 7th May, 1951

9.00 a.m. Meeting of Executive Council, Arthur's Seat Hotel, Sea Point.

Tuesday, 8th May, 1951

9.00 a.m. Registration, Issue of Papers, etc.

10.00 a.m. Official Opening of the Convention by His Worship the Mayor of Cape Town, Councillor C. O. Booth, J.P.

10.30 a.m. Refreshment interval.

11.00 a.m. Annual General Meeting: Annual Report of Secretary, Treasurer, Election of Officers, etc.

12.30 p.m. Luncheon adjournment.

2.30 p.m. Convention resumes. Presidential Address. Reports of Sub-Committees, etc.

4.00 p.m. Refreshment interval.

4.30 p.m. Assemble for official photograph.

5.15 p.m. Civic Cocktail Party at City Hall.

Wednesday, 9th May, 1951

8.30 a.m. Meeting of Executive Council.

9.30 a.m. Convention resumes: Business matters.

10.30 a.m. Refreshment Interval

11.00 a.m. Paper by A. C. T. Frantz, B.Sc., A.M.I.E.E., A.M.I.Mech.E., Chief Technical Officer, Cape Town Electricity Department: "Economics in the Electricity Supply Industry."

12.30 p.m. Luncheon adjournment.

2.30 p.m. Paper by E. L. Smith, M.(S.A.)I.E.E., A.M.I.E.E. Electrical Engineer, Boksburg.

4.00 p.m. Refreshment interval.

5.00 p.m. Convention adjourns.

8.00 p.m. Cinema Party.

Thursday, 10th May, 1951

8.15 a.m. Meeting of Executive Council.

9.00 a.m. Leave for Stellenbosch.

10.30 a.m. Welcome by His Worship the Mayor of Stellenbosch.

10.45 a.m. Refreshment interval.

11.15 a.m. Discussion on Papers and other business.

12.30 p.m. Luncheon adjournment.

2.30 p.m. Return to Cape Town via Sir Lowry's and Fransch Hoek Passes.

Friday, 11th May, 1951

8.30 a.m. Meeting of Executive Council.

9.30 a.m. Convention resumes: Discussion on Papers and other business.

10.30 a.m. Refreshment interval.

11.00 a.m. Convention resumes.

12.30 p.m. Convention closes; business completed.

LADIES' PROGRAMME

Tuesday, 8th May, 1951

10.00 a.m. Assemble for Official Opening of Convention.

4.00 p.m. Assemble for official photograph.

5.15 p.m. Civic Cocktail Party at City Hall.

Wednesday, 9th May, 1951

10.00 a.m. Demonstration of Cookery—Electricity House.

2.30 p.m. Trip round Mountain: Sea Point, Camps Bay, Hout Bay and Chapman's Peak.

4.15 p.m. Tea and refreshments at Muizenberg.

4.45 p.m. Return to Sea Point.

8.00 p.m. Cinema Party.

Thursday, 10th May, 1951

All-day trip to Stellenbosch. While Convention is in progress, a visit may be arranged to the Jonkershoek Fish Hatcheries.

Friday, 11th May, 1951

10.00 a.m. Trip to Kirstenbosch Botanical Gardens for tea.

J. C. DOWNEY, SPRINGS

President, 1951-1952

THE ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA

Proceedings of the Twenty-Fifth Convention, 1951

The Twenty-Fifth Convention of the Association was opened in the Sea Point Town Hall, by His Worship the Mayor of Cape Town (Councillor C. O. Booth, J.P.) at 10 a.m. on Tuesday, 8th May, 1951.

Representatives of 67 Councils attended the Convention, including 45 Councillor Members, 66 Engineer Members and Engineers representing Municipalities, 2 Honorary Members, 8 Associates, 18 Delegates or Representatives of Government Departments, other Supply Authorities, etc., 68 Trade Representatives, 75 Ladies and 10 other visitors—a total of 292.

CIVIC WELCOME

PRESIDENT (Mr. C. R. Hallé, Pietermaritzburg):

Ladies and Gentlemen: It gives me great pleasure to ask His Worship the Mayor, of Cape Town to open this our Twenty-Fifth Annual Convention.

HIS WORSHIP THE MAYOR OF CAPE TOWN (Councillor C. O. Booth, J.P.):

Mr. President, Ladies and Gentlemen: It gives me great pleasure as Mayor of the City of Cape Town to welcome all you delegates here today. I am sure you have brought good weather with you. We have been having rather bad weather during the last few days, but I think from now on we are going to have something good, and I hope so for your sakes.

Mr. President, you have here today the official delegates, engineers and council members, you have also got representatives of Government departments, representatives of the Electricity Supply Commission of South Africa and of the Electricity Supply Commission of Southern Rhodesia, associates and visitors. I wish to extend a hearty welcome to all those different bodies that are represented here today, and I would also like to make especially welcome Mr. J. C. Downey and Mrs. Downey of Springs because this will be the first occasion on which the President is not to be the Electrical Engineer of the centre in which the Convention is being held. I understand that this is being done in recognition of the hard work put in by Mr. Downey on behalf of the Association and because he has for many years been a very valuable member of your executive. I wish him and his good lady every success during their term of office.

Mr. President, this is the third Convention to be held in Cape Town. The last was held in 1938, before the last great war, and then tradition was broken by the election as President of Mr. Horace Eastman, who was not the City Electrical Engineer in those days; the late Mr. George Swingler was then our City Electrical Engineer. Is Mr. Eastman here? He is. Well, I would like to bid him a very hearty welcome, knowing the work that Mr. Eastman has done, not only for your Association but also for the City of Cape Town in building up this great structure which we have here where we can give the cheapest electricity in the world. I think a lot is due to Mr. Eastman.

On making enquiries—I may say I have just been away on a Conference and I had to get all the information I could within a few minutes—I got some particulars of electricity undertakings and the way that they have grown since you first started your conventions 35 years ago. The figures are very interesting. The number of units sold by Municipal Electrical Undertakings in 1916 was 74,000,000; in 1948–49 it was 2,408,000,000, over 30 times the 1916 figure. The number of consumers was 53,000 in 1916 and in 1948 it was 445,000. I understand that the membership of your Association in that time has grown from 15 to 225, which shows the strides that you are making and the interest being taken in your work.

I would like to just give you a few points on how Cape Town has grown. Over the same period the population of this City increased from 167,000 to 415,000 but

today I think you will find Cape Town has a population of over 450,000. Well, that is a very big improvement. Electricity consumers in Cape Town have increased from 8,306 to 72,306; the units sold were over 13,000,000 in 1916, and 476,000,000 in 1948, which is 36 times as much. I can go back possibly a little further than that. I can remember, when Claremont, Cape, was a municipality, in 1907 you paid 1s. 3d. a unit for electricity. That was the second highest in the world. I remember there was a place in China that was higher.

Since the Convention was last held in this city, great developments have taken place. The city is expanding in all directions, industrial areas are being opened up and new housing schemes are providing for the growing population. Of course the most outstanding development in Cape Town has occurred on its foreshore. A large area has been reclaimed from the sea, following upon the completion of the Duncan Dock, and already plans are being considered and approved for extending the city into this area. The roads are already going ahead, and so is the drainage. The Foreshore Board, comprising representatives of the Government and the Council, has been established to control the development of the foreshore. The main celebrations in connection with the Jan van Riebeeck Tercentenary are going to be held on the foreshore and a lot of work will be done in preparing the reclaimed ground for this event. Cape Town is going to go gay for two or three months during that time and I am sure that any of you who can reach Cape Town during the celebrations will enjoy yourselves to the full.

Other towns in the Union have developed in the same way with the growth of industry and commerce, population and the providing of amenities. I may say that in Cape Town whilst we have our natural amenities, we as councillors are trying with all our power to provide further amenities for the people, but unfortunately our ratepayers turn us down every time. We had a poll the other day, and only two per cent of the ratepayers voted. This was a loan programme, so you can see the interest the ratepayers take in the work of the city.

The fact that electricity supply is taken so much for granted these days is a credit to the electricity undertakings in that it shows how efficiently these undertakings are being managed. In all phases of human activity from getting up in the morning to going to bed at night, in one's travels, at work, everywhere the service of electricity plays its part. Without this service, civilisation would literally return to the dark ages. It makes one appreciate how great the responsibility is for those who are in control of our electricity undertakings. In these days, when it is difficult to obtain electrical plant and equipment, the cost of which is also increasing, it is no mean task to maintain supplies of electricity and when in addition it becomes necessary to consider load shedding the municipal electrical engineer's lot is certainly not a happy one. All the more emphasis, therefore, must be placed on maintaining existing plant in first-class running condition and retaining it for as long as possible. Also conditions such as these accentuate the need to conserve financial resources and ensure that adequate reserves are built up to provide for betterment and development in such a way as to avoid recurring annual charges related to the present day exorbitant cost of plant and materials.

I think this will interest the electrical engineers. These are times when the policy of city councils should be such as to ensure that electricity undertakings retain their financial surpluses to build up reserves rather then exploit for the relief of rates. (Applause.) Many of the problems now confronting municipal electrical engineers will be discussed at this Convention, as has been done at previous Conventions. Benefit will be derived from papers that will be read as well as from discussions on matters of mutual interest.

Ladies and gentlemen, I always feel that these conferences are not worth while unless papers are read. I have been to so many conferences, and I find that the papers are read in the ordinary way and individuals ask questions at random. I think the group system is a far better method of attack. The paper is studied and discussed by a group and the group leader puts the questions to the author. In this way you get down to all the fundamentals in the paper and the questions asked are not merely shot at some young man who has just read the paper. I remember going to

Front Row: L. to R.—Mrs. H. J. Seymour, Edenvale; C. Kinsman, Durban; Cr. L. P. Davies, Springs; Cr. C. E. K. Young, Pietermaritzburg; Cr. Maj. Pannall, Krugersdorp; J. L. van der Walt, Krugersdorp; J. C. Fraser, Johannesburg; C. R. Hallé, Pietermaritzburg; J. C. Downey (*President*), Springs; A. R. Sibson, Bulawayo; Cr. C. M. Newman, Bulawayo; D. A. Bradley, Port Elizabeth; A. Foden, East London; D. J. Hugo, Pretoria; C. G. Downie, Cape Town; A. T. Taylor (*Secretary*), Johannesburg.

Second Row: L. to R.—Mrs. C. J. Fourie, Potchefstroom; Mrs. M. M. Best, Cape Town; Miss Y. M. Grant, Cape Town; Mrs. H. D. T. Harris, Johannesburg; Mrs. A. R. Campbell, Johannesburg; Mrs. J. C. Fraser, Johannesburg; Mrs. R. J. Bates, Port Elizabeth; Mrs. C. Kinsman, Durban; Mrs. J. C. Downey, Springs; Mrs. D. A. Bradley, Port Elizabeth; Mrs. C. M. Newman, Bulawayo; Mrs. H. A. Eastman, Cape Town; Mrs. A. Rodwell, Johannesburg; A. Rodwell, Johannesburg; Mrs. A. T. Taylor, Johannesburg.

Third Row: L. to R.—Cr. C. J. Fourie, Potchefstroom; J. E. Stone, Salisbury; Cr. C. Olley, Salisbury; Mrs. D. R. Verschoor, Vrede; Mrs. L. G. Axe, Johannesburg; Mrs. N. R. Yorke, Cape Town; Mrs. R. Tarran, Benoni; Mrs. P. L. Vergottini, Brakpan; Mrs. C. R. Sprighton, Standerton.

Fourth Row: L. to R.—Cr. P. J. Raubenheimer, Potchefstroom; A. R. Campbell, Johannesburg; A. L. Sanders, Johannesburg; A. K. Tait, Cape Town; R. T. Park, Johannesburg; W. M. Andrew, King William's Town; W. Rush, Vryheid; J. C. Callie, Johannesburg; Cr. M. Jaffray, Salisbury; J. E. Mitchell, Salisbury; J. S. McGill, Cape Town; W. Herd, Johannesburg; . . . . . ; Cr. J. H. De Bruin, Boksburg; E. L. Smith, Boksburg; D. R. Verschoor, Vrede; R. Tarran, Benoni; G. Roeske, Johannesburg; P. L. Vergottini, Brakpan; C. E. Gregor, Alberton.; . . . . . .

Fifth Row: L. to R.— . . . . . ; J. C. Royce, Johannesburg; F. H. Tyler, Johannesburg; J. A. F. Mitchell, Johannesburg; D. v. S. Dreyer, Brandfort; J. W. Swardt, Pretoria; J. M. Magowan, Salisbury; B. T. Janas, Nigel; Cr. N. C. Korsman, Benoni; P. H. Newcombe, George; G. E. H. Jones, Mafeking; H. A. Eastman, Cape Town; H. Bahr, Ventersdorp; L. G. Axe, Johannesburg; N. R. Yorke, Cape Town; J. T. Williams, Johannesburg; J. A. Matthews, Uitenhage; Cr. H. J. Ofsowitz, Uitenhage; C. R. Sprighton, Standerton.

Sixth Row: L. to R.—A. W. Allen, Cape Town; W. N. Randall, Johannesburg; J. S. Craig, Greytown; J. R. Cherry, Randfontein; P. C. Asselbergs, Barberton; Mrs. P. C. Asselbergs, Barberton; Cr. J. G. P. Sinclair, The Strand; C. Sims, The Strand; . . . . . ; R. J. Bates, Port Elizabeth; J. M. Georgala, Cape Town; G. R. Usher, Port Elizabeth; K. Lewis, Cape Town; Sir George Usher, Johannesburg; . . . . . ; J. Iverach, Grahamstown, J. F. Lategan, Heidelberg; W. G. Thackwray, Kokstad; C. H. Adams, Oudtshoorn; J. W. du Toit, Stellenbosch; C. E. Scott, Cape Town; Cr. B. S. Gericke, Brakpan.

Seventh Row: L. to R.— . . . . . ; . . . . . ; D. J. R. Conradie, Ficksburg; H. J. Seymour, Edenvale; R. W. Barton, Welkom; R. C. Jordan, Johannesburg; Cr. C. P. du Toit, Vrede; Cr. W. F. du Plessis, Bloemfontein; C. Lombard, Bloemfontein; E. R. J. Smith, Johannesburg; Mrs. C. Fletterman, Ladybrand; C. Fletterman, Ladybrand; P. D. Kruyt, Allanridge; A. F. Turnbull, Vereeniging; . . . . . ; V. E. Williams, Windhoek; H. M. Rochester, Johannesburg; W. H. Schrages, Cape Town; J. D. Hattingh, Bothaville; E. V. Perrow, Johannesburg; Mrs. E. V. Perrow, Johannesburg; H. M. S. Muller, Kakamas.

Eighth Row: L. to R.—W. I. Tarleton, Cape Town; G. D. Davidson, Cape Town; W. H. Milton, Johannesburg; J. Rodgers, Fort Beaufort; A. E. O'Dowd, Johannesburg; E. G. Ivey, Cape Town; J. J. Mills, Cape Town; H. D. T. Harris, Johannesburg; . . . . . ; N. Gold, Cape Town; S. G. Mortimer, Cape Town; . . . . . ; A. C. Grant, Johannesburg; T. D. Pratt, Johannesburg; Cr. J. J. Reynders, Bothaville; N. Ferreira, Odendaalsrus; Mrs. W. Rossler, Kroonstad; W. Rossler, Kroonstad.

Ninth Row: L. to R.—T. Riley, Johannesburg; . . . . . ; F. D. Opperman, Cape Town; N. Larkin, Cape Town; G. A. Dalton, Johannesburg; F. Stevens, Ladysmith; C. L. de Beer, Johannesburg; . . . . . ; . . . . . ; T. R. Strawson, Johannesburg; Cr. D. J. C. Baxter, Kimberley; P. Bechler, Harrismith; G. H. Robinson, Cape Town; R. Bedford, Cape Town.

Back Row: L. to R.—J. White, Johannesburg; B. Marchand, Witbank; V. A. Bright, Johannesburg; B. S. van der Merwe, Graaff-Reinet; Cr. E. B. Conway, Graaff-Reinet; H. Littlewood, Johannesburg; M. C. Rayner, Cape Town; G. Drewett, Johannesburg; P. H. Conradie, Cape Town; A. C. Tilley, Johannesburg; S. G. Redman, Johannesburg; Cr. F. O. Rapson, Ladysmith; . . . . . ; Cr. D. J. Coetzee, Louis Trichardt; . . . . . ; R. R. Lyall, Nelspruit.

one conference where a young man read a paper—you generally get young men to come out and read these papers—and an older man who had been his chief, tackled him on certain things and made this fellow look very small. I think that is the wrong attitude altogether. I see a gentleman here from Salisbury. Well, that young man is now curator of Salisbury parks. The greater benefit derived from conventions of this nature comes from personal contacts which are made with others engaged in the common task of furthering the objects of the Association.

Now, ladies and gentlemen, you don't want to hear long speeches. I wish to welcome you again; I declare your Conference open and wish you every success in your deliberations.

PRESIDENT (Mr. C. R. Hallé, Pietermaritzburg):

Your Worship, on behalf of everyone present I wish to thank you very much indeed for your very fine opening address. I may say we always find it most refreshing to be told by some worthy mayor how really wonderful we are. I think that is the only time we ever suspect it. I think we are all very grateful for your invitation to visit this beautiful city. At every previous Conference in Cape Town we have enjoyed ourselves immensely. We not only look on you as a mother city, but almost as the grandmother city, and we find it very difficult to come here and teach you how to suck eggs.

I can assure you that we appreciate everything that you have said and thank you again for coming here and opening this Convention personally.

OBITUARY

I have to get on to a more serious note. Since our last Convention in Pietermaritzburg we have lost three of our members, I have to refer to the passing on of Mr. D. W. Ritson, late Electrical Engineer of Stellenbosch; Messrs. G. A. Stewart and W. Houreld, Associates. To the memory of these men who have done their fair share towards the success of our Association, I would ask you to stand for a minute.

HONORARY MEMBERSHIP: MR. H. A. EASTMAN

Ladies and Gentlemen: We have another ceremony to perform and that is to confer honorary membership of this Association on one of our members and I am going to call on Mr. Bradley to propose the member.

MR. D. A. BRADLEY, Port Elizabeth:

Mr. President, Ladies and Gentlemen: It is my privilege this morning to submit to this Convention the name of Mr. Eastman to be added to our very valued list of Honorary Members of this Association. Mr. Eastman's work, indeed his great work on behalf of this Association, could never be adequately described by me—it is so voluminous and of such value that I doubt if anyone could possibly find words to suitably express our appreciation of that wonderful service given through the years. I understand it is a matter of 30 years since Mr. Eastman first became associated with this Association. Although this is only our twenty-fifth Convention Mr. Eastman, of course, was in office during the years when Conventions were held at longer intervals, and that is how it comes about that we have members who are older in years' service and membership than the actual number of Conventions. Mr. Eastman's services, not only to this Association, but shall I say to the Union of South Africa, stand in a very high order. Mr. Eastman would rank as the premier Electrical Engineer of all the Municipal Undertakings in the Union, and it is, Sir, with those remarks, which I know are totally inadequate, that I submit to this Convention the recommendation from the Executive that Mr. Eastman's name be added to the list of Honorary Members of this Association.

It is my pleasure, Mr. Eastman, Sir, to offer you on behalf of the Association, our gratitude for work well done, and with extreme pleasure; we know that after completing such an arduous and worthy task throughout the years, you are now able to go into retirement physically fit to enjoy every minute that may come to you.

Your worthy Mayor has just said that you are a young man. Well, Sir, you look it, and we do hope and extend to you and

Mrs. Eastman every good wish for all the success and happiness, particularly health abounding, in the coming years, and may they be many in number.

Before I conclude, Sir, I would just like to express a word of praise to Mrs. Eastman. Most of us know that if the lady does not pull along with you your difficulties are increased considerably, and Mrs. Eastman has been such a charming lady at all our Association's affairs and functions that it is now my privilege to offer to her our sincere thanks, and we trust that she, with her good husband, will enjoy many many years of happy retirement.

With those remarks, Sir, I now put it to the Convention that Mr. Eastman's name be included in the list of Honorary Members of this Association.

PRESIDENT (Mr. C. R. Hallé):

I take it that this is an unopposed motion, and there is no need for a seconder. I have great pleasure in declaring Mr. Eastman an Honorary Member of this Association, which honour he richly deserves and we all grant him with our fullest hearts.

Mr. H. A. EASTMAN, Cape Town:

Mr Mayor, Mr. President, Mr. Bradley, Ladies and Gentlemen: I thank you very sincerely for this very high honour that you have conferred on me. I appreciate it very greatly, more greatly than I can adequately tell you. But I do want you to know that what I have done—as best I could do it—in the interest of the Association, has been done out of a sense of duty to the Association of which I have been a member for so long and out of a sense of duty also to the trust that you have put in me in electing me to carry out the work of various offices and functions at a time when, for various reasons, others were not available to do it; and also, may I add, through my being imbued all the time with the need, in my opinion, for consumers of electricity to have always an active interest in the service on which they are so dependent for the amenities of civilised life. I think that feeling is shared by other municipal electrical engineers, namely, that if consumers of electricity can exercise an active interest in electricity matters it is all to the good of the Undertaking and for the service which we render them. This I believe is best achieved by electricity Undertakings being owned by municipalities in this country. Municipal Undertakings took the lead in giving supplies to individuals and they continue to set the pace. Indeed, the very large undertakings came into operation in this country only for the purpose of supplying power for mining purposes and heavy industries, and in the first place except for them there were no supplies of electricity other than those given by the municipalities. Conditions have changed, but we still have as the fundamental principle of the Constitution of this Association that the interests of consumers are best served through municipal ownership of the undertakings which provide them with the essentials of life. I commend that thought to you, Mr. President, and Gentlemen, on my retirement. In conclusion I thank Mr. Bradley for his kind reference to my wife; I appreciate his remarks very much, and so does she.

PRESIDENT (Mr. C. R. Hallé):

Your Worship, Ladies and Gentlemen: We will now adjourn for tea, and start the serious business afterwards.

PRESIDENT (Mr. C. R. Hallé):

Ladies and Gentlemen: We will now proceed with the business. The next item is the Annual Report which I will ask the Secretary to read.

ANNUAL REPORT

March, 1951.

To the President and Members of the Association.

Gentlemen: I have the honour and pleasure of submitting to you the Annual Report, together with the Revenue and Expenditure Account and Balance Sheet. This report is from the 1st September 1949, to the 28th February, 1951, a period of 18 months, the reason being that the financial year end was changed from the end of August to the end of February, in order that the financial position of the Association may be presented to Conventions, which usually take place during the month of May, within a reasonable time after the closing of the financial year.

Obituary:

I regret to have to record the passing on of the following members and the Chief Inspector of Factories:—

Mr. D. W. Ritson, late Electrical Engineer of Stellenbosch, one of the oldest and most popular members, Mr. H. O. Smith, late Chief Inspector of Factories (Engineering) well known to and respected by all those who came in contact with him and whom he at all times, during his years of office, was ready to assist whenever it was possible for him to do so.

Messrs. G. A. Stewart, and W. Houreld, Associates, no doubt remembered by many of the older Engineer Members.

Twenty-Fourth Convention:

The Twenty-Fourth Convention of the Association was held in Pietermaritzburg from Tuesday the 9th May, to Friday the 12th May, 1950, inclusive.

The attendance of 263 members, delegates and visitors was accounted for; this number was undoubtedly exceeded, but unfortunately quite a few did not sign the Attendance Register.

It is opportune at this stage, to express the appreciation and sincere thanks of the President, members of the Association, delegates and visitors who had the privilege of attending the Convention, to His Worship the Mayor and the City Council of Pietermaritzburg for the splendid entertainment and facilities provided and to those officials who assisted in making the business portion of the Convention an undoubted success and our stay in Pietermaritzburg most enjoyable, and last but not least to those engineering firms who so generously entertained us and afforded opportunities of visiting their factories which was acclaimed to be most interesting and educating.

Papers:

In all four papers were presented:—

"Aspect of the Law Relating to Electricity as it Affects Local Authorities" by Mr. A. P. Burger, Legal Assistant to the Town Council of Springs.

"Automatic Protection of Diesel Power Plants" by Mr. P. C. Asselbergs, Town and Electrical Engineer, Municipality of Barberton.

"The Engineer in the Office" by Mr. F. G. McDonald, Assistant City Electrical Engineer and Transport Manager, City Council of Pietermaritzburg.

"The Use of Cut-Off Lanterns for Street Lighting" by Mr. G. C. Theron, Electrical Engineer, Vanderbijl Park.

By the time this report reaches members and visitors the Proceedings of the Convention will have been in their hands for some considerable time. It should therefore suffice for me to refer to the Proceedings wherein the discussions which took place and comments made at the Convention and communicated, are recorded and reveal the interest taken in the papers.

1951 Convention:

The City Council of Cape Town invited the Association to hold its next Convention, the Twenty-Fifth, in Cape Town during the month of May, 1951, which was unanimously accepted at the Pietermaritzburg Convention in May, 1950.

Membership:

The following new members were elected during the period under review:—

Council Members:

Bethal (Transvaal) and Venterspost (Transvaal).

Engineer Members:

L. Dreyer, Electrical Engineer, Venterspost.

F. P. W. Hall, Electrical Engineer, Somerset West.

B. T. Janas, Electrical Engineer, Nigel.

A. F. Turnbull, Electrical Engineer, Vereeniging.

F. J. Coetzee, Electrical Engineer, Komgha.

J. G. F. Erikson, Electrical Engineer, Estcourt.

D. S. van der Merwe, Electrical Engineer, Graaff-Reinet.

The comparative figures of membership for the years 1949 and 1950–51 are as follows:—

	1949	1950–51
Council Members ...	95	97
Engineer Members ...	95	92
Honorary Members ...	3	4
Associates	29	24

Financial:

It is pleasing to note from the Balance Sheet that income for the period under review exceeded expenditure and that the general financial position of the Association is sound.

I wish to take this opportunity of thanking the Council Members and Advertisers, on behalf of the Executive Council and Members, for their financial support and continued keen interest shown in the Association's welfare.

In conclusion, my thanks are due to the President and Members of the Executive Council for the advice, assistance and courtesy at all times extended to me.

I remain,

Mr. President and Gentlemen,

Yours faithfully,

A. T. Taylor,

Secretary and Treasurer.

PRESIDENT (Mr. C. R. Hallé):

Thank you, Mr. Taylor. Gentlemen, you have the Report before you, and the Balance Sheet. Will somebody move the acceptance, if there are no comments.

Mr. F. STEVENS, Ladysmith:

I move the acceptance of the Report and Balance Sheet.

Mr. E. L. BUCHANAN, Louis Trichardt:

I second the motion.

PRESIDENT (Mr. C. R. Hallé):

The acceptance of the Report and Financial Statements has been moved and seconded. Is that agreed, or are there any comments?

AGREED.

ELECTION OF PRESIDENT

PRESIDENT (Mr. C. R. Hallé):

Well, Gentlemen, we now come to the election of officers, and the first office is that of President and I call for nominations for President for the ensuing year.

Councillor Major J. W. O. BILLINGHAM, Cape Town:

I have great pleasure in proposing as President of this Association for the ensuing year Mr. J. C. Downey, Town Electrical Engineer, Municipality of Springs.

Mr. J. C. FRASER, Johannesburg:

Mr. President: It is my privilege and honour to second the motion. I have known Mr. Downey for a number of years. At one time he was a colleague of mine in the Electricity Department at Johannesburg, and later on he decided to go to Springs. Since he has been at Springs I have taken a very keen interest in his activities, and apart from the fact that he will insist on making Johannesburg a suburb of Springs, he is doing very well. I do not want to sing his praises in regard to the work he has done for this Association. His Worship the Mayor has already done that this morning, but I want to assure members that Mr. Downey has given a great deal of his time to this Association and we could do no better than honour him with the post of President. I have great pleasure in recommending him to you as your President for the year 1951—52.

PRESIDENT (Mr. C. R. Hallé):

Gentlemen: Are there any further nominations? There being no other nominations, I declare Mr. J. C. Downey of Springs duly elected as President for the current year.

Mr. Downey, I have great pleasure in investing you with the badge of office of President which you very well deserve and I wish you all the best for a happy and successful year.

PRESIDENT (Mr. J. C. Downey, Springs):

Mr. Hallé, Ladies and Gentlemen: I appreciate the honour you have conferred on me this morning in electing me as your President for the year 1951—52. I do not propose to say much at the moment because I think you will have had about enough of me by the time this Convention is over. I trust you will give me your support and help, and I will do my best to carry out the duties of this Association in the best traditions of the worthy Past Presidents who have gone before me. Thank you.

VENUE OF NEXT CONVENTION

We will now proceed with the next item on the Agenda, gentlemen, Item 5. "Venue of next Convention".

Councillor G. M. NEWMAN, Bulawayo:

Mr. President and Gentlemen: I would like to put forward a suggestion that your next Convention should be held in the city of Bulawayo, Southern Rhodesia, and I am authorised by the City Council to extend that invitation to this Convention. In doing so I would like to point out that you will be visiting an area which to many of you will be new, and you will be seeing a city the growth of which has been phenomenal. In the last 18–19 years we have grown from 25,000 of all races to well over 80,000.

Now, sir, I do suggest that in addition to the desire of the City Council of Bulawayo to afford you their hospitality, the engineer no less than the councillor delegates will find much of surpassing interest in Bulawayo. To mention one thing only, we have an electrical installation which, if its growth goes on, bids fair to become one of the foremost in Southern Africa. In 25 years we have jumped from a consumption of less than 1,000,000 units in a year to a consumption this year of 140,000,000. You will see the immense amount of construction going on, and it would be of interest to everybody. Our plant installed when we took it over from the concessionaires was 600 kilowatts. As at present installed and operated it is 43,500 kilowatts. New plant is now being installed which will bring the operation up to 80,000 kilowatts, and we have further authority to bring it up to 118,000. I don't think I need say any more. I will say this, that from the Convention's point of view there will be something useful to see.

I do not need to enlarge on Rhodesian hospitality, but merely ask, sir, that this Convention will give us a chance of showing what we can do.

PRESIDENT:

Thank you, Councillor Newman. I take it, gentlemen, by your applause, you accept the invitation of Bulawayo for the 1952 Convention to be held there. Is that agreed, gentlemen?

AGREED unanimously.

ELECTION OF VICE-PRESIDENT

PRESIDENT:

Now comes the election of Vice-President.

Mr. C. G. DOWNIE, Cape Town:

Mr. President, Ladies and Gentlemen: It gives me very great pleasure, because I happen to have been born and brought up and educated in the country that he is now serving so well, to propose Mr. A. R. Sibson, City Electrical Engineer of Bulawayo as the Vice-President of our Association.

Mr. A. FODEN, East London:

Mr. President, Ladies and Gentlemen: I have known Mr. Sibson for many years indeed, and I can assure you that he has done yeoman service for our Association. He is one of the backroom boys, but nevertheless he has done, as I said earlier, yeoman service, and it gives me very great pleasure indeed to second the proposition.

PRESIDENT:

Any further nominations, gentlemen? There being no further nominations, I declare Mr. Sibson elected Vice-President of your Association for the year 1951–52.

Mr. A. R. SIBSON, Bulawayo:

Mr. Downie, Mr. President, Ladies and Gentlemen: I am very deeply concious of the honour you have done to me this morning. I cannot claim, as my proposer and seconder have suggested, to have made much of a mark as yet in the deliberations of your Conferences, but I do hope to have the opportunity of doing so. I certainly shall do all that I can to further the interests of the Association during this year and I trust that the opportunities will be made available to one who is, perhaps, somewhat divorced from the matters that interest many of you, certainly those involving the laws under which you operate. Nevertheless, sometimes the outsider can see something of the game and now and then make a few suggestions as to how it should be played. Thank you, Mr. President.

ELECTION OF EXECUTIVE COUNCIL

PRESIDENT:

We now come to the election of the Executive Council. The retiring members are Messrs. Foden, Kinsman, Muller, Fraser, van der Walt and Mr. C. G. Downie, who was co-opted in place of Mr. Eastman on his retirement. We require to elect six engineer members, and their councillor members will then automatically become

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA
BALANCE SHEET, 28th FEBRUARY, 1951

Accumulated Funds				£2,261	14 7
Balance at 31st August, 1949 ...	£1,654	4	0		
Add: Excess of Income over Expenditure for year ended 31st August, 1950	381	14	1		
Excess of Income over Expenditure for six months ended 28th February, 1951	225	16	6		
Creditors				4	5 11
Subscriptions in Advance	2	2	0		
Petty Cash	2	3	11		
C. R. HALLÉ, Chairman.					
A. T. TAYLOR, Secretary.					
				£2,266	0 6

Presidential Badge ... ... Nominal Valuation.			1 0 0
Furniture and Fittings ... ... At Cost less Depreciation.			78 17 6
Investments ... ... United Building Society. Fixed Deposit including interest accrued.			2,054 13 2
Debtors			21 4 0
Cash ... ... At Barclays Bank (D.C. & O.)			110 5 10
			£2,266 0 6

To the Members of the Association of Municipal Electricity Undertakings of Souther Africa.

We report that we have examined the above balance sheet with the books and vouchers of the Association for the eighteen months ended 28th February, 1951; that we have satisfied ourselves of the existence of the securities; and certify that, in our opinion, the above balance sheet is properly drawn up so as to exhibit a true and correct view of the state of affairs of the Association as at 28th February, 1951, according to the best of our information and the explanations given to us and as shown by the books of the Association.

SAVORY & COMPANY,
Incorporated Accountants,
Auditors.

Johannesburg, 27th March, 1951.

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA
INCOME AND EXPENDITURE ACCOUNT FOR THE PERIOD 1st SEPTEMBER, 1949 TO 28th FEBRUARY, 1951

	For the year ended 31/8/1950	*For the six months ended 28/2/1951*
Audit Fees	£7 7 0	
Bank Charges	10 6 3	3 1 4
Convention Expenses	82 18 2	
Insurance	2 9 0	2 9 0
Printing and Stationery	17 6 4	10 14 0
Postages and Telegrams	19 7 3	12 19 11
Rent	48 0 0	24 0 0
Secretarial Expenses	83 7 0	45 0 6
Salaries	360 0 0	186 15 0
Telephone	9 18 0	4 19 6
Executive Committee Expenses		5 7 6
Subscriptions	5 5 0	
Donation—World Power Conference	10 0 0	10 0 0
B.E.A. Journal		2 1 0
Depreciation	9 2 6	4 3 6
Excess of Income over Expenditure transferred to Accumulated Funds	381 14 1	225 16 6
	£1,047 0 7	537 7 9

	For the year ended 31/8/1950	*For the six months ended 28/2/1951*
Sale of Proceedings	156 15 0	177 15 0
Advertising in Proceedings	352 15 7	344 14 2
	£509 10 7	£522 9 2
Less Cost of Printing Proceedings	420 3 3	480 16 0
	89 7 4	41 13 2
Subscriptions	904 1 0	464 2 0
Interest		
Union Loan Certificates	21 1 1	3 4 10
United Building Society — Fixed Deposit	30 15 2	28 7 9
B.E.A. Journal	1 16 0	
	£1,047 0 7	537 7 9

members of the executive. I now call for nominations for the election of six Executive Members.

Mr. C. KINSMAN, Durban:

Mr. President, at this stage might it not be well that the delegates were notified of the automatic change in the constitution of the executive. Now that Mr. Hallé becomes one of the immediate past presidents, Mr. Foden relinquishes that position and therefore is eligible for nomination to the executive.

PRESIDENT:

Yes, that is the position.

The following members were duly proposed and seconded:—

Mr. P. L. Vergottini, Brakpan
Mr. L. J. van der Walt, Krugersdorp
Mr. A. Foden, East London
Mr. J. C. Fraser, Johannesburg
Mr. C. Kinsman, Durban
Mr. G. J. Muller, Bloemfontein
Mr. J. E. Mitchell, Salisbury
Mr. C. G. Downie, Cape Town
Mr. D. J. Hugo, Pretoria
Mr. F. Stevens, Ladysmith.

Ten nominations having been received for six vacancies, it was necessary for a ballot to be taken, Messrs. W. H. Milton and A. C. T. Frantz acting as scrutineers.

PRESIDENT:

While the scrutineers are busy, gentlemen, we can perhaps deal with sub-committees' reports and I should like to call on Mr. Eastman to give his report on the World Power Conference.

WORLD POWER CONFERENCE

Mr. H. A. EASTMAN, Cape Town:

Mr. President and Gentlemen: I do not think I need read the whole report, but I would like to refer briefly to its contents. The meeting held in London was the first plenary meeting which has been held since the end of World War II. At the meeting it was possible to complete, as far as possible, a survey of the energy resources of the world by means of the papers presented by numerous authors. A plenary meeting of this kind, of course, very naturally becomes a scientific and technical event of first magnitude and whilst it is naturally impossible for our Association, as well as large numbers of other associations, always to be represented at those meetings, it is gratifying to know that South Africa was represented by Mr. A. M. Jacobs, Chairman of the South African National Committee and Chairman of the Electricity Supply Commission and by Mr. G. R. D. Harding, Joint General Manager of the Electricity Supply Commission — Rand Undertaking — and Secretary of the South African National Committee of the World Power Conference, who not only attended on behalf of the Committee, but submitted one of the papers, a paper on the Energy Resources and their Development in South Africa. The complete Proceedings of the whole Conference are printed and published, and will be available during June or July of this year to any of our members, and I can thoroughly recommend from what I have seen of the Proceedings of previous Conferences, that Undertakings obtain those Proceedings because of their unique interest. I can recommend also the Statistical Year Book No. 5 of the World Power Conference as being of particular interest in giving an authoritative inventory of the power resources of the world.

The Proceedings and also the Year Book are obtainable through the Secretary, S.A. National Committee of the World Power Conference, P.O. Box 1091, Johannesburg.

I have pleasure in submitting my report, copies of which have been handed to delegates attending this Conference.

The fourth Plenary Meeting of the World Power Conference was held in London from 10th to 15th July, 1950. The theme of the Conference was "Energy Resources and the Production of Power" and the papers reflect faithful adherence to this subject.

It was attended by Mr. A. M. Jacobs (Chairman) as the official delegate of the Union Government and the South African National Committee was represented by Mr. G. R. D. Harding (Secretary).

The world's energy resources were discussed country by country in one group of papers which give valuable data on the present day position of fuel resources, hydro-electric power, etc., and also indicate new trends in the constant search for improved economy.

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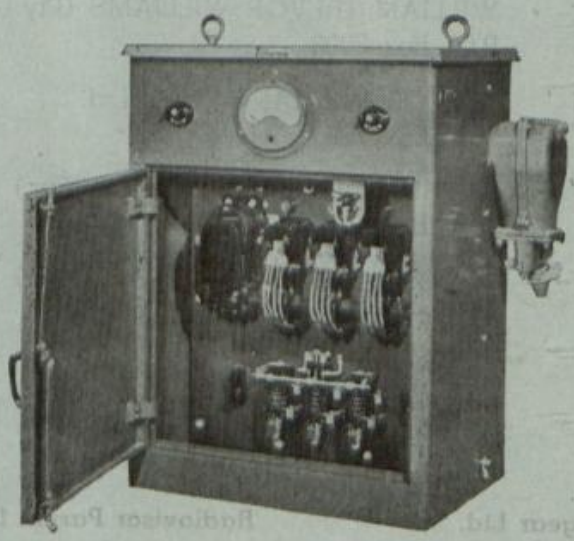

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The following papers were contributed by South African authors:—

Energy Resources and their Development in the Union of South Africa (Harding).

Preparation of Coals of High Ash Content (Meyer).

The Occurence and Exploitation of Oil Shales in South Africa (Stelling and Robertson).

Production of Power in the Union of South Africa (Reay).

Among the papers which dealt with specialised aspects of energy resources and power production four were of unique interest in describing unusual methods of generating and transmitting energy, namely wind power, the production of power by making use of the temperature difference between surface sea water and deep sea water, underground sources of steam for the generation of electricity, and progress in the use of the heat pump.

The Transactions of the Conference comprising five volumes have been printed and are obtainable through the South African National Committee.

The Statistical Year Book No. 5 of the World Power Conference has also just been issued. This contains an authoritative collection of data which in effect forms an inventory of the power resources of the world, and so is of particular interest to those who are interested in the wide aspects of the production of electricity. Copies are obtainable through the S.A. National Committee also.

A Sectional Meeting of the World Power Conference was held at Delhi, India, from 10th to 15th January 1951, on the the theme "The Utilisation of Energy" and dealt particularly with:

(i) The use of electricity in agriculture.

(ii) The co-ordination of the development of industries and the development of power resources.

The fourth Congress of the International Commission on Large Dams was held at Delhi at the same time.

These conferences followed the lines of the Plenary Meeting held in London but no papers from South Africa were submitted to them nor were they attended by delegates from this country.

A Statement of Accounts of the S.A. National Committee of the World Power Conference for the year ended 31st December, 1950, is laid upon the table for the information of members of our Association.

PRESIDENT:

Thank you, Mr. Eastman.

PRESIDENT:

I have pleasure in calling on the retiring President to give his valedictory address.

VALEDICTORY ADDRESS

By

C. R. HALLÉ, M.I.E.E.,

City Electrical Engineer and Transport Manager, Pietermaritzburg.

ELECTRICITY AND ROAD PASSENGER TRANSPORT

First of all I must thank our Secretary and the members of the Executive for all their good work and full support during my year of office.

As you may know I have been in rather a unique position in finding myself, at one and the same time, President of both the Municipal Electricity Undertakings and of the Road Passenger Transport Undertakings of South Africa.

Today affords an opportunity of expressing some views on a subject that really concerns both these bodies, namely, the part I feel that electricity should play in road passenger transport.

During the lives of many of us present here, we have seen the horse tram replaced by the electric tram and then the electric tram replaced by the motor bus.

Speaking both as an electrical engineer and a transport manager I am sorry to see this being taken lying down, so to speak, by the electrical industry.

In the old days of electric trams, public passenger transport Undertakings generally were in a far healthier financial position than are our bus systems of today—the big deficits have come with the motor bus. The failure and replacement of trams was not because trams proved inadequate, but because of the growth of other forms of street traffic.

SOUTH AFRICAN NATIONAL COMMITTEE—WORLD POWER CONFERENCE
RECEIPTS AND PAYMENTS ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1950

PAYMENTS

To	Payment made to World Power Conference—Central Office (London) Maintenance Fund in respect of the year 1950			£50	0 0
,,	Exhange on £20 14 11 only				2 1
,,	Contrbution towards printing costs of four papers written for Fourth World Power Conference ...			45	0 0
,,	Exchange on £45				4 6
,,	Membership Fees Paid—Ordinary Delegates Foutrh World Power Conference			18	0 0
	Dr. A. J. Petrick	£6	0 0		
	Mr. G. G. Robertson	6	0 0		
	Professor W. J. Walker	6	0 0		
,,	Exchange on £18				1 9
				£113	8 4
,,	Excess of Payments over Receipts 1950			£8	18 3
,,	Balance as at 31st December, 1950			86	12 4
				£95	10 7

RECEIPTS

By	**Subscription Received**			£55	0 0
	Electricity Supply Commission ...	£10	0 0		
	South African Railways & Harbours	10	0 0		
	Association of Municipal Electricity Undertakings of Southern Africa	10	0 0		
	Associated Scientific and Technical Societies of South Africa ...	5	0 0		
	Department of Mines	5	0 0		
	S.A. Institution of Engineers ...	5	0 0		
	S.A. Institute of Electrical Engineers	5	0 0		
	Fuel Research Institute	5	0 0		
,,	**Sale Statistical Year Book No. 4** Rand Water Board			2	5 0
,,	**Membership Fees Received—Ordinary Delegates Fourth World Power Conference**			18	0 0
	Dr. A. J. Petrick	£6	0 0		
	Mr. G. G. Robertson	6	0 0		
	Professor W. J. Walker	6	0 0		
,,	Allowance for Statistical Year Book No. 4—unsold copies held on behalf of International Executive Council			29	5 1
,,	Balance being excess of Payments over Receipts ...			8	18 3
				£113	8 4
,,	Balance brought forward from 1949			£95	10 7
				£95	10 7

G. R. D. HARDING,
Secretary.

Johannesburg, 20th March, 1951.

Perhaps the flight from the tram has been too rapid and too complete—on the Continent and in America tramway systems are still used extensively, and are being developed as light railways, sometimes over or under the ground to keep them away from ordinary vehicular traffic.

The trolley bus is a compromise; it keeps the electric virtues of the tram, and it gains some of the flexibility of the motor bus in traffic. Outside of the biggest cities, there has been little enthusiasm shown for trolley buses, probably because of the high capital cost of establishing a route. Yet in America, the home of the motor vehicle, more and more cities are changing over to trolley bus systems, and for fully built up areas, the trolley bus may still prove to be the future choice.

For developing towns, and changing routes, and the sort of conditions we are used to, more flexibility than is given by the trolley bus is usually required, and it is just this one feature—flexibility—which brings that completely independent unit of transport—the motor bus.

(This same extreme flexibility—the complete independence of each bus—makes a motor bus fleet the least suitable for operating a highly co-ordinated service.)

For the sake of this one feature—flexibility—transport managers have to use vehicles which are most costly to maintain and which depend on imported fuel; and they use them along roads where adequate "home-grown" electric power is available in cables and overhead wires—often on both sides of the street. To my mind this is no compliment to human ingenuity.

For some time the only solution of the problem appeared to lie in the improvement and perfection of the electric battery vehicle. Unfortunately this section of our electrical industry has produced no major fundamental development for a very long time, and a battery operated omnibus does not at present seem likely.

I think the problem should be tackled on a new line. It seems to have been overlooked that in urban centres electricity is available at every bus stop, certainly at every bus shelter. Why is it therefore necessary that a bus should do 40-50 miles range on one charge—which is standard for commercial battery vehicles. Why is a battery not available to take in sufficient electrical energy in minutes or fractions of a minute, to propel an eight to ten ton vehicle a few hundred yards?

If this problem could be solved the electric bus would no longer need trolley wires, or trolley poles. At bus stops and bus shelters, while it picked up or let down passengers, the bus would make contact with O.H. or U.G. brushes and pick up sufficient energy to get to its next source of supply.

It is most interesting to note that this system is today in operation in Switzerland, but instead of storing electrical energy in secondary cells, kinetic energy, stored in a two-ton flywheel which runs in hydrogen, is used. Called the gyrobus the vehicle resembles a trolley bus without booms. I quote from the London Passenger Transport Journal's 1951 March issue:

> "It has a three-phase, asynchronous motor taking its power from a flywheel rotating in a horizontal plane. When the bus stops, a motor directly mounted on the flywheel accelerates the flywheel to 3,000 r.p.m. causing it to store energy. The same motor, when disconnected from the supply system and excited by condensers, can function as an alternator and convert the kinetic energy of the flywheel into electrical energy. It is the flywheel, therefore, which provides energy during the journey, while losing speed. After some time, it must be accelerated again to 3,000 r.p.m. According to the length of the journey this takes one to three minutes and may easily be carried out at important stops, especially at the termini.
>
> "The driver, without leaving his seat, has only to operate three vanes mounted on the roof above him which make contact with the overhanging arm of a standard placed at the kerbside and supplying power from the ordinary mains. On a flat road the energy of the flywheel can propel the bus about 3¾ miles at a time; on hilly routes the distance is less.
>
> "The bus seats 30 and has room for 20 standing. The top speed is about 32 m.p.h. and speed is varied by pole-changing on the motor and alternator.

When braking takes place, part of the energy of movement is recovered by the flywheel."

The idea was first tried out on a rail car, where a longer range was found possible. There may be other practical methods of storing the energy required for short runs—by compressed air or even spring pressure—but I am firmly convinced that we electrical engineers are neglecting a vital phase of city life in letting all fields of urban transport depend on imported fuel.

I therefore commend this idea to you, and leave the Presidential Chair with the hope that some day, in this electric age, the term "all electric" will be applied to cities and mean what it says.

PRESIDENT:

Thank you, Mr. Hallé.

Mr. A. FODEN, East London:

Mr. President, Ladies and Gentlemen: We have, I am sure, listened with interest to our Past President's valedictory address. Mr. Hallé has touched upon that very controversial subject, public transport, trams or trolley buses versus internal combustion engined vehicles. As he states, he is in the very unique position of controlling as he does the electricity and transport undertakings and, of course, as such, he can speak with authority on both these subjects. I, for one, am a protagonist of the trolley bus but, in my opinion, the financial aspect should be seriously considered. Mr. Hallé says that the flight *from* the trams has been too rapid. In a young country such as ours, with its long distances between residential districts and its meagre population compared with European and American populations, I am of the opinion that the flight *to* the trams was too rapid as most transport undertakings would, I think, not be showing such large deficits as they do today due to the heavy capital charges of the obsolete tramways systems that these undertakings now have to face. I agree with Mr. Hallé that electric trolley buses use the Union's natural resources, but the heavy capital cost of a new trolley bus system for a sparsely populated and spreading town should be seriously considered. I am of the opinion that the ideal is a compromise, namely the trolley buses for the constantly busy routes and internal combustion engines acting as feeders from the busy routes to the outlying districts, until those districts and routes thereto become more densely populated. The battery vehicle and the gyrobus, which Mr. Hallé mentioned, may possibly become the solution to the transport manager's financial anxieties, particularly bearing in mind the rapid growth of the world's population, the zoning of industrial areas away from residential areas as visualised by town planning legislation and the general improvement in the standard of living.

Let me say at once, Mr. Hallé, that I join you in hoping that the term "electric age" will, in the not too distant future, mean what it says and that we will truly see cities and their inhabitants go "all electric".

Mr. Hallé, thank you very much indeed for your interesting address giving us, as it did, food for thought in not allowing, where circumstances and conditions permit, any other form of power to usurp electric power.

Thank you, also, for what you have done for the Association particularly and for the excellent work you did during your year of office, and I trust that you will look back with many pleasant memories on your year of occupation of the presidential chair.

PRESIDENT:

Thank you, Mr. Foden.

EXECUTIVE MEMBERS

Gentlemen: I have now received the result of the ballot, and have pleasure in announcing that the following members have been elected to the Executive Council for the year 1951–52.

Mr. J. L. van der Walt, Mr. A. Foden, Mr. J. C. Fraser, Mr. C. Kinsman, Mr. C. G. Downie and Mr. D. J. Hugo.

Gentlemen: I would at this stage make it clear that each of the following towns will now be represented on the Executive Council by a Councillor:—

Springs, Bulawayo, Krugersdorp, East London, Johannesburg, Durban, Cape Town and Pretoria.

PRESIDENTIAL ADDRESS

By

J. C. DOWNEY, M.(S.A.)I.E.E.
M.I.Cert.E.

Electrical Engineer, Town Council, Springs.

Gentlemen: It is now my privilege and pleasure to deliver my presidential address.

I am deeply concious of the great honour you have conferred on me in electing me as your President for the year 1951–52.

I value this honour as it is the second occasion on which a tradition has been broken at a Convention in Cape Town. The last time was when you elected the late Mr. Geo. Swingler's assistant to the presidential chair here in 1938. I refer to our well-known friend and the respected retired chief of the Cape Town Undertaking, Mr. H. A. Eastman. Today you have broken tradition again in the Mother City, by electing a President from a potential one other than from that where the convention is being held.

Today electricity is taken for granted. Very few realise it is an industry only 70 years old. Many of us can recall the time when coal gas was the main source of illumination and heating; the steam engine the usual source of power for industrial purposes.

It is not even a lifetime since electricity began to revolutionise industrial production. In the home, one plug in the kitchen for an iron or a kettle was then the peak of luxury. The older engineers present remember how 35 years ago flat irons heated over coal fires, paraffin or primus stoves were in general use. It was a radical who installed the first electric stoves. Today we have them streamlined and automatic.

The old, dark, cramped workshops with flying belts, countershafts and hissing steam engines have gone. Electricity has modernised the factory.

The march of progress has not given merely comfort or convenience, it has stimulated a drive to reduce the consumption of manpower, the means that will bring as its end a fuller, and a sounder economy.

In this country of ours the stage has been set for the development of its industrial resources. We have reached a milestone in our history, in my opinion, more important the the discovery of gold or diamonds. The welfare of our State is the sounder when we produce goods, process our own raw materials, and when we can depend less on sources outside Southern Africa for the simpler needs of our people. For a long time we shall be dependent upon imported technical skills and specialised plant from the long established countries oversea. Nevertheless we have reached a time in our history from which development will be spectacular.

If you turn to sheet 1, the curve of expansion shown there is one that is now familiar to every engineer. Take almost any town; if the results are plotted, you will notice we are all reaching the same stage in precisely the same decade. Provided our way of life is based upon the expansionist capitalistic pattern, the sky is the limit. The production of goods for our people can make our life fuller and give us ample time for the enjoyment of its human values. I use the words "capitalistic pattern" in the broad sense of a wider application of the spirit of free enterprise by groups neither too small nor too large. This is the time to put to use what we can learn. We can benefit from the experiment of Britain towards a Welfare State and profit by the observed results of the social adventure by comparing the tremendous output per man of the U.S.A.

You will note from the curve for a number of towns we have been expanding the sales of electricity steadily at a compounding rate. The onset of an industrial revolution is apparent in the steep rise of the demand for electricity, which today has become so obvious but was so to trained engineers for the past 10 years.

In South Africa, for many years, the production of electricity has been vested in public bodies. I exclude the case of the old Victoria Falls and Transvaal Power Company Ltd. The charter of the industry is the Electricity Act.

The time, however, is overdue for a review of our legislation. It is important also to overhaul our ideas on our means of production. You engineers are familiar with the planning of your resources to meet future demands. Your training and experience will have taught you also the impera-

tive need for interim measures to maintain output at the highest possible level while the major plans mature. Too many of us slavishly follow the lines of the future forgetting we have to exist in an everyday world. The cost of interim measures are not really wasted. Our training and our way of life as engineers immersed in the future make introspective persons the more so. We are by nature introverts, and with the years become more so. We must try to be realists and include in our planning a regard for immediate needs. My advice to you planners is to remember that the mistakes of every generation are the price we pay for progress. You get nothing unless you pay for it. So from each mistake we profit and proceed.

Do not develop a fear complex about mistakes till it dominates your outlook and delays your planning. A dynamic economy makes mistakes. They are inevitable but it also gets things done. In all it is better to make a wrong decision in good faith than no decision at all.

I know most of us get to thinking we know what a Welfare State looks like; what is good for the people we serve. Do we? Let us rather match our plans with practical considerations. Generally the task of a Municipal Engineer fully occupies his hours and those of his staff meeting day to day demands. Don't overlook these when you sit down to plan the next 20 years. In order to achieve the two ends might I suggest you consider:—

(*a*) The people.
(*b*) The means at your disposal.
(*c*) The nature of planning.
(*d*) The training grounds.
(*e*) The maintenance of our means of production.
(*f*) The satisfying of the demand.

My time is too short to mention more than one or two aspects of each.

The good of our State in the long run depends on the people. We must take into account the resources in manpower at our disposal. It is also of no use concentrating all the good men in one cog of a vast industry. If for example you follow the lines of the City of Birmingham, and select skilled apprentices on the recommendations in its report upon the research undertaken in that city, you will get the best of the youth available. But what of the contractors and manufacturers? Who takes the duds? Do we each shoulder part of the burden and give full employment? And in our large State organisations do we develop people with the right to think. Even the master States run by supermen must depend, if they are to progress, upon slaves who are allowed to think. Nature in her perverse moods, produces a genius here and there. These are the tools you need.

Social tensions and disharmonies are developed when your master planners ignore the men they use, and the people they serve.

When you build up a huge State or a Municipal organisation, remember it is also necessary to permit your staff to differ from you, or from the organisation's views, if progress is to be maintained. In fact the development of Municipal enterprise only lightly reined by the central government adds to the prospects of success. Shackled public utilities can be more prone to staleness than the most powerful monopoly. The development of electricity in this country owes a lot to the spirit of keen rivalry, which might have existed between the late John Roberts and George Swingler.

The freedom to develop upon different lines unfettered by a central planning bureau must be maintained whilst retaining all the advantages of a planning council and guidance from it. We are a free people, and engineers, like members of other professions who have progressive ideas, are not usually types who subscribe easily to centralised direction of thought or executive action. As the greatest proportion of production is by the mass of the people, it is necessary to weld them into the same pattern as the system of which they are a part, and apply the same principles to their conduct. We have a "capitalistic system" which for all its faults has worked. To step up production, should we not encourage our labour force to pull in the same direction? I believe we must be progressive and re-design a system which will provide an incentive to every worker to produce more in a shorter time. Every worker, not merely the owners of the means of production, must be made to feel part of the system. I believe this can be done even in a Welfare State.

When you plan to meet the needs, present or future, you must marshal the resources at your disposal. In the older countries in comparison with ours, greater use for example is made of contractors to carry out major projects. In South Africa we now manufacture where once we imported many goods. So too, it is now often economic to set up organisations to do, say cable laying, excavations, architectural designs, etc. Don't just build up your organisation for the sake of the power that proceeds from it. I believe it has become economic for contractor's organisations, with the special tools and equipment necessary, to go from town to town carrying out reconstruction and development schemes in a much shorter time, and at a cost lower than we can do it by building up our own personnel. For instance, don't duplicate the purchase of a 10-ton tractor trailer if the cartage contractor in town has one. You won't use it often. He does. If someone is in a better position to use a labour force or plant and equipment regularly, and you are not, do not set up a rival organisation which raises costs all round and guess what it costs you to do similar work. Be alive to the overhead costs of your own organisations. By doing this you will be taking full advantage of the means at your disposal.

Planning ahead is naturally bound up with assumptions and decisions on world and internal trade over which we have no control. It requires not merely foresight, but insight into the daily tasks if planning is to be translated into executive action. Plans must be agreed upon. They must give a pattern that is flexible and leave discretion to the persons entrusted with day to day action.

The strange result which will follow in the wake of a nationally planned system, is the need to agree upon all the tasks ahead before any action can be taken. A planned system by the State makes planning almost impossible for the individual. In the end he cannot take decisions while the State comes to a decision. No positive thinking is possible while indecision is encouraged and action is delayed.

Are we not being misled into an error when we condemn our tried economic system because of its minor defects? Do not let us throw overboard a system with roots in nature's evolutionary plan. The laws of chance may seem to guide it but are these not the laws of the Universe? Planning on a vast scale does seem to restrict our freedom, and does seem to bring in its train cuts and rationing because we lose our perspective. To make it succeed might mean sacrificing our essential freedoms.

From the sources of manpower at our disposal we have a limited reservoir. Engineering is running short of manpower. Are our training grounds adequate? I do not believe we take our share in leading the country or in advising our educationalists. There is in my opinion inadequate liaison between educationalists and those in charge of the fields in which the trainees ultimately earn a living. Have we ever, as a body, been asked to submit our needs for operatives and engineers to any body governing higher or technical education? Have we ever made forecasts of our needs? Do we exert any influence upon the universities?

For example, desirable as high standards might be, is it sound to make the standard of the entrance examination so high or the first year papers such that large numbers of potential engineers fail, lose heart and drift into something easy? Do we not today also need men not necessarily qualified to be top executives? The technical resources of this country I maintain are totally inadequate for its present needs, let alone the future with its developing industrial character. We can march only as fast as our average member. Today we know, municipalities are finding it difficult to obtain engineers with a certificate of competency and municipal experience, and salary is not the only reason for the state of affairs.

Is it not time we had special courses for engineering diplomas, something between a university degree and the technical college certificates? There again do we go the right way to develop our youth? The civil engineer profession is much older and I believe much wiser. Every civil man gets, I believe, a much sounder training. He serves as a resident engineer on construction and gets a practical background for municipal work. Our graduates go to the manufacturing works, but the everyday

application of their theoretical training to meet our needs is neglected. Should we not consider much more important than we do, the need for detailed supervision of our construction programmes by a young engineer? We underrate the importance of our LV distribution network, of the pole lines, of the services and leave it to the artisan. I believe our status is low because we ourselves regard with no pride the details of our everyday jobs. We have not built up a high enough standard, and we do not take sufficient pride in everything we do. Might I suggest as an association we take more interest in the training grounds. This applies to our artisans and our plant operators no less than the engineers. A more haphazard method of training future plant operators can scarcely be imagined. We waste years training cable jointers. Could we not in collaboration with the engineering unions speed up our technical training by setting aside bench training of young cable jointers, linesmen, etc? Today experience is often gained at the expense of the employer long after training should have been complete.

In maintaining our plants and our networks, do we put sufficient thought to their needs? Most municipalities do so much construction work, carry out the extensions departmentally, and generally utilise the available manpower to an extent which precludes attention to our domestic needs. May I suggest you think big. Put out work to private enterprise and encourage its development so that you can look after the day to day problems of the town. The curve of expansion is likely to be steep from now on and very few of us can overtake the expansion and maintain the welfare of our concerns. The sources of manpower are going to be increasingly inadequate for years.

To satisfy the demand on our resources we should know what the future will require, and how our plans are affected by world conditions. Our future has to be integrated with a similar picture of development over the whole world. Desirable major plans may be delayed. We must be content with much compromise. For example, tarred roads over the whole country-side would be most desirable, and probably the maintenance of gravelled roads in many cases far exceeds the annual loan charges on the capital costs of tarred roads. Large desirable plans of expanding our industry with super stations and national grids may be wise, but the capital programme must allow parallel development of other activities too, water, transport, etc. We cannot have all the capital available. The productive capacity of the world is limited, and if we increase it for goods of a permanent nature we have less to spend on current consumption. To the planners of the future, I would say pay heed to my needs. Future generations may benefit by our sacrifices but not if we make a series of major mistakes. I also want a pleasant life, not all the things I like, but some of them. I am not prepared to subscribe to guesses of future generations, likes and sacrifice present enjoyment to satisfy these plans. So interim measures may still be necessary if we are to meet the demand. We cannot turn the world upside down overnight. The steady and wise development of our capital resources is much sounder than a revolution of ideas. Our objective must be to satisfy the demand by an integrated plan that will involve both interim and long-term measures. Rationing is a confession of our failure to do so.

In conclusion I should like to express a personal view. I believe we have failed in this country to work together. On the one hand we have the E.S.C. working to its plans. May I say, sometimes without the goodwill of a sufficient number of municipalities and not because we are opposed to each other's plans. As an Association we are in the dark. We are not represented on the Commission. In many cases we are large users with no say in things affecting our welfare. I believe the National Joint Board proposed in 1944 might have helped. I believe the task before the country needs the united efforts of all who serve the cause of our industry. Our help is also necessary, not just for the immediate programme, but for all time. In many cases the municipalities are in opposition to the E.S.C.'s plans, most probably in ignorance. It is a pity this lack of co-operation should exist. The lead cannot come from us.

Finally because we have reached the present stage in the development of the country, I think we should be constantly critical of every angle of our huge industry.

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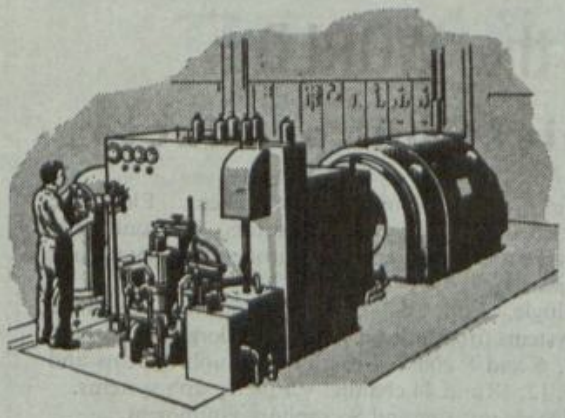

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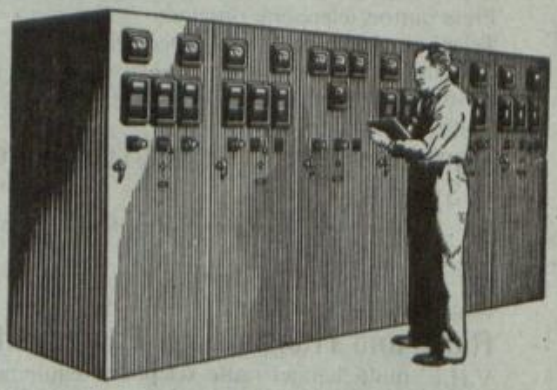

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Criticism by itself is not enough. We must analyse and then set about the job with a will, building it so that we can be proud of every brick we lay, not just those on the surface of the organisation. Don't let us become self satisfied and content. A system that is content is what we would call in equilibrium. There is no call for such a system to progress. Change and development stem from dissatisfaction and mistakes as well as natural causes.

In accepting the honour, I have set myself the task of endeavouring with the help of the Association and your executive to find answers to the questions I have raised. Before one can synthesise one must analyse. When we have analysed the problems we can perhaps prepare a thesis and a programme, neither of which may be perfect but which will serve as a basis from which we will gather experience and profit as we go. With your co-operation and criticism I hope we will reach out to greater things.

Mr. A. R. SIBSON, Bulawayo:

Mr. President: I have felt for some years that by virtue of his training, experience and general manner of his life, the engineer is one of those members of the community best fitted to analyse social and sometimes perhaps political problems. We have heard in your address this morning, sir, a very fine example of the approach to such problems that is possible when it is made by an engineering mind.

There is not time now, Mr. President, to say all the things that I would like to have said about your very fine address, but I do suggest, gentlemen, that our President has given us a clarion call to interest ourselves in those things upon which the manner of our life depends, and to apply our training and our understanding of problems in the way he has suggested to the betterment of mankind.

Mr. President, on behalf of the Association I wish to congratulate you both on your appointment to the high office that you now hold and for the very stirring address that you have just given to us.

PRESIDENT:

Gentlemen, kindly note that we have to assemble for the group photograph at 4 p.m.

Convention adjourned and resumed at 2.30 p.m.

IMPORT CONTROL

PRESIDENT:

I will now ask Mr. Fraser to deal with Item 7, "Import Control."

Mr. J. C. FRASER, Johannesburg:

Mr. President and Gentlemen: There is very little to report, on the question of import control. As you all remember last year a committee was formed on which our President, Mr. Downey, Mr. Hugo and myself were elcted as your representatives. We had two or three meetings last year which I reported on at the last Convention. This year, there have been no meetings; it appears that there has been no necessity for one. One or two little items have trickled through to me from outlying districts which I managed to satisfactorily fix up with the Controller over the telephone. Other than that I have nothing to report.

PRESIDENT:

Thank you, Mr. Fraser. While Mr. Fraser is here I will ask him to deal with Item 7 (ii) "Electrical Wiremen's Registration Board".

ELECTRICAL WIREMEN'S REGISTRATION BOARD

Mr. J. C. FRASER, Johannesburg:

Mr. President and Gentlemen: I have pleasure in presenting a brief review of the activities of the Wiremen's Registration Board for the year 1950.

1. Personnel of the Board

During the year the Board sustained grievous losses owing to the death of:—

Mr. H. O. Smith, Chief Inspector of Factories (Chairman) and Mr. J. C. Calder, representative of the South African Electrical Workers' Union.

The vacancies were filled by the appointment of Mr. R. N. F. Smit—Chief Inspector of Factories (Chairman—vice the late Mr. Smith) and Mr. A. Elisio (South African Electrical Workers' Union—vice the late Mr. J. C. Calder).

The following personnel constituted the Board as at 1st January, 1951:—

Mr. R. N. F. Smit—Chief Inspector of Factories—Chairman.

Mr. P. Sommerville. (Representative of the Labour Department on Administrative Matters.)

Mr. J. C. Fraser. (The Association of Municipal Electricity Undertakings of South Africa and Rhodesia.)

Mr. H. R. Townsend. (The National Federation of Building Trade Employers of South Africa; The Federated Chamber of Industries; The Electrical Engineering and Allied Industries Association.)

Mr. A. Elisio. (The South African Electrical Workers' Association.)

No representative has been appointed by the following bodies to fill the position vacated by Mr. D. W. Harvey:—

The Amalgamated Engineering Union.
The Building Workers Industrial Union.
The Western Province Building, Electrical and Allied Trades Union.

In passing reference should be made to the death during the year of Mr. H. Gosse a foundation member of the Board and who retired therefrom in 1948.

Messrs. Smith, Calder and Gosse rendered valuable services to the Board and their passing is regretted.

2. Meetings of the Board

During the year 1950 the Board held 12 ordinary meetings and the Examinations Sub-Committee met on 11 occasions.

3. Applications for Registration

During the year 1950, 460 applications for registration were received; of these 338 were accepted for examinations and 122 were refused owing to inadequate documentary evidence of experience in wiring work. Numerous inquiries were also received from intending applicants.

The slight decrease in the number of applications for registration is no doubt due to the partial cessation of immigration and the fact that most of the ex-soldiers had complied with the requirements of the Act.

4. Examinations

During the year under review the Board held 3 written and 9 practical examinations; 557 candidates attended the written examinations whilst 393 were present at the practical examinations. A total of 1,246 notifications were sent out in connection with the written examinations and 477 for the practical.

The attached Tables II and III reflect details of the position. The figures for the current year include candidates accepted for the examinations during previous years but who had not been successful. The Board considered that, although the number of candidates for examination had lessened, the position did not warrant any departure from the examination schedule which now satisfactorily coped with all aspirant candidates during any one year.

5. C.O.T.T. Trainees

The Board approved eight applications for the examination arranged under the C.O.T.T. Scheme. This decreased number of candidates is attributed to the fact that most of the pupils are now being indentured under the Apprenticeship Act and others, through efflux of time are no longer eligible for this examination.

6. Determination of Areas

The magisterial districts of Kimberley, Witbank, Bronkhorstspruit, Uitenhage, Bellville, Somerset West, Oudtshoorn and Kokstad were determined during the year as areas in which Sections 19 and 20 of the Act would be applicable. Notices of the Minister's intention to determine the magisterial districts of Newcastle, Kroonstad and Hermanus were published in the Government Gazette.

7. Prosecutions

It was reported to the Department during the course of the year that the number of registered wiremen then available in determined areas was sufficiently adequate to warrant the stricter enforcement of the Act. It was consequently decided to solicit the co-operation of electricity supply undertakings, employers associations and trade unions with this object in view. As a result six persons were prosecuted during the year and reports were received of 23 prosecutions conducted by municipalities.

8. Conclusion

The thanks of the Board are due to the examiners for the manner in which they have performed their onerous duties. The nominal fees paid to these gentlemen are insufficient recompense for the zeal and enthusiasm with which the duties are carried out thus enabling the Board to function in a proper manner.

SCHEDULE I
PARTICULARS OF APPLICATIONS RECEIVED

Particulars	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	*Total*
Number of applications for Registration.	2668	172	120	281	299	444	721	625	730	569	460	7089
Number of applicants registered.	725	780	193	178	208	218	350	501	418	572	433	4576
Number of applicants accepted for examination.	127	282	148	182	159	179	418	603	634	503	338	3573
Number of applications refused.*	92	91	108	54	55	57	93	78	62	39	122	741

*This number includes imporperly completed applications as well as the applications refused by the Board.

SCHEDULE II
SECTION A: WRITTEN EXAMINATION
(PARTS I & II)

Particulars	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	*Total*
Number of examinations held.	2	2	2	2	2	2	2	2	3	3	22
Number of candidates who sat for examination.	93	164	247	296	332	512	639	819	920	557	4579
Number of candidates who passed Parts I and II	19	65	68	96	101	185	106	132	144	91	1007
Number of candidates who passed Part I only.	6	48	45	77	14	135	213	222	139	135	1034
Number of candidates who passed Part II only.	6	43	62	47	28	59	35	144	83	72	579

SCHEDULE III
SECTION B: PRACTICAL EXAMINATION

Particulars	1942	1943	1944	1945	1946	1947	1948	1949	1950	*Total*
Number of Examinations held.	2	2	3	4	7	8	7	9	9	51
Number of candidates who sat for examination.	50	73	130	158	249	362	249	460	393	2124
Number of candidates who passed.	49	67	123	145	229	299	227	381	347	1866

23rd April, 1951.
E.G.

Thanks are also due to the clerical division of the Department for their wholehearted support—another important factor in enabling the Board to perform the duties prescribed in the Act.

Finally, may I express my appreciation to the Chairman of the Board for furnishing the facts upon which it has been possible to frame this report.

PRESIDENT:

Gentlemen, you have heard Mr. Fraser's excellent report on the Electrical Wiremen's Registration Board. As Mr. Smit, Chief Inspector of Factories is here, perhaps he would like to add a few words to what Mr. Fraser has already said.

Any discussion on this report, gentlemen?

Mr. C. KINSMAN, Durban:

Mr. President, I think it would be fitting for me to express, as I am sure I can confidently do, the thanks of our members for the wonderful work Mr. Fraser has done and continues to do on this Board.

Mr. J. L. VAN DER WALT, Krugersdorp:

May I ask Mr. Fraser whether the Board has considered the question of allowing final year apprentices doing work on their own without supervision. This request has come from various contractors and in my area I am continually being requested to permit fifth year apprentices to do work without supervision.

Mr. J. C. FRASER, Johannesburg:

Mr. President and Gentlemen: This question has been before the Wiring Registration Board on one or two occasions for discussion. The Board's attitude is that contractors must comply with the Act. If my memory serves me correctly there is no provision in the Act for a fifth year apprentice to undertake work entirely on his own. He must be under the constant supervision of a licensed wireman.

It is largely a question of the interpretation of the words "constant supervision". If by agreement between supply authorities and the electrical contractors a commonsense attitude of the interpretation of the Act can prevail, it may not be necessary for the licensed electrician to continually stand over the fifth year apprentice whilst he is doing his work, provided the licensed electrician was within a reasonable distance for the fifth year apprentice to get whatever advice he may require and that his work is finally checked by the licensed wireman, such arrangements may be able to prevail until such time as the Act has been amended.

PRESIDENT:

Thank you, Mr. Fraser.

S.A. BUREAU OF STANDARDS SAFETY CODES AND OTHER COMMITTEES

I will now call on Mr. van der Walt to give us his report on the S.A. Bureau of Standards—Safety Codes and other Committees.

Mr. J. L. VAN DER WALT, Krugersdorp:

Mr. President, Ladies and Gentlemen: In submitting my report regarding the activities of the above organisation, allow me to give a short outline of the organisation and procedure. I would refer you to the establishment chart attached, reproduced from the Fifth Annual report of the Standards Council.

The Electrical Engineering Division, in which your Association is interested, is subdivided into the following groups:—

1. General Electrical Engineering

This section is mainly concerned with the testing of electrical equipment at the request of both manufacturers and consumers, such as cables, insulators, insulating materials, motors, switchgear and circuit breakers.

2. Electrical Appliances Section

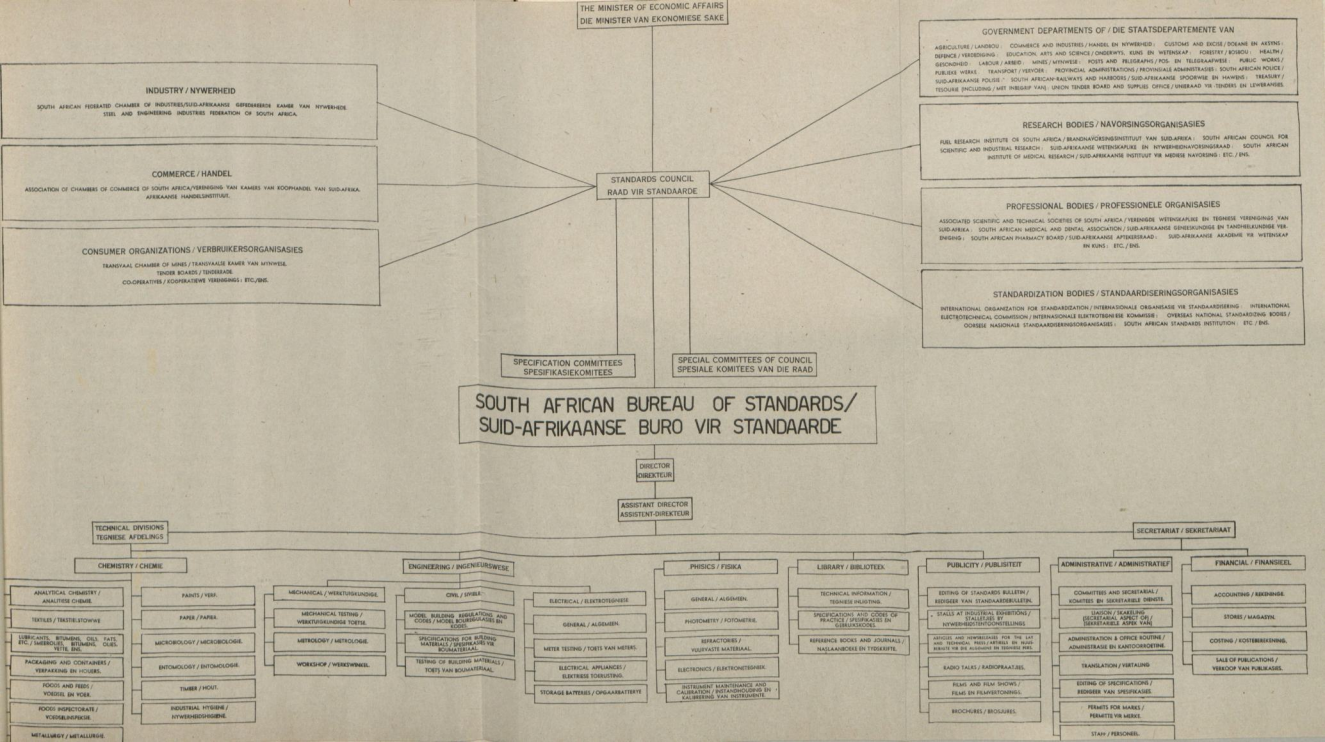
This section deals with the testing of heating and cooking appliances, such as, water heaters, stoves and hotplates and portable heating appliances. Electrical accessories and installation material, such as switches, plugs, lampholders, insulated wires and flexible cords and motor driven appliances.

3. Battery Testing Section

4. Meter Testing Section

Your Association has been represented on all activities of the above four sections, whenever new specifications had to be drafted.

Basically there are two types of specifications, namely, safety and quality. Safety specifications are to become compulsory.


THE MINISTER OF ECONOMIC AFFAIRS
DIE MINISTER VAN EKONOMIESE SAKE
GOVERNMENT DEPARTMENTS OF / DIE STAATSDEPARTEMENTE VAN
AGRICULTURE / LANDBOU ; COMMERCE AND INDUSTRIES / HANDEL EN NYWERHEID ; CUSTOMS AND EXCISE / DOUANE EN AKSYNS ; DEFENCE / VERDEDIGING ; EDUCATION, ARTS AND SCIENCE / ONDERWYS, KUNS EN WETENSKAP ; FORESTRY / BOSBOU ; HEALTH / GESONDHEID ; LABOUR / ARBEID ; MINES / MYNWESE ; POSTS AND TELEGRAPHS / POS, EN TELEGRAAFWESE ; PUBLIC WORKS / PUBLIEKE WERKE ; TRANSPORT / VERVOER ; PROVINCIAL ADMINISTRATIONS / PROVINSIALE ADMINISTRASIES ; SOUTH AFRICAN POLICE / SUID-AFRIKAANSE POLISIE ; SOUTH AFRICAN RAILWAYS AND HARBOURS / SUID-AFRIKAANSE SPOORWEE EN HAWENS ; TREASURY / TESourie (INCLUDING / MET INBEGRIP VAN) ; UNION TENDER BOARD AND SUPPLIES OFFICE / UNIERAAD VIR TENDERS EN LEWERANSIES.
INDUSTRY / NYWERHEID
SOUTH AFRICAN FEDERATED CHAMBER OF INDUSTRIES/SUID-AFRIKAANSE GEFEDEREERDE KAMER VAN NYWERHEDE
STEEL AND ENGINEERING INDUSTRIES FEDERATION OF SOUTH AFRICA.
COMMERCE / HANDEL
ASSOCIATION OF CHAMBERS OF COMMERCE OF SOUTH AFRICA/VERENIGING VAN KAMERS VAN KOOPHANDEL VAN SUID-AFRIKA.
AFRIKAANSE HANDELSINSTITUUT.
CONSUMER ORGANIZATIONS / VERBRUIKERSORGANISASIES
TRANSVAAL CHAMBER OF MINES / TRANSVAALSE KAMER VAN MYNWESE.
TENDER BOARDS / TENDERRADE.
CO-OPERATIVES / KOOPERATIEWE VERENIGINGS : ETC./ENS.
STANDARDS COUNCIL
RAAD VIR STANDAARDE
RESEARCH BODIES / NAVORSINGSORGANISASIES
FUEL RESEARCH INSTITUTE OF SOUTH AFRICA / BRANDSTOFNAVORSINGSINSTITUUT VAN SUID-AFRIKA ; SOUTH AFRICAN COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH : SUID-AFRIKAANSE WETENSKAPLIKE EN NYWERHEIDSNAVORSINGSRAAD ; SOUTH AFRICAN INSTITUTE OF MEDICAL RESEARCH / SUID-AFRIKAANSE INSTITUUT VIR MEDIESE NAVORSING ; ETC. / ENS.
PROFESSIONAL BODIES / PROFESSIONELE ORGANISASIES
ASSOCIATED SCIENTIFIC AND TECHNICAL SOCIETIES OF SOUTH AFRICA / VERENIGDE WETENSKAPLIKE EN TEGNIESE VERENIGINGS VAN SUID-AFRIKA ; SOUTH AFRICAN MEDICAL AND DENTAL ASSOCIATION / SUID-AFRIKAANSE GENEESKUNDIGE EN TANDHEELKUNDIGE VER-ENIGING ; SOUTH AFRICAN PHARMACY BOARD / SUID-AFRIKAANSE APTEEKRAAD ; SUID-AFRIKAANSE AKADEMIE VIR WETENSKAP EN KUNS ; ETC. / ENS.
STANDARDIZATION BODIES / STANDAARDISERINGSORGANISASIES
INTERNATIONAL ORGANIZATION FOR STANDARDIZATION / INTERNASIONALE ORGANISASIE VIR STANDAARDISERING : INTERNATIONAL ELECTROTECHNICAL COMMISSION / INTERNASIONALE ELEKTROTEGNIESE KOMMISSIE ; OVERSEAS NATIONAL STANDARDIZING BODIES / OORSESE NASIONALE STANDAARDISERINGSORGANISASIES ; SOUTH AFRICAN STANDARDS INSTITUTION ; ETC / ENS.
SPECIFICATION COMMITTEES
SPESIFIKASIEKOMITEES
SPECIAL COMMITTEES OF COUNCIL
SPESIALE KOMITEES VAN DIE RAAD
SOUTH AFRICAN BUREAU OF STANDARDS/
SUID-AFRIKAANSE BURO VIR STANDAARDE
DIRECTOR
DIREKTEUR
ASSISTANT DIRECTOR
ASSISTENT-DIREKTEUR
TECHNICAL DIVISIONS
TEGNIESE AFDELINGS
CHEMISTRY / CHEMIE
ANALYTICAL CHEMISTRY / ANALITIESE CHEMIE.
TEXTILES / TEKSTIELSTOFWWE
LUBRICANTS, BITUMENS, OILS, FATS, ETC. / SMEEROLIES, BITUMENS, OLIES, VETTE, ENS.
PACKAGING AND CONTAINERS / VERPAKKING EN HOUERS.
FOODS AND FEEDS / VOEDSEL EN VOER.
FOODS INSPECTORATE / VOEDSELINSPEKSIE.
METALLURGY / METALLURGIE.
PAINTS / VERF.
PAPER / PAPIER.
MICROBIOLOGY / MIKROBIOLOGIE.
ENTOMOLOGY / ENTOMOLOGIE.
TIMBER / HOUT.
INDUSTRIAL HYGIENE / NYWERHEIDSHYGIENE.
ENGINEERING / INGENIEURSWESE
MECHANICAL / WERKTUIGKUNDIGE.
MECHANICAL TESTING / WERKTUIGKUNDIGE TOETSE.
METROLOGY / METROLOGIE.
WORKSHOP / WERKSWINKEL.
CIVIL / SIVIELE.
MODEL BUILDING REGULATIONS AND CODES / MODEL BOUREGULASIES EN KODES.
SPECIFICATIONS FOR BUILDING MATERIALS / SPESIFIKASIES VIR BOUMATERIAAL.
TESTING OF BUILDING MATERIALS / TOETS VAN BOUMATERIAAL.
ELECTRICAL / ELEKTROTEGNIESE
GENERAL / ALGEMEEN.
METER TESTING / TOETS VAN METERS.
ELECTRICAL APPLIANCES / ELEKTRIESE TOERUSTING.
STORAGE BATTERIES / OPSLAANBATTERYE
PHISICS / FISIKA
GENERAL / ALGEMEEN.
PHOTOMETRY / FOTOMETRIE.
REFRACTORIES / VUURVASTE MATERIAAL.
ELECTRONICS / ELEKTRONIETEGNIEK.
INSTRUMENT MAINTENANCE AND CALIBRATION / INSTANDHOUDING EN KALIBRERING VAN INSTRUMENTE.
LIBRARY / BIBLIOTEEK.
TECHNICAL INFORMATION / TEGNIESE INLIGTING.
SPECIFICATIONS AND CODES OF PRACTICE / SPESIFIKASIES EN GEBRUIKSKODES.
REFERENCE BOOKS AND JOURNALS / NASLAANBOEKE EN TYDSKRIFTE.
SECRETARIAT / SEKRETARIAAT
PUBLICITY / PUBLISITEIT
EDITING OF STANDARDS BULLETIN / REDIGEER VAN STANDAARDBULLETIN.
SALES AT INDUSTRIAL EXHIBITIONS / STALLETJIES BY NYWERHEIDSTENTOONSTELLINGS
ARTICLES AND NEWSRELEASES FOR THE LAY AND TECHNICAL PRESS / ARTIKELS EN PERSBERIGTE VIR DIE ALGEMENE EN TEGNIESE PERS.
RADIO TALKS / RADIOPRAATJIES.
FILMS AND FILM SHOWS / FILMS EN FILMVERTONINGS.
BROCHURES / BROSJURES.
ADMINISTRATIVE / ADMINISTRATIEF
COMMITTEES AND SECRETARIAL / KOMITEES EN SEKRETARIELE DIENSTE.
LIAISON / SKAKELING (SECRETARIAL ASPECT OR / SEKRETARIELE ASPEK VAN)
ADMINISTRATION & OFFICE ROUTINE / ADMINISTRASIE EN KANTOORORDING
TRANSLATION / VERTALING
EDITING OF SPECIFICATIONS / REDIGEER VAN SPESIFIKASIES.
PERMITS FOR MARKS / PERMITTE VIR MERKE.
STAFF / PERSONEEL.
FINANCIAL / FINANSIEEL
ACCOUNTING / REKENINGE.
STORES / MAGASYN.
COSTING / KOSTEBEREKENING.
SALE OF PUBLICATIONS / VERKOOP VAN PUBLIKASIES.

Quality specifications will not be compulsory, but manufacturers will be entitled to apply for the S.A.B.S. mark.

An Electrical Equipment Specification Co-ordinating Committee has been established, its function being to screen and co-ordinate the work done by Electrical Equipment Technical Committees and to make recommendations to the Standards Council regarding the approval of electrical specifications.

The procedure in drawing up a new specification is as follows:—

1. Application is made to the Standards Council.
2. If warranted, the Standards Council instructs the South African Bureau of Standards to proceed.
3. The Bureau of Standards invites interested bodies, manufacturers and consumers, to form a Technical Committee.
4. This committee draws up a draft specification.
5. The draft specification is circulated for comment. Copies are sent to all interested parties in South Africa and to 32 standards organisations abroad.
6. After the comment period, the Technical Committee reviews the specification in the light of the comments received, and submits the amended draft to the Electrical Equipment Specifications Co-ordinating Committee.
7. The Electrical Equipment Specifications Co-ordinating Committee in consultation with the Technical Committee, approves of the draft, and submits the draft to the Standards Council for approval and publication.

Specifications and codes of practice published at date of our previous Convention (May, 1950) are as follows:

2—1947 B. Storage Batteries for use in Motor Vehicles.

SV. 103—1949. Electric Radiators (safety.)

SV. 105—1949. Fixed Electric Water Heaters (safety).

03—1947 B. Protection of Buildings from Lightning (*Under Review*).

The following specifications have been published during the ensuing year:—

Quality Specifications:

56—1949. Tungsten Filament General Service Electric Lamps.

97—1950. Paper Insulated Electric Cables for General Purposes.

98—1950. Paper Insulated Electric Cables for Heavy Duty.

150—1950. Polyvinyl-chloride (P.V.C.) Insulated Electrical Conductors.

151—1950. Fixed Electric Storage Water Heaters.

153—1950. Electric Stoves and hotplates.

154—1950. Electric Cooking Plates.

Safety Specifications:

SV. 101—1949. Manually Operated Air-break Switches.

SV. 102—1948. Portable Electric Immersion Heaters.

SV. 103—1949. Electric Radiators.

SV. 105—1949. Fixed Electric Water Heaters.

SV. 108—1950. Domestic Electric Washing Machines.

SV. 109—1950. Plugs, Socket Outlets and Socket Outlet Adaptors.

SV. 111—1949. Replacement Type Heating Units.

SV. 112—1950. Electric Hand Lamps.

SV. 115—1950. Electric Soldering Irons.

SV. 117—1950. Electric Stoves and Hot Plates.

SV. 123—1950. Portable Electric Reading Lamps.

Codes of Practice:

01—1948. Electricity Meter Testing Code.

In Course of Publication:

Safety:

SV. 100—1949. General Requirements for Electrical Materials and Equipment.

SV. 104—1949. Flexible Cords.

SV. 106—1948. Single Core Rubber Insulated Cables.

SV. 107—1950. Portable Electric Appliances for Heating Liquids.
SV. 113—1950. Electric Toasters.
SV. 114—1950. Electric Hand Irons.
SV. 118—1950. Small Extra Low Voltage Transformers.
SV. 119—1950. Lampholders and Bayonet Lampholder Adaptors.
SV. 121—1950. Apparatus Connectors.

Quality:

157—1950. Electric Toasters.
158—1950. Portable Electrical Appliances for Heating Liquids.
159—1950. Electric Irons.
160—1950. Electric Air Heaters and Radiators.

Under Review following comment:

Domestic—Radio and Electronic Apparatus.
Manually Operated Enclosed Type Air-break Switches (quality).
Miniature Circuit Breakers for Lighting Heating and Domestic Installations (quality).
Miniature Circuit Breakers for Protection of Electric Motors (quality).
Porcelain Insulators and Bushings (quality).
Screwed Steel Conduit and Fittings for Electrical Wiring (quality).
Wall and Appliance Switches (quality).

Issued for Comment:

Flameproof Enclosures for Electrical Apparatus.
Protection of Electrical Insulating Materials against Fungus.

New Specifications Being Drafted:

Rubber Insulated Cables (quality).
Electric Motors (quality).
Fuses (quality).
Insulating Tapes (quality).
Fractional Horse Power Motors (safety).
Motor Driven Electrical Appliances (safety).
Lightning Arrestors (quality).
Electric Heating Pads (safety).
Protection of Electrical Insulating Materials against Fungus.
Plugs and Socket Outlet Adaptors (quality).
Explosion Hazards in Operating Theatres and Anaesthetic Rooms.
Nomenclature in Electrical Engineering and Standardisation of Electric and Magnetic Magnitudes and Units.

During the year under review, 12 new committees were constituted to prepare specifications of an interest to your Association. Your Association, as one of the largest groups of consumers, were represented on each of these committees.

It is evident from the above that the Electrical Division has covered a tremendous amount of work during the year under review.

As reported by my predecessor, Mr. J. C. Downey, it is the intention of the Standards Council to recommend to the Minister of Economic Affairs, to promulgate practically all safety specifications. The effect of this promulgation will be, that articles not complying with these safety specifications will not be permitted to be sold. This is considered necessary due to appliances, which lack basic requirements, being manufactured in this country, with the result that users are exposed to dangers.

The Electrical Equipment Specifications Co-ordinating Committee therefore considered it justifiable to have recommended to the Standards Council the promulgation of "SV. 107—1950 Portable Electric Appliances for Heating Liquids". This would prevent further sales of an inherently dangerous portable electrode type heater, intended for warming baby feeding bottles. Similar recommendations are to be made regarding practically all Safety Specifications. If approved of by the Standards Council, they in turn will recommend to the Minister of Economic Affairs to have these Safety Specifications promulgated, and after the lapse of a specified time, sales in the Union of appliance not complying with these specifications will be prohibited. It is therefore hoped that in the very near future these Safety Specifications will be compulsory.

Meter Testing Code:

Although the Meter Testing Code has been published the Electricity Control Board is at present considering the promulgation of this Code, perhaps in a slightly modified form. Information is being collected from various municipalities regarding the accuracies of meters with long service periods, and in the light of results thus obtained, a decision will be made. Members are at liberty, however, to adopt the Code on a voluntary basis.

I consider it imperative that your Association should be represented on all committees which may be of interest to the Municipal Engineer. Your representatives on these committees have a considerable responsibility, as they speak, I am sure, for the largest group of consumers in the country. The support of members, in the form of comments, or information during the drafting stage, is therefore of great help. I suggest that the Association's Bulletins be instrumental in notifying members of committees being formed.

Special thanks are due to Reef Members, Johannesburg, Pretoria, Boksburg, Roodepoort and Vanderbijl Park for assisting me in my onerous task of representing your Association on all the committees mentioned in the report. The support and advice from my predecessor Mr. J. C. Downey was highly appreciated.

My appreciation is also due to the Director and staff of the Bureau for their co-operation in all matters affecting your Association.

PRESIDENT:

Thank you, Mr. van der Walt.

Mr. J. W. SWARDT, S.A. Bureau of Standards:

Mr. President, Gentlemen: I would very much like to thank Mr. v.d. Walt for giving so much time to such an extensive and comprehensive report. We are glad to be assured by him that he fully appreciates the importance of the work of drafting specifications useful to your Organisation. Judging from the interest of various municipal engineers, electrical and other engineers, in specification work, I am sure that there still is a certain measure of further appreciation necessary of the actual work involved in specification drafting. The one point I want to make is that we very much welcome criticism and comments you have to offer on any draft specifications. Another point is that unless you acquire copies of these specifications—as you notice there are a large number now ready —they mean nothing to you. It is absolutely essential that you should be familiar with all the provisions covered by the specifications so that you can know for yourself exactly what is being prescribed in these specifications for the various materials and commodities and which are really all materials and products with which you are in daily contact.

Mr. v.d. Walt has referred to the fact that the Electrical Co-ordinating Committee has found it necessary to recommend to the Standards Council that a number of *safety* specifications are now to be made compulsory. I am glad to inform you that the Standards Council has accepted the recommendations made by the committee and it is the intention now to lay the matter before the Minister for his consideration and if he agrees he will give due notice in the Government Gazette when the various specifications will become compulsory.

The other kind of the specifications deals with *quality* specifications. A number of quality specifications have now been published for various commodities, and, as explained to you, the quality mark, that is the ellipse mark, is now available for quite a number of products. Again here it strikes me that there is not sufficient appreciation of the value of the mark by municipal engineers. The quality mark indicates that the manufacturer not only in his product complies with the requirements of the Standards Council quality specification, but also that his whole manufacturing process is under the scrutiny of the Bureau of Standards. That means further that there need be no hesitation about the acceptance of a product that has the mark on it whether the order for the particular product has been placed by you specifically or not; it needs no further inspection by yourselves. No manufacturer can use a mark on his product unless his product has gone through a process of manufacture and inspection that would satisfy the Bureau. In fact it boils down to this that it saves you the bother about sending an inspector down to the factory to inspect any particular product or any particular cable to ensure that the cable is quite in accordance with the specification that you have prescribed.

There is one further point I would like to make in connection with the mark, and that is that you must, when you are buying anything in accordance with the South African specification, insist upon a mark upon the product. It is no use if the salesman comes along and shows you something for which you have no assurance that it is not in accordance with the specification of the Bureau. Often that has happened. We all appreciate that it is very easy to

make a special sample or a special product, get it tested by the Bureau and find it complies; and then the salesman will come round and say to you: "Here is a test certificate to show that it complies with the specification requirements". Well, that is the sample we tested, but what of the rest of the products?

Further I would like to mention the Meter Code. This has been published and has been in use for a short time. From the comments we have received since its publication, it appears that technically the Meter Code is working very well. It has also become apparent to us that there are a few points covered by the section on administration which no doubt will need a little amendment, but that has not distracted from the value of the Meter Code as a technical publication in itself. Another aspect which is rather interesting is this, that at one stage engineers, during the deliberations on the Code at previous Conventions, saw real difficulty in regard to costs involved in the acceptance and working of the Code. In the meantime quite a number of smaller municipalities have gone quietly ahead and found the money and bought themselves small testing outfits for testing meters. We have also had quite a number of enquiries from municipalities asking for advice on a simple type of bench for testing their single phase meters. The Bureau now has prepared some recommendations in this connection and anybody who wishes to have these suggestions, *i.e.*, just for the ordinary house type of single-phase meters, have just to write to us and we will send them a copy.

The instrument as we find it on the market today costs about £85, and with a few additions such as transformer for potential and current, resistances and so forth, you could build the whole thing yourselves for about £150.

The suggestion made by Mr. v.d. Walt that you should give publicity through your bulletin to the new work that the Bureau has in hand, is I think, a very good one. We feel that many members are still unaware of the work that is going on, and this work is to a large extent for yourselves.

Of course I think most members are aware of the fact there is also a Standards Bulletin. Members who are interested in the Standards Bulletin should obtain copies from representatives of the Bureau as well as any other information they may wish to have.

I think, Mr. President, that is all I have to add to the report.

PRESIDENT:

Thank you, Mr. Swardt.

Raadslid P. S. SCHOEMAN, Roodepoort-Maraisburg:

Mnr. die Voorsitter, Here: Ek is mnr. van der Walt dankbaar vir die toespraak gelewer. Ek wil graag die vraag aan hom stel of dit die voorneme is as die aanbeveling aan die Minister gemaak word dat die voorgestelde wetgewing onmiddellik van toepassing sal word of, inagnemende die posisie oorsee in die moeilikheid om die geskikte metertoetser apparate te verkry, dit in oorweging geneem sal word om moontlik 12 maande uitstel aan plaaslike owerhede te gee. Dit sal plaaslike owerhede in staat stel om voorsiening op hulle begrotings vir sodanige apparaat te maak. As daar 'n moontlikheid is dat hierdie Kode in eerskomende jaar uitgevaardig sal word kan ons die nodige voorsiening maak, maar as ons nie weet nie, dit gaan met daardie soort dinge soos geld, jy moet die geld vind en tensy jy weet wanneer dit gebeur, en of die Minister die saak goedgesind sal wees, sal dit baie moeilik wees om die finansies daarvoor te vind. Ek voel dat as die Buro van Standaarde 'n aanbeveling aan die Minister doen dit nodig sal wees dat ons gereed moet wees en moet weet of ons die Kode onmiddellik moet aanvaar, en of daar 'n tydperk van kennis sal wees om owerhede in staat te stel om die nodige reelings te tref.

Mnr. J. L. VAN DER WALT, Krugersdorp:

Mnr. die Voorsitter, in antwoord op mnr. Schoeman wil ek hom net sê dat sover as my kennis strek die Buro van Standaarde hulle werk gedoen het wat die Meter Kode aan betref. Dit is nou in die hande van die Raad van Beheer oor Elektrisiteit om te handel en as hulle besluit om hierdie toets kode te kontroleer sal daar definitief 'n periode toegelaat word vir munisipaliteite om hulle sake in orde te bring.

Mr. Chairman, just to repeat the question of Mr. Schoeman. He asked that if the Test Code is promulgated, Local Authorities be given an opportunity of bringing their

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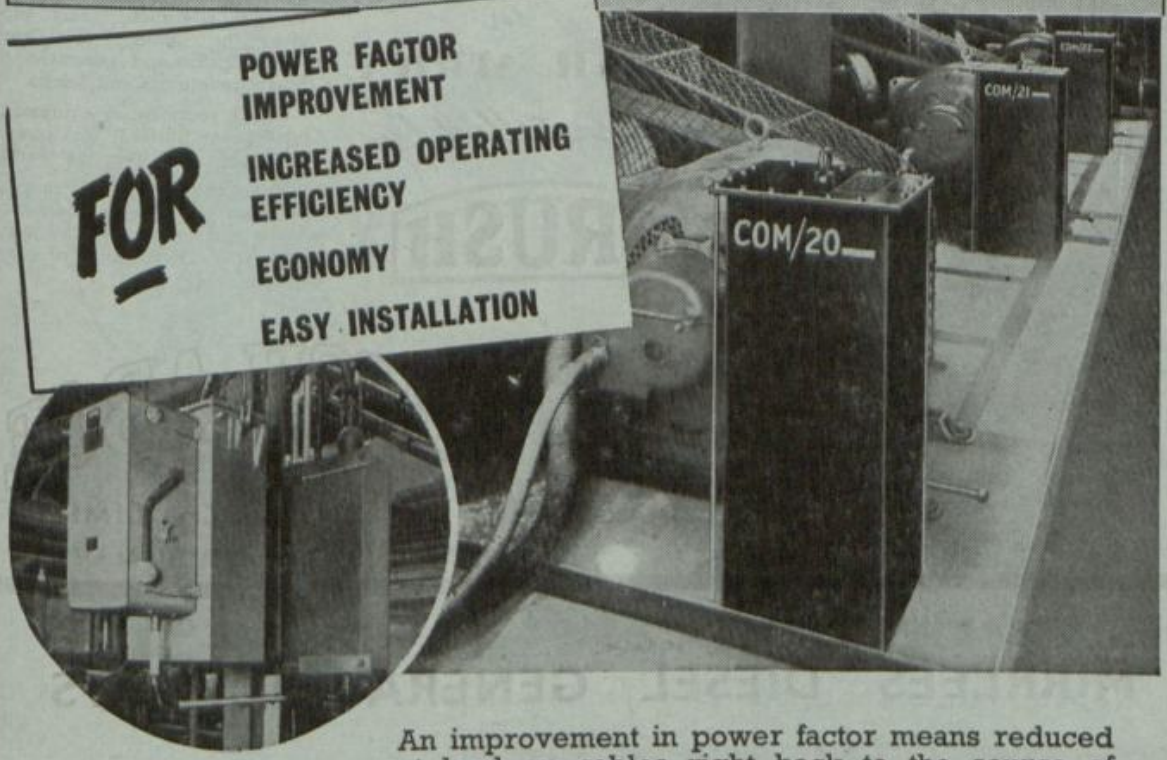

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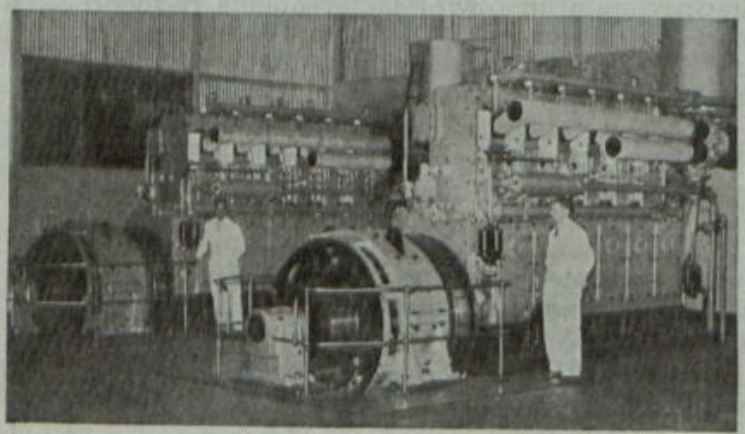

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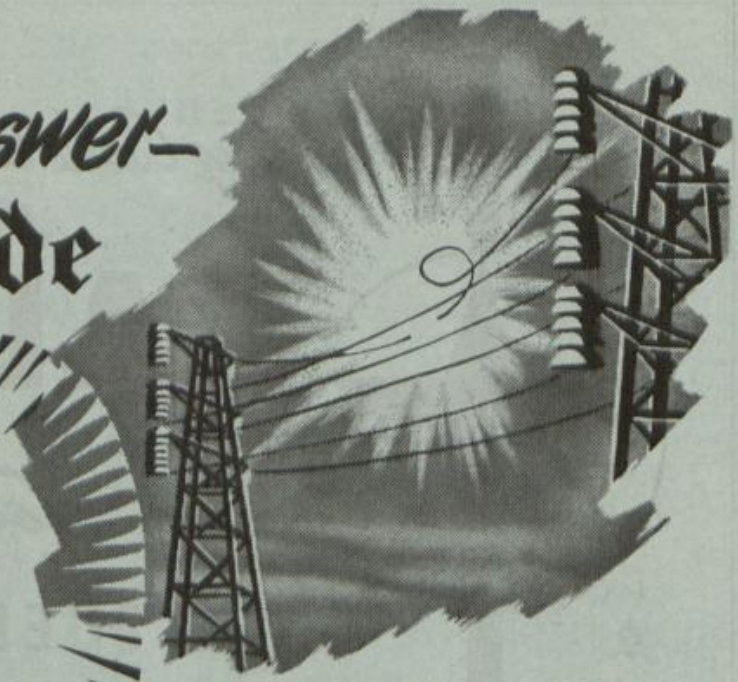

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house in order and get the necessary equipment. I wish to say that the promulgation of the Meter Test Code is now not in the hands of the South African Bureau of Standards, but in the hands of the Electricity Control Board, but I am of opinion that if they decide to promulgate, enough time will be allowed for local authorities or other concerns to bring their house in order.

Ek dink ek is reg, mnr. Swardt.

Mnr. J. W. SWARDT:

Ek dink mnr. Mullins sal die saak verder omstandiglik kan verduidelik.

Mr. C. MULLINS, Electricity Control Board, Pretoria:

Mr. President, Gentlemen: I am in full agreement with what Mr. Swardt has just said; as you know I am the representative, of the Electricity Control Board. The Chairman of the Control Board would have been here today, but he has been called away to Europe, and I am sure he would have been very pleased to have been here to meet you.

The question of making the Meter Testing Code compulsory, promulgating it under the Electricity Act, depends on whether the municipal councils are all agreeable to it or whether at least the majority are. There have been one or two questions brought to our attention, and I will just mention them to more or less clarify the matter. If this Code is promulgated and made compulsory, it would be a matter of two years before it is made compulsory, that is, there will be two years to get your house in order for testing purposes, and as the small municipalities now will have facilities at a much cheaper cost than originally intended I think you will find very few, if any, objections to that, Mr. President—at least the Chairman of the Board has told me so. The Chairman of the Control Board happens to be also the Chairman of the Standards Bureau. The period, I think it is under Section 2.1.2, was laid down for six years; the intention now is to make it a period of 10 years between the testing of meters; not more than 10 years. It gives undertakings a chance to bring these meters more easily into line. Some of the municipalities are at present testing within the 16 years limit, but I spoke to several of them, and they will be only too pleased to see it made into 10 years. There are a few discrepancies here such as scratches on the meter. Well, we all know that a scratch on the meter is not going to make it read higher or lower. Perhaps it makes it look a little bit neater if the scratch is taken out, but to condemn it for that seems a little bit odd. That will have to be taken out. Dr. de Villiers, the Chairman, told me to let you know.

There is also a little matter under Section 2.1.2.(c); you might take a meter out of service for a few days for a certain reason best known to yourselves, but there is no reason to condemn it because of that.

There is also another point the Chairman has asked me to tell you about and that is under Section 2.1.1, the sealing of a meter by an appropriate authority. Well it was understood that it was going to be sealed by some officer of the Standards Bureau. Our intention today is to make the testing officer of any municipality or his assistant, registered in the Bureau of Standards, responsible for doing the sealing. Little things like that will be put right as we go along and find these anomalies. I have just mentioned these few particularly. If I could go from this meeting with the confidence that the majority of the municipalities are in full agreement with the Code, I think it would go a long way. The paper that is going to be read is very instructive, and gives all details of a board similar to that which Mr. Swardt has told you about. The cost of testing apparatus for household meters in small municipalities is not going to exceed £150 today. Before, it was rather a tall order for a small municipality to tackle. Even if in fact they had to send them to a central place to be tested it would be an expensive matter. Today that has been altered. The majority of the municipalities will accept the Code now with these few variations, and as time develops, any other little matter that may become irksome to the proper authorities, if our attention is drawn to it I can assure you it will be put right. The testing of maximum demand meters has also been brought to our notice The intention so far is to test maximum demand meters within a period of two years or at the very most, three years. That is a matter for consideration among yourselves and for recommendation to the Bureau of Standards at any later date. I think, Mr. President, this covers the matter.

PRESIDENT:

Thank you, Mr. Mullins. Does anyone else wish to speak on this matter?

Mr. J. C. FRASER, Johannesburg:

Mr President and Gentlemen: In connection with the Code of Practice for the Testing of Electricity Meters, I was glad to hear at this Convention that municipalities would be given a further opportunity to pass comments on the Code before the Electricity Control Board intends making the Code of Practice a compulsory Act.

At the present time I understand that it is purely a Code of Practice which could be voluntarily adopted by all municipalities, but it now appears that the next step will be for the Electricity Control Board to get it passed as an Act of Parliament.

Knowing that this subject would be discussed at this Conference, I got our Meter Engineer to give me some notes as to how the Code of Practice would affect a big concern such as the Johannesburg Municipality. The notes have been circulated and I have no intention of reading the document, but I would like to draw attention to the table on Page 4 which gives you the difference in cost between a 10 year and a six year periodic change.

References are to paragraphs of the Code.

General:

With the exception of the six year period of certification of meters (2.1.2), the provisions of the Meter Code are generally reasonable and follow those laid down in the British Meters Act.

Objection might be made to a few technical points, principally those concerning dial testing procedure (2.3.2.*b* and 2.3.3.*b*) and the number of revolutions deemed necessary for final tests on 1/20th load (2.3.2.*a*). No criticism can be directed at the limits of error imposed (2.2.1), the number of tests necessary (2.4.2), the type of substandard instruments required (Section 4) or the standardising procedure laid down. (Section 3.)

There are certain notable omissions in the Code which are:—

1. Demand meters are not included within its scope (1.1). This is also the case with the Meters Act in Britain. Considering the amounts paid for maximum demand, it is probable that this point will be queried by consumers. Johannesburg consumers on Scale six for example, pay about twice as much for maximum demand as for units consumed.
2. No regulations are given concerning approved methods of transporting tested meters.
3. No mention is made of essentials in the overhauling procedure to be adopted when re-conditioning meters for re-certification.
4. A list of approved types of meter is not included (2.1.1.*a*)
5. The latest methods of testing by stroboscopic and photo-electric cell devices are not mentioned, but suitable arrangements would no doubt be approved under 1.6.2.*a*.

The Period of Certification:

The main concern of both the S.A. Bureau of Standards and the Electricity Supply Undertakings has been the cost involved in putting the Code into practice. The principal cost factor, particularly in the case of the larger undertakings, is the period that a meter is allowed to remain in service before it becomes uncertified, *i.e.*, no longer considered fit to register accurately.

At least 90 per cent of the meters affected are single phase house service meters of small rating. As far as the best types of such meters are concerned, it is considered that the period of six years laid down in the Code (2.1.2.) is too short, both from the point of view of meter performance and of justifiable maintenance cost.

Convincing figures on meter performance in service are difficult to obtain because of the general lack of attention to meter maintenance in the past. The choice of a suitable period has therefore to be decided mainly by the opinion of Meter Engineers of long experience. The Johannesburg Electricity Department's views based on 20 years experience with meters, is that 10 years is a suitable period for this class of meter.

However, in the case of small three-phase meters and single-phase meters on fairly large supplies, the period of six years is

about right and for all meters used on large bulk supplies, a period of three years is considered adequate. The British Meters Act stipulates a period of 10 years for A.C. meters and six years for D.C. meters.

Accuracy of Meters in Service:

Reliable statistics on the deterioration of meter accuracy with time out on service are difficult to obtain and the figures available for the Johannesburg Electricity Department's meters are as yet only dependable for ½ load accuracy for certain period-groups. We are primarily concerned with the number of meters of good types which have drifted beyond the Code limits of ± 2½ per cent over periods up to at least 12 years. All meters considered should have been calibrated to within the finest practicable limits before issue and should have been properly overhauled.

1. Prior to 1944 all our meters were sent out between 1 and 2 per cent fast. They have since been calibrated to within ± 1 per cent.
2. Prior to 1945 all light load calibration was made at 1/10th load. Since then 1/20th load has been used in accordance with British practice and the S.A. Meter Code.
3. Prior to 1946 bottom jewel bearings were simply cleaned with benzine; some were oiled with clock oil and the majority left dry.

Extensive* investigation on jewel wear carried out in England has shown that the chances of jewel surface breakdown are very much greater with dry bearings and that the only suitable oil is a certain type of mineral oil. As from 1946 these bearings have been cleaned only with pure alcohol (which leaves no residue) and have been given a trace of the correct type of oil plus anti-creep solution.

These fairly recent changes in procedure explain one of the difficulties in providing reliable figures based on Code requirements. As time goes on, however, the data collected should become more valuable.

"Off-circuit" tests on single-phase meters as received have been systematically recorded since 1946, one incoming meter in every 10 of each type being tested for this purpose. The figures for 1,300 such tests have been analysed, the service periods chosen being 1 to 3, 3 to 5, 5 to 7, 7 to 9, 9 to 11, 11 to 13, and over 13 years. These correspond to average periods of service of 2, 4, 6, 8, 10, 12 and about 18 years respectively. The number of tests in each year group vary considerably, those for the short periods being naturally very much in the minority. However, there are sufficient tests available for all these groups except the four years and the figures are as follows:

SINGLE-PHASE METERS OF SATISFACTORY TYPES

Average years in service	*Percentage of Meters found exceeding ± 2½% on ½ load when returned from service*
2	2%
6	7
8	6
10	7
12	11
18 (approx).	24

Loss of accuracy in kilowatt-hour meters is due to three principal causes, namely:—

1. Weakening of brake magnets, causing high registration on all loads. The effect is greatest during the first few years after manufacture and drops away considerably as the magnets stabilise through natural ageing. Even amongst the best types a small number of meters are found showing a marked weakening of magnets. Some types have a very bad reputation in this respect.
2. Failure of surface of bottom bearing jewel, causing low registration at low loads. Owing to the microscopically small area of contact between the pivot and the jewel, the intensity of pressure on the jewel due to the weight of the rotor is of the order of tons per square inch. While the meter is completely de-energised, no harm is done, but when the potential coil is energised the pivot moves continuously over the jewel surface due to vibration. This movement is of course modified when the current coil is also energised and the rotor rotates. The continuous movement of the pivot is the primary cause of eventual

scoring of the jewel surface and pivot point. The effect is greatly aggravated by formation of abrasive oxide particles on the pivot. The number of revolutions made by the meter is a factor in jewel wear in addition to time alone.

3. Increased friction due to wear of top guide bearing bush, dirt and, sometimes, corrosion. This also causes low registration at low loads.

EFFECT OF PROMULGATION OR ADOPTION OF THE CODE ON THE JOHANNESBURG MUNICIPAL ELECTRICITY DEPARTMENT

Under the Code classification the Johannesburg Electricity Department (Meter Branch) would rank as a Class A Electricity Meter Testing Station (1.4.2.).

1. Concerning the certification period, the periodic changing of small single-phase meters (up to 50 amp., inclusive but excluding two-rate meters) was commenced in the middle of 1946 and was carried out for about a year at a rate corresponding to a 12 year period. After this the rate was increased to that necessary for a 10 year period. As from April 1950 all types of meters on the system were included in the periodic changing schedule, the rate being based on the following periods:—

Type of Meter	*Period*
Single phase up to 50 amp. inclusive.	10 years.
Single phase 100 to 400 amp. inclusive. Three phase up to 75 amp. inclusive. Three phase kVA demand up to 25 amp. H.T. inclusive. D.C. over 50 amp. inclusive.	6 years.
Single phase over 400 amp. Three phase over 75 amp. Three phase kVA demand over 25 amp. H.T. D.C. over 50 amp.	3 years.

Within a few months the total number of meters in service will be 100,000 allocated as follows:—

Group as indicated above	*No. of Meters*	*% of Total*
10 year.	93,750	94
6 year.	5,300	5
3 year.	950	1
	100,000	

The annual cost to the Department of the periodic changing, re-conditioning and re-calibrating of all meters is as follows:—

Group	On our Schedule		On Code (6 yrs. for all meters)	
	per meter in service	Total	per meter in service	Total
10 years	2·53 shillings	£11,800	4·22 shillings	£19,800
6 years	9·95 shillings	£2,600	9·95 shillings	£2,600
3 years	28·58 shillings	£1,400	14·29 shillings	£700
		£15,800		£23,100

It will be noted that to change the large group of small meters from the present 10 year period to a six year period as required by the Code, would cost an additional £8,000 per annum. This expenditure is considered to be unjustified. A saving of £700 per annum would be effected by adopting the six year period for the small group of three year meters but this would be inadvisable in view of the importance of the supplies metered and/or the reliability of the types of meters involved.

It should be mentioned that the total annual cost of maintaining the Department's meters inclusive of periodic changing (on the existing schedule), inspection on site, changes other than periodic, testing of new meters, major repairs, etc., is as follows:—

Group	*Per meter in service.*	*Total*
10 year.	4·20 shillings.	£19,700
6 year.	14·15 shillings.	3,700
3 year.	37·84 shillings.	1,800
		£25,200

Time switch maintenance costs an additional £2,200 per annum.

2. The adoption of the Code would entail the payment of certification fees (1.6.3.). These have not yet been decided upon but I understand that a fee of 3d. per meter is probable. This would mean about £200 per annum. Sundry fees for certification of standard cells, potentiometer resistances and sub-standard instrument transformers (3.2) would probably amount to about £25 per annum.

3. The only essential new apparatus required by this Department is a potential transformer test set. This is necessary apart from Code requirements. A suitable instrument is now being designed and will be constructed in the Meter Branch at a cost of about £100, which is much lower than that of any commercial equipment. There is a possibility that a D.C. electronic stabiliser may be deemed necessary under 4.1.2.4. This could also be economically constructed in the Department.

Recommendations:

It is recommended that:—

1. The Meter Code should be approved in general principle.
2. There should be no voluntary adoption of the Code unless the period of certification for single phase meters of 50 amps. and under is increased to 10 years.
3. Regular standardisation of the Johannesburg Electricity Department's primary standards should be carried out by the S.A. Bureau of Standards as recommended in the Code.
4. After the first round of periodic changing of the system is completed, clause 33 of the by-laws should be amended to read 2½ per cent. Refunds of complaint test fees and adjustments of accounts would then be made on meters found exceeding 2½ per cent (the Code limit) instead of five per cent as at present.

Our recommendation at this stage, Mr. President and Gentlemen, should be that the Code of Practice for the Testing of Electricity Meters be accepted in general principle and that municipalities should be guided by the experience which they will get in adopting the Code of Practice.

As far as large undertakings are concerned, there is also the question of the payment of a certification fee (1.6.3.). There are rumours that after meters have been tested they will be sealed by an authorised person and councils will probably have to pay 3d. per seal. Some further information is also required on this point. I gather from Mr. Mullins' remarks this morning that authority may be given to the larger municipalities to seal their own meters and there will be no charge. Am I correct Mr. Mullins?

Mr. C. MULLINS, Electricity Control Board:

That is correct, because it will not be a Bureau officer who will be doing the sealing, it will be one of the testing officers, somebody approved by the Bureau of Standards and registered by the Bureau of Standards.

Mr. J. C. FRASER, Johannesburg:

It looks as if the councils are going to be saved 3d. per certificate per meter.

Anyway I am glad the Electricity Control Board is going to give members a further opportunity to submit their comments before the Code of Practice is finally placed in an Act.

Mr. C. MULLINS, Electricity Control Board:

Before closing this matter, Mr. President, is it possible for you to say on behalf of the Association that the majority of the municipalities will accept the Code?

PRESIDENT:

We will take a vote on it, Mr. Mullins, before we finish the discussion.

Mr. J. W. SWARDT, S.A. Bureau of Standards:

Mr. President: If I may be allowed to say one more word, there are just two points I would like to remark on in view of the discussion which has just taken place; one is that Mr. Fraser mentioned that they are glad to know that they will have an opportunity to offer comments and criticism on the Code. That, I may mention to you, is the broad principle at all times established by the Standards Council of the Bureau. Comments and criticism on all documents whether in the draft stage or in the final stage—that is, when fully printed and in published form—are desirable and welcome. These codes have to be overhauled from time to time, in fact all documents and all standards have to be, for that matter, otherwise we are going to become technically stagnant. For this reason we always welcome comments and criticism, in fact it is the comments and criticism that we have received so far that have brought out the weaknesses that have been referred to today.

The other point is that of a fee. I feel that that is hardly a matter that this Conference can discuss in much detail. I feel it is mainly a matter between the Electricity Control Board and the Bureau of Standards. I do not at this stage wish to elaborate on the whole issue because this still remains to be crystallised between the Board and the Bureau, and that is, that if the officers or inspectors of each local authority seal and certify their own documents, it may be desirable to have a Bureau officer or inspector from time to time making spot tests. In order to do that, the cost of such work will have to be borne in some way or another. At this stage I merely visualise what may happen and I express my own opinion in the matter, but there may be this small fee necessary. What it is going to be I cannot say, I don't think it will be more than 3d., it all depends. I merely mention it at this stage, but this is a matter which has still to be finalised; there is nothing definite as yet. It is merely a matter between the Electricity Control Board and the Bureau.

PRESIDENT:

Thank you, Mr. Swardt.

Mr. D. A. BRADLEY, Port Elizabeth:

Mr. President, Gentlemen: There is one feature in this particular item we are now discussing, not as yet mentioned and that is "Labour". I do not know where we are going to get meter testers and meter mechanicians to do this work. My municipality is probably comparatively small as compared with Johannesburg and Cape Town but I have been trying for the last six months at least to get meter mechanicians. I advertised and did all in my power to get them but there are none forthcoming. I wonder if anyone here has had a similar experience and whether they can suggest how we will overcome the problem of undertaking the Meter Test Code conditions. There may be a solution in the designated new trade which we now have as the "Power System Instrument Mechanicians", but the point is can the municipalities train adequate numbers to fill the necessary labour requirements involved in this Act? I have undertaken myself, as far as Port Elizabeth is concerned, to get apprentices there. I called for apprentices last week for this particular designated trade, but whether I will get any suitable applications for that trade I don't know. That is the serious factor in the operation of this Test Code, if it becomes law within the next year or two. Probably as time goes on, the problem will become more accentuated. I do not know of any meter men coming from England, I mean artisans, and I don't know just how we could get them out here. The payment, salary, wage or whatever we may call it in Port Elizabeth is equal to that of most of the cities in the Union and I can't get men. Is there anyone here who can give me any indication how to overcome this problem from the labour point of view?

PRESIDENT:

Thank you, Mr. Bradley.

Mr. C. MULLINS, Electricity Control Board:

Mr. President: I suggest training girls in that occupation.

Mr. J. C. FRASER, Johannesburg:

Mr. President: I would like, if I may be allowed, to enlarge on Mr. Bradley's remarks. Johannesburg has been placed in exactly the same difficult position as Port Elizabeth. In fact only last week we called the shop stewards and trade union leaders together to see if we could implement labour in our meter department. For the benefit of those who are situated in a similar position I can assure you that Mr. Mullins' suggestion of training girls is not going to be received by the trade unions in South Africa. They are very adamant about it. They told us we could bring in anybody we liked to test meters, provided we paid them the standard tradesmen's wages. Now, sir, it is one of the most difficult trades to staff that I know of. It is the most difficult trade I know of to encourage boys to become apprenticed to. We had only one meter apprentice during the last five or six years. This year we happened to get another boy; but as soon as their time is completed they try to get into the heavier power work, and there are very few lads coming forward to take the place of old meter testing mechanics. It is quite a problem, gentlemen. As Mr. Bradley points out it is going to be a greater problem if the Code is made compulsory. I do not know where the labour is coming from, unless the Government gets together with the trade unions and solves this question for us.

Mr. A. FODEN, East London:

Mr. President: I would like also to refer to Mr. Fraser's remarks with regard to meter repairing and testing. Would not the trade unions agree to testing, as apart from repairing?—because meter testing, as such, is not in my opinion a skilled trade. You have a standard test bench and it is merely a matter of putting the single phase meters on racks and connecting up. There is nothing to it, and I cannot for the life of me see why this should become a skilled trade; but the repairing of meters, I quite agree, is a different matter. I think the trade unions should be approached from that angle, whether they will not agree to the testing of meters to be done by semi-skilled persons at a reasonable rate of pay and the repairing of meters to be done by skilled men.

PRESIDENT:

Any further discussion, gentlemen?

Councillor P. S. SCHOEMAN, Roodepoort-Maraisburg.

Mr. President: I listened to this discussion with great interest. In South Africa today the cry is for man-power. We have not got the man-power. These women have displayed what they can do in this particular line in England and on the Continent. Women operatives are winding transformers, they are doing multiple jobs. I am in agreement with the first speaker that this, except for the repairing of meters, is not a job you could put a skilled artisan to, and I think that this is a matter that could be gone into with the artisans and the trade unions concerned. I feel that women—we know what they can do as we saw in the last war—can do very high precision work and I do not see any reason why, if they are given adequate training, they could not be engaged as such. This would put South Africa in a very favourable position in the event of calling on these women's services when we do not know what lies ahead of us.

PRESIDENT:

Thank you, Mr. Schoeman.

Mr. H. A. EASTMAN, Cape Town:

Mr. President: The discussion on this matter has taken a rather unexpected turn, to my mind. I think we are all agreed and we have agreed already twice on the introduction of an accepted Meter Testing Code.

I may say in regard to the labour force, in Cape Town in the new test laboratory which has recently been constructed provision has been made for employing women on the testing rack for the testing of meters. This has been done on account of the difficulty of obtaining men folk employment on that class of work. Accommodation has been set aside to conform to the Factories Act in regard to rest rooms, lavatories, and the like, with a view to the

necessity arising for the employment of women folk. The City of Cape Town is not interested in the view point of trade unions on the question.

PRESIDENT:

Thank you, Mr. Eastman. Well, gentlemen, is it your wish that we indicate to the Control Board that it is the desire of the Electricity Undertakings that the Meter Testing Code should be introduced as a compulsory code? We have already taken a vote on it, but Mr. Mullins wishes to have an indication.

Mr C. KINSMAN, Durban:

Mr. President: I feel that this has been rather rushed on us, and I wonder whether it would be acceptable to the Convention that the matter be referred to the Executive for discussion tomorrow morning, and then be brought forward to the Convention at a later date. I think we want to think this over, and it might even be fairer to refer it to our Councils. It may even be that we should have a mandate from our Councils. We may, as engineers, say it is desirable, but to say anything stronger than that might place us in a difficult position. I move, sir, that the matter be referred back to the Executive.

PRESIDENT:

Mr. Kinsman has moved that the matter be referred to the Executive, to report back to the Convention. Are you agreed, gentlemen?

Agreed.

PRESIDENT:

Gentlemen: there is one thing I must remind you of; the Councillor Members on the Executive are: Springs, Bulawayo, Cape Town, Durban, Johannesburg, Pretoria, East London, Krugersdorp. The Executive Meeting will be held in the Committee Room at Arthur's Seat Hotel tomorrow morning at half past eight. We will now adjourn for tea, gentlemen, and after tea we will assemble for the photograph, and from there we will proceed to the cocktail party.

9th May, 1951

Convention resumed 9.30 a.m.

PRESIDENT:

Good morning, gentlemen: We will proceed with today's business. We adjourned our discussion yesterday on the Meter Testing Code and I will call on Mr. Kinsman to introduce the matter this morning.

Mr. C. KINSMAN, Durban:

Mr. President and Gentlemen: You will recall that yesterday when this matter was under discussion, there was a feeling that the Code as at present published had certain weaknesses, and Mr. Mullins has told us that the Control Board will effect certain amendments to the Code as now published. There was a fear expressed on the part of some municipalities that if the Code as published was made compulsory, it would involve them in expense they did not feel would be justified at this stage; Mr. Mullins replied to that and said that for the smaller municipalities, with single phase service meters, it was felt, and we were assured, that the cost would not be more than £100 to £150. Then there was the view expressed that although the Convention had on two previous occasions decided in favour of a compulsory Code—that was two or three years ago—things have changed since then and we might be very unwise to take a definite vote in that particular direction and so it was referred to the Executive. The Executive have discussed it, and we feel we would be meeting all points of view if we put forward a resolution for adoption by this Convention. In the spirit that something is necessary, and that once the draft of the Code has been published, amendments will be made; on behalf of the Executive I move:

> That this Convention is of the opinion that before the Electricity Control Board takes any steps in the direction of its promulgation as a compulsory Code, the Meter Testing Code of Practice should be adopted by all Municipal Undertakings as a voluntary Code with a view to experience being gained in regard to its implications, cost and possible weaknesses in its existing form.

Mr. J. C. FRASER, Johannesburg:

I second the motion.

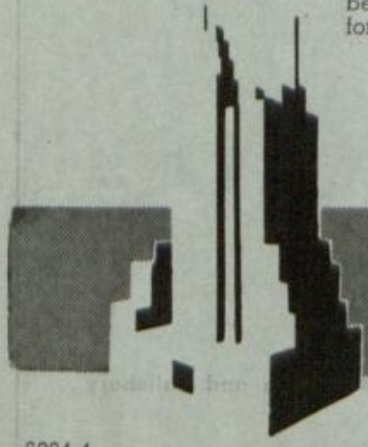
Agreed unanimously

Mr. H. M. S. MULLER, Kakamas, asked whether it was possible to fix a definite period during which it would operate as a voluntary measure.

Through 10,000 yesterdays

It is a far cry from the primitive days of the Bushmen to the modern civilization of South Africa. And most of the striking developments that have made that civilization what it is today have taken place during the more recent chapters of Africa's history.

One of the most important of those developments has been the widespread use of electric power. Escom, the national power supply undertaking, has been in existence for twenty-eight years. Throughout those 10,000 yesterdays Escom has supplied electric power at cost price to farms and industries on an ever-increasing scale. Today, Escom operates seventeen power stations in the four provinces and still the demand for more and more power continues to grow, so that seven more power stations are already planned or in course of construction to cope with it. Escom supplies nearly nine-tenths of the power requirements of the Union.



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Mr. C. KINSMAN, Durban:

No, that was not our intention. Our intention was that it should be applied now, but we don't know for how long it should be a temporary measure. It may be that in six month's time municipalities may be satisfied that they have been able to get ready and the necessary equipment is available; they may be in a position to say: "Yes, we will be able to do it in six months". On the other hand they may not, and it may be necessary to have the period extended to two years. I suggest that it would be inadvisable to commit the Association to a specific period.

Apoligies and greetings, etc.

PRESIDENT:

I will ask the Secretary to read the telegrams that have been received.

SECRETARY:

The first is from **Mr. T. P. Ashley, Queenstown:** "Regret unable to attend Conference owing to unforeseen circumstances. Trust Convention will prove highly successful and pleasant."

The next is from **Mr. H. J. Gripper, Port Elizabeth:** "Best wishes for successful conference, with that Table Mountain load curves avoid devils peaks and please sea point."

The other is from **Mr. E. Poole:** "Wishing successful Convention, kind regards to all."

Communicated

Councils:

Bethal, Elliot, Gatooma, Middelburg (Tvl.), Paarl, Port Shepstone, Stanger, Vryburg.

Government and Other Institutions, etc.:

Mr. A. M. Jacobs—Chairman, Electricity Supply Commission.

Mr. F. J. de Villiers, Chairman, Standards Council.

Mr. C. L. F. Borckenhagen, Director of Imports and Exports.

President, South African Institution of Engineers.

Mr. J. S. Trelease, Joint Manager, Electricity Supply Commission, Rand Undertaking.

President, South African Federated Chamber of Industries.

Mr. E. W. Dohse, Chief Officer, Public Works Department, Pretoria.

Mr. F. W. Joubert, Ex-Chief Inspector of Factories.

Engineering Firms:

Mr. A. E. Wooll, Mitchell Engineering Group, South Africa (Pty.) Ltd.

Mr. G. Poole, Standard Telephones & Cables Ltd.

COAL SUPPLIES

PRESIDENT:

Thank you, Mr. Taylor. We will now deal with Item No. 7, Coal Supplies, and I will call on Mr. Bradley.

Mr. D. A. BRADLEY, Port Elizabeth:

Mr. President and Members: I think my report on coal supplies has been circulated. You will note from my report that we are still frustrated, and we don't seem to get anywhere in respect to the reliability of delivery of coal, and it is really most difficult to go to bed with an easy mind not knowing what is going to happen before the week is ended. Since I wrote my report, which is only a matter of a few days ago, the coal supply at Port Elizabeth has been reducing daily and when I left on Saturday morning there was only one day's supply for the power station.

Throughout the years we have been told, and rightly so I must admit, that we have never yet been let down. We have never been shut down, at least in Port Elizabeth, although Natal has had that experience, but, Mr. President, you will note that in last night's paper there is an article emanating from Port Elizabeth, although it was not the Municpality of Port Elizabeth, to the effect that the collieries forecast that the coal mines have had to limit their output because of the inability of the Railways to move bulk commodities rapidly. And then again they say with winter closing in, the demand for coal for power stations and domestic use is increasing and is expected to reach its peak at the same time as the revival in the flow of coal for export. Now, I don't know just what the inference is or just what they mean by that, but there is no doubt that something should be done to bring this matter to Governmental Heads' notice. I have in

front of me extracts from the *Government Gazette* of 14th June, 1950, in which it is stated that the control of coal has been effected by the Minister of Economic Affairs. He has the sole right to require the owner of any coal producing or any coal mine or coke agent or anyone else to allocate that product in any manner he wishes. He can declare that it shall be delivered to any particular place at any specified time and in any specified period.

That sounds very well and it looks as if we are assured of our requirements, because I don't need to stresss the importance of electricity supply. Someone yesterday said, I think it was the Mayor, from the time we get up until we retire at night we find electricity is at our service in all spheres. Perhaps the difficulty may be increased in value if I say that industry is solely dependent on electricity, and thereby homes and life generally are affected.

If you wish I will read my report, but actually it is just a record of frustrated effort. Mr. Eastman tried everything possible last year as a result of our Convention's resolution to arrange an interview with the powers that be; he was unable to do so. They say "there is no need to see us," and "we have never been let down yet and everything has been arranged." Last week the stocks at Port Elizabeth were down to half a day's supply and I wired the collieries. The reply wired to me was that there were no trucks. I got in touch with the Railways and said: "Well, now, here is a statement, how do you propose to get out of this?" They said: "There is a little truck shortage but that will be remedied within a day or two." There has been no good results from that mode of operation at all, and it is my opinion that we will have to do something further or else there will have to be drastic measures adopted if the station has to close down and all essential services stopped.

I do recommend to this Convention that they think about this matter very seriously. No doubt they are. Those engineers controlling coal burning stations will be thinking very seriously, because Port Elizabeth is not isolated. We happen to be at the other end of South Africa, likewise Cape Town, and it is just we people who are very much afraid of wash-aways. A single line only, for a matter of 200 to 250 miles on the stretch between Port Elizabeth and Bloemfontein is the only means for coal transport, and if any wash-away takes place there Port Elizabeth has "had it". These possibilities give us great concern. Other speakers may wish to put some points, so I will close my remarks for the moment.

Mr. C. G. DOWNIE, Cape Town:

Mr. President and Gentlemen: Cape Town is a bit more fortunate than Port Elizabeth at the moment, we have enough coal in stock to last us ten days, but there is no saying that in a month's time we shall be reduced to what we were in 1948 when all the coal we had in stock was in the bunkers. As in the case of Port Elizabeth when we see our stocks falling like this we appeal to the Railways and they assure us that they have got sufficient trucks; they make the trucks available to the collieries, and then the collieries, in turn, tell us they are not getting enough trucks. As far as the collieries are concerned I understand that they have to make a choice as between using trucks for coal for power stations and local consumption and using trucks to take the coal to the ports for export. But what is disturbing about this regular shortage of coal is the fact that our stocks are reduced to the point where we have nothing except what we have in the bunkers.

And then, gentlemen, finally I ask why don't the Railways start picking up when we have about ten days' stock in hand? No, they don't hold us to ten days' stock, we have to come right down to when we get the jitters and get very worried. It makes one wonder whether this sort of thing is being done deliberately. Today the position is that we do not know where we are in regard to the supply of coal. We have tried in the past to get the Minister of Economic Development to receive a deputation, to listen to our troubles, to get them to do something for us, but nevertheless we do not seem to get anywhere. I strongly support the suggestion that we renew our efforts to get the Minister to receive a deputation from this Association to see whether we can get some practical help from him, or that we can find out definitely where we stand in regard to the supply of coal to the power stations.

Mr. C. LOMBARD, Bloemfontein:

Mr. President, Gentlemen: As Mr. Bradley has indicated before me, most of us are facing the winter without adequate coal stocks in reserve. It has been our experience that the trucks do not arrive at our siding in the same order in which they are dispatched. Some trucks take three or four times as long to reach our siding as others do. This would seem to indicate that there are serious delays on the system while these trucks are in transit. That would probably account for the delays which we all have to experience and all the irritation we have to suffer about these slow deliveries. I think the only thing we can do is to have the whole question of the coal supplies investigated from the point of view of the proper use of the coal trucks. It seems to me that the trucks we have available in the country are not being used to the best advantage.

Councillor E. B. CONWAY, Graaff-Reinet:

Mr. President and Gentlemen: I am not going to make a long speech. I think this is an extremely important matter and it affects all the Municipalities. I want to say this: I do not entirely excuse the collieries from blame in regard to coal, but I am quite definite in my own mind that the delays today are entirely the fault of the Railway Administration. I urge that the incoming Executive should make every effort to see that we get this matter straightened out. In the Municipality which I represent, Graaff-Reinet, we have had our difficulties in the past in regard to coal. I feel that this laxity in the delivery of coal is due to utter inefficiency on the part of the Railway Administration and a great deal could be done to speed it up.

I am also profoundly interested in Mr. Bradley's comments about tariffs. I happen to be a departmental merchant, so I have very fixed ideas about railway tariffs, and not all of them are entirely complimentary to the Railways. I don't know whether you are aware of the fact that about three years ago a Commission of Inquiry was set up to reconsider the whole of the tariff rate. That Commission sat for three years; they have been enjoying themselves for a very long time and I don't think the report has been published yet. I have not seen it. I think that when this deputation waits upon the Minister, if you are successful in arranging for such a deputation, he should be asked to give some definite indication as to what the future railway tariff is going to be on such an essential commodity as coal.

Mr. A. R. SIBSON, Bulawayo:

Mr. President, Gentlemen: We meet here every year and we talk about the shortage of coal, why the situation exists, and details about how long trucks take to get from the point A to the point B and so forth, but all these details are matters which should be attended to by some other body than ours. All we are concerned about is getting the coal and getting it in time.

I think it would not do any harm to spend just a moment considering exactly what would happen if the coal supply to power stations such as those in Cape Town or Port Elizabeth did in fact run right out. We have heard from Mr. Bradley a few moments ago that last week he had half a day's supply of coal. It was obviously a pure accident, a pure miracle that he did not run out of coal on that day. Now, had that happened, those of you who are concerned with the operation of steam stations can fill in the blanks in your own imaginations. You watch the last piece of coal coming down the chute on to the grates and a few moments after that you will see the steam pressure starting to drop and the staff will have to take very, very prompt action. Now, the action called for by the staff would be of a nature with which they would be largely unfamiliar, and it is highly probable that in such an emergency they would not do all the things that ought to be done and done in a very short space of time.

I pass over the things that ought to be done and visualise the situation when the whole station is closed down; it may be for some time, because the effect of a station being closed down is that the electric railways are no longer functioning. So it is possible that the coal which will be brought along will have to be brought by road. Anyhow, some hours will have elapsed before it is possible to start operations again, in fact it may be longer than that. Now, you don't start power stations up by just turning a switch. You have to start setting a new fire; you have to start warming up the brickwork; it will

take at least four hours to do that before it will be possible to say you have raised sufficient pressure to operate the steam pump which is the first thing to be done before the power station can be recommissioned. Then you have to drain the steam ranges, and that takes some time, particularly in a large station. Then you have to start the turbines, and that takes some time with large units. Generally speaking, from the time that coal is once more available to burn in the boilers eight hours may have elapsed before the station can be regarded as being in commission again. Further minor points are that in a large station there is no power to run the coal handling plant, there would be no conveyor-belts operating, and you would have a pretty picture of hundreds of Natives with wheelbarrows carrying coal up ladders in order to get it into the boilers.

Now then, gentlemen, eight hours have elapsed since the arrival of coal before the station can be re-commissioned, plus the time that elapsed from the time that the coal ran out to the time that some more ran in. Now just visualise what has happened to the community in the meantime. There has been no water pumping going on; there has been no sewage pumping going on; there have been no accounting machines working anywhere; commerce has come to a dead stop; industry has been entirely held up; all trains have stopped, especially in a city like Cape Town; there are no traffic signals operating, no lights of any sort; and, in fact, the life of the whole community has come to a standstill.

That, gentlemen, is the situation that is going to exist when another twelve hours have elapsed from the deadline that Mr. Bradley has described to us as existing last week. That is not a long time, twelve hours. How it is that Mr. Bradley's hair is not completely white, I don't know. I suggest that it is entirely wrong that anybody should have such a responsibility placed upon his shoulders. I suggest that your proper course of action is not to permit that situation to arise, and it does lie within your power, gentlemen, to prevent such a situation from arising. Mr. Bradley had a day's supply of coal in his bunkers. That might be extended to at least three days, if he was to provide only essential supplies and power station auxiliaries.

I think you should each consider what period of time you would regard as the margin, the absolute irreducible margin of coal stocks and that you should never permit your stocks to be reduced below that margin of whatever number of days' essential running is involved. Say for example that you decided that under no circumstances should you ever reach the stage where you are unable to keep essential and power station auxiliaries operating for less than three days. That is a very short period of time for such small supplies. Let us assume that one day's normal running is equivalent to three days' running on auxiliaries and essential supplies. That would mean that the moment your stocks drop to one day you would forthwith cut off all supplies to all consumers other than the essential ones in order to spin out the amount of coal you have left for a period of at least three days, which I consider is the very minimum which one should have in hand against emergencies such as can arise on the railway system.

Now, gentlemen, that would only have to be done once, only once, in your city before there would be such a hullabaloo that somebody would have to do something about it. I am not suggesting this in a frivolous way, or merely as a threat to consumers or to the Government. It is a proper and a logical and a correct thing for engineers to do and for councillors to do to safeguard the essential supplies and to reduce the danger of their being discontinued for lengthy periods. I think that is a matter you should give very serious consideration to. I know you cannot finalise a thing like that at this Convention, but I suggest that you go back to your Councils and place before them the proposition that in future when your coal stocks drop to one day that you forthwith disconnect the majority of your consumers in order to maintain supplies to those that are most essential and in order to maintain power station auxiliaries and thereby prevent the very drastic consequences that a total shut-down would involve you in.

Mr. C. R. SPRIGHTON, Standerton:

Mr. President and Gentlemen: We have heard a lot of surmising what would happen but I think there are those of us who have already experienced what would have

happened. The Municipality I represent, Standerton, has been in the position already where we have totally run out of coal which meant closing down on more than one occasion.

The first occasion we were fortunate enough to borrow coal from a nearby industry, the South African Condensed Milk, and we could keep going by carting the coal by lorries for two days. Eventually their stock ran out as well, or they got down to a point where they could supply no more; that meant that we had to close right down.

The second occasion we were told that the coal had left the colliery, and on inquiring from the Railways were informed that they knew nothing about it. The trucks had at some time or other come into the siding and had gone out again, or I should say, into the railway station. Whether they reached Port Elizabeth or Cape Town, I don't know, but anyway their coal was kept going, whether at our expense or not I don't know, but we were without. We had immediately to start phoning up the big consumers, the industrialists, and request them to reduce load. The following day we asked them to reduce still further. Now, these industries are run by continental people, who, I think it is accepted, have rather a peculiar temperament and they did not take to the idea at all. While there was power they wanted it. They were not concerned about the housewives who were to cook our meals; they had employees they were paying, and as long as they had to employ and pay them they wanted to keep them in work and they wanted power.

I think in the larger municipalities like Cape Town and Port Elizabeth the engineer does not know all the inside story. He has not had the housewives phoning him up. He has an assistant and everything goes to the assistant. In the smaller municipalities definitely the engineer gets all that. He has to shoulder all the responsibility, and, as the Americans say, he has to carry the buck himself. When the housewives start it is worse than the continental industrialists.

To get back to the serious side, Standerton now is changing over from its steam, and we haven't got that problem, but I would like the Association to know that it has Standerton's engineer's support in anything they would like to do or anything they intend to do to try and better the position of coal supplies.

Mr. E. L. DAMANT, Manager Natal Undertakings, Electricity Supply Commission, Durban:

Mr. President and Gentlemen: I agree fully with what has been said by many speakers and particularly by Mr. Downie. Up to the present I thought I held the record of being in charge of the only power station to be forced to shut down through lack of coal, but our station has been shut down once only, and the station of our friend the last speaker has been shut down many times. My sympathies are with him. I do not need to stretch my imagination as Mr. Sibson has invited us to do. I know exactly what happens. I also have the continental industrialists; I also have housewives to contend with and my assistant has the happy knack of disappearing when the housewives come along.

It would appear to me that many of the speakers do not understand the whole of the issues that are involved. It is not just so simple a matter as one of transport. There are other problems that are very difficult to solve and we have got to realise that both the collieries and the Railways have those problems to solve. Mr. Downie suggested certain things in regard to the collieries. There are no other speakers as far as I can gather who have even thought on the same lines as Mr. Downie. I suggest that the collieries have their problems and, therefore, it is not only the Railways that we have to approach. The collieries have a trade which is a controlled trade. They have a large export business to which they sell large-size coal. They have a bunker trade. They have a trade of various sizes and quality of coal all of which carry different monetary returns to themselves. The coal which we burn comes from their total output and is a natural arising. Their trade for the export business and the bunker coal is an extremely variable one. They don't know when the ships are coming in and have very little storage capacity at the ports for these ships' supplies. It costs many hundreds of pounds a day to keep a ship lying idle in the docks so they must have the coal literally on call. The natural

result is that when they receive trucks the tendency is to send most of the trucks to the ships with the best quality coal which is the coal from which they obtain the greatest return. So you see there are many problems that they have to solve and there are many problems that the Railways have to solve because they have seasonal traffic just the same as the collieries have seasonal trade.

I don't think it is much use approaching the Railways by themselves. I think if you want to get a hearing you will have to find the facts first and you should endeavour to seek the assistance of the collieries. I suggest that be done first. Thereafter, if some measure of success is obtained in this approach a joint meeting of representatives of this Association, the collieries and the S.A. Railways might be arranged.

I also concur with Mr. Downie's suggestion that power stations be permitted to retain a minimum emergency stock to safeguard them against untoward interruptions to regular supplies of coal. In my opinion this is perfectly feasible and possible if the will were there on the part of those concerned to arrange it.

Mr. FRASER, Johannesburg:

Mr. President, Gentlemen: You may be under the impression that it is only the coastal towns that suffer from this disadvantage, but Johannesburg has been placed in a similar position as I pointed out this morning. We have endeavoured since last summer to accumulate a stock of coal to meet our winter loads. Mr. Damant has given you the facts. I have been on various sub-committees appointed by this Association. We have met the Minister of Economic Affairs; we have also met the Railways officials and the coal owners but the responsibility has just been switched from one authority to the other. I don't quite know what the answer is, but I feel there is a lot in what Mr. Damant said that we should form a further committee to try and sift this matter a bit further and perhaps we will be better off when we again approach the Ministers or the Railways officials.

I feel, gentlemen, that it is criminal for the Railways or for the collieries to place power station engineers in the position they are doing today. Power station engineers have enough trouble on their shoulders what with shortage of materials and shortage of labour without being short of coal, because as far as we can see there is plenty of coal in the country. In Johannesburg's case these last few weeks we have proof that the trucks have been loaded at the collieries and they have taken twice and three times as long as they should do to reach the power station. We insist now that the trucks when they are loaded at the collieries should have the date they are loaded put on them so that we can tell how long the trucks have taken to reach us. The Railways admit that there is a shortage, either of trucks or of engine power, at the present time. My experience in interviewing the Ministers has not been what one may call satisfactory. One Minister palms you off on to another, but I do feel that the voice of this Association should be heard—and Mr. President I am sorry to say that I do not see any Press here this morning, because some publicity, some propaganda, will no doubt have more effect than deputations to the Minister. I do think it is a vary serious matter and this Association should exercise all the authority that it has to try and bring this question to finality.

Mr. D. A. BRADLEY, Port Elizabeth:

I thank the speakers who have followed me because apparently I am not the only one who is in trouble on this issue. Mr. Damant's remarks have been something, I think, to add to my remarks of the necessity of having requisite coal stocks. Sir, just to close this discussion—it is getting late—I suggest for the consideration of this Conference, and I now move the following resolution:

> "That in terms of Government Notice appearing in *Government Gazette* No. 4427, dated 14th July, 1950, that the Government be called upon to take advantage of the powers provided and take the necessary steps forthwith to implement these measures."

If you are not aware of the powers in that Government Notice I shall read them with the permission of the President:

> "(1) No person shall export from the Union any coal or coke produced within the Union except with the consent of the Assistant General

Manager (Operating) South African Railways granted on the recommendation of the Secretary for Commerce and Industries and on such conditions as may be specified.

(2) The Secretary for Commerce and Industries may require the owner of any specific grade or kind of coal or coke, or his agent, to sell to any specified person, at a price fixed by the Secretary, a specified quantity of such coal or coke and deliver such coal or coke to such person within a specified period at a specified place.

(3) The Assistant General Manager (Operating), South African Railways, may, in consultation with the Secretary for Commerce and Industries, regulate the transport, storage and handling of coal and coke intended for inland consumption or for export as cargo or as bunker.

Note.—Attention is invited to Regulation 37 of the Regulations contained in the annexure to War Measure No. 146 of 1942 (Proclamation No. 319 of 1942) which prescribes the penalty for any contravention of the provisions of this Order."

I think, sir, all the powers required to give us the necessary coal is embodied in the measures stipulated.

The PRESIDENT:

Gentlemen: you have heard the proposition by Mr. Bradley. Is there a seconder to that resolution?

Mr. C. H. ADAMS, Oudtshoorn, seconded.

Mr. J. C. FRASER, Johannesburg:

Before you put the resolution, Mr. President, I think we should seriously consider the position. I personally do not think that the resolution which Mr. Bradley has read out will help this problem. I think we have to take far more drastic steps than that suggested by Mr. Bradley. "This Association again views with alarm the shortage of coal at power stations and that it calls on the Executive Council to take immediate steps to interview some authority to put the matter right." I would like such a resolution adopted rather than the one suggested by Mr. Bradley.

Mr. A. R. SIBSON, Bulawayo:

Mr. President: May I suggest an amendment: "That the whole question be referred back to the Executive from this Convention, having taken due note of the remarks that have been made this morning, with the request that the Executive take such steps as they may deem desirable to bring the matter to a head."

Mr. C. G. DOWNIE, Cape Town, seconded.

PRESIDENT:

Gentlemen: time is getting on, so I will put the amendment first:

"That the question of coal supplies to power stations be referred back to the Executive of this Association and that due regard be paid to the remarks made at this meeting, and that such steps be initiated as the Executive deems desirable to bring the matter once again before the Government."

Those in favour? Those against?

The Amendment is carried.

After a few announcements were made by the President, the Conference adjourned for tea.

Convention resumed at 2.30 p.m.

PRESIDENT:

Gentlemen: it gives me great pleasure in calling on Mr. Frantz, Chief Technical Officer of the Cape Town Electricity Department, to deliver his paper on "Economics in the Electricity Supply Industry."

"ECONOMICS IN THE ELECTRICITY SUPPLY INDUSTRY

By A. C. T. FRANTZ, B.Sc., A.M.I.E.E., A.M.I.Mech.E.,

Chief Technical Officer, City of Cape Town Electricity Department

1. INTRODUCTION

The fact that electricity is playing an increasingly important part in modern civilisation is now generally accepted and load shedding, because of inadequate plant capacity or shortage of supplies of fuel or water, since the end of World War II, has

made the general public more aware of the valuable service that an electricity undertaking renders to a modern community. In South Africa electricity consumers have been fortunate in this respect but news from overseas and occasional local breakdowns have caused the public to realise more than ever how dependent they are on the service rendered by the electricity undertakings.

Being a public utility demands efficient, courteous, expeditious and continuous service at minimum cost and the object of this paper is to draw attention to the manner in which the principles of economics can be applied to electricity undertakings to enable them to reduce the cost but not the quality of their services.

The demand for electricity continues to grow in magnitude and in a widening field. In the urban areas, which are already highly developed, the consumption of electricity is increasing steadily but there are far larger areas as yet undeveloped and there is still a great field for developing the use of electricity in agriculture. Unfortunately the increasing capital cost of generating and distribution plant tends to retard such development and makes a careful study of the economics of the problem more than ever essential if the costs to the consumer are to be kept as low as possible and tariff increases are to be avoided.

It is an unfortunate circumstance for the electricity supply industry that electric energy cannot be stored in any appreciable quantities so that an electricity undertaking must always have available sufficient plant to enable it to supply instantly the highest demand. The result is that electricity undertakings become heavily capitalised to the extent that capital charges form anything from 33 to 50 per cent of the cost of production. When it is remembered that the capital cost of generating plant, which before the 1939-1945 war was something like £20 per kW, now costs up to £70 per kW and the cost of distribution plant shows similar large increases, it is not difficult to imagine the effect of the increased capital charges on the revenue and expenditure accounts of the undertakings.

When the provision of new or additional generating plant or distribution plant becomes necessary, a careful survey of the position should be made and economic principles applied, so as to be reasonably sure that the plant which it is decided to purchase and install will, as nearly as can be estimated, provide a satisfactory service at the lowest possible cost. Typical questions to be answered in this connection are size of units, whether outdoor or indoor installation is to be adopted, whether automatic voltage regulation should be installed in substations or not and other similar far-reaching decisions have to be made. This might be called the "design" stage and the calculations made must necessarily be based on estimated figures of capital costs, maintenance costs, cost of losses, etc.

Having decided on the type of plant, size of units, etc., to be provided it is necessary usually to call for tenders, on receipt of which it is the duty of the person in charge of the undertaking to recommend for acceptance that tender which will be in the best interests of the undertaking. It is here that the question of economics comes very much to the fore. The temptation to accept the lowest tender is always very great, particularly now that the cost of the equipment is so very much more than it was twelve years ago and probably more than was budgeted for in any case. But a critical examination of all the circumstances is very necessary if the undertaking is not to fall into the trap of being "penny wise and pound foolish", for very often it can be shown that it is not always the cheapest tender which results in the lowest overall costs.

In the larger undertakings these things are probably well known but there must be many of the more numerous smaller undertakings where a statement such as "This particular transformer, although costing so much more to buy, will actually cost you less in the long run" is not understood and frequently not acted upon. And it would be well nigh impossible to get some people to turn down a piece of plant or machinery offered to them for nothing and choose something relatively expensive with what looks like only slightly better efficiency, but which in fact will cost less to own and operate than the machine to be supplied free.

This paper is therefore an attempt to show those responsible for the management and running of electricity undertakings

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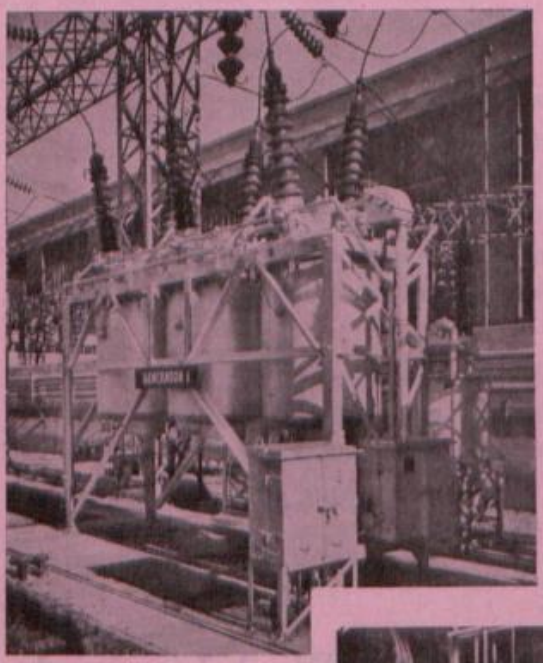

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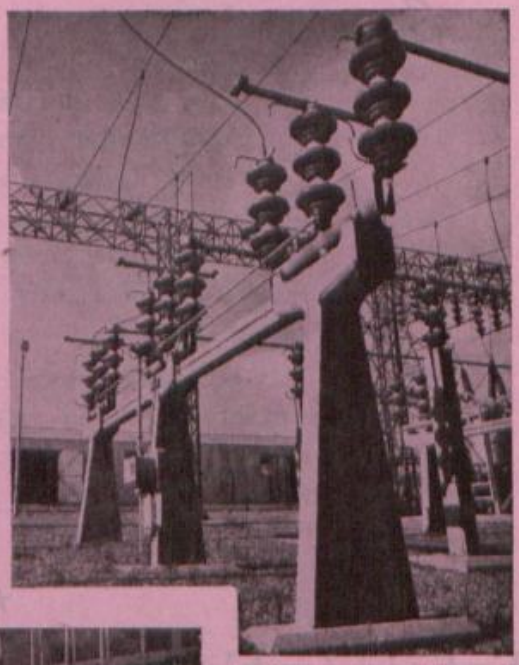

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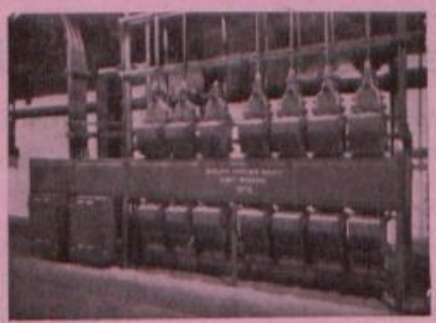

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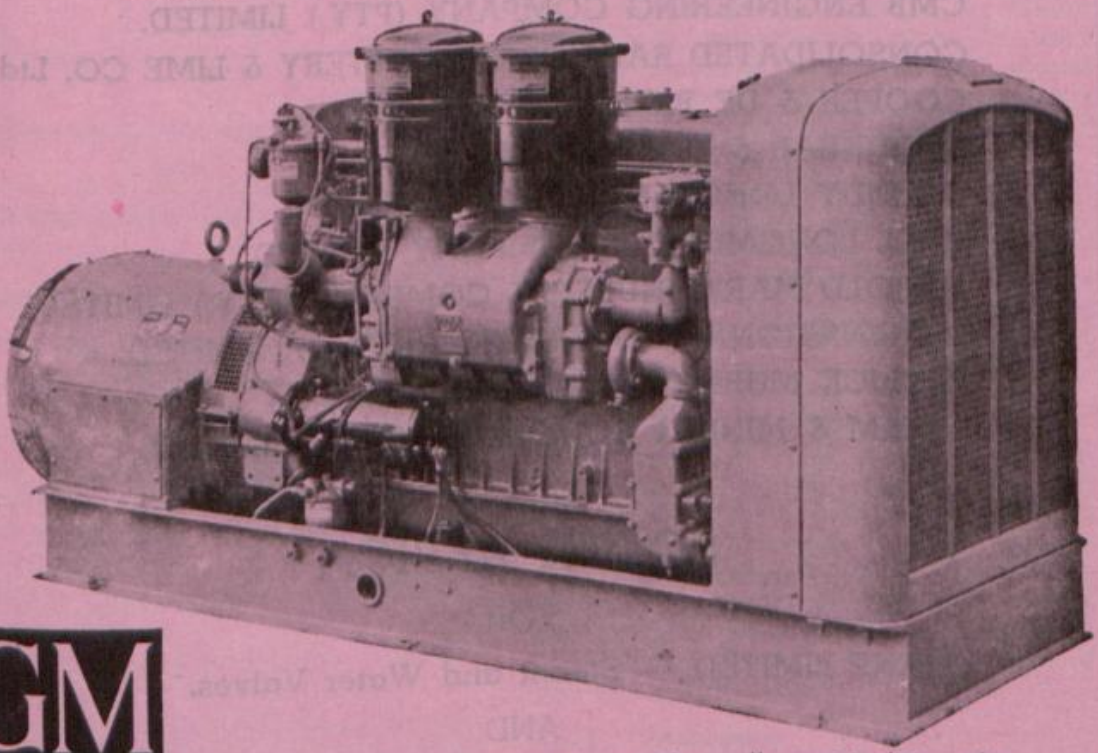

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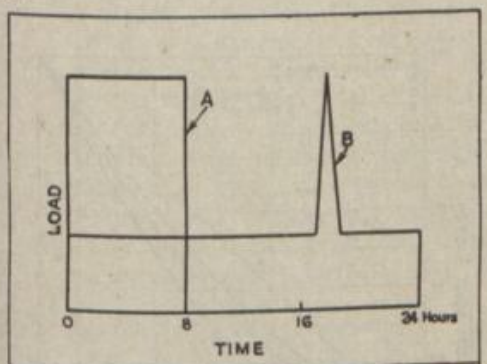
how the principles of economics can be applied to determine which of several alternatives is likely to be in the best interests of the undertaking.

Having purchased and installed the plant the question of the most economical method of operating it arises. The capital charges are high and once having purchased the plant there is nothing that can be done to reduce them. Costs can only be reduced by concentrating on efficiency and here again the principles of economics come to the fore.



DAILY LOAD CURVES – LOAD FACTOR 30%.
Fig. 1.

2. ECONOMIC PRINCIPLES

2.1. Bases for Comparison of Costs

Before proceeding to show when and how economic principles can be applied, it is essential to be quite clear that the object to be achieved is a comparison of cost of alternative schemes or designs, and to select a basis which will give the most useful comparison.

There are three bases for comparison, namely:—

(*a*) Cost per year, known as the "Annual Cost Basis";

(*b*) Cost per lifetime of the plant, known as the "Capitalised Cost Basis"; and

(*c*) Cost per unit of output or service, known as the "Unit Cost Basis".

2.1.1. Annual Cost Basis

For this purpose the period covered is the expected life of the plant. The annual cost will include three main items, namely interest, depreciation and operating expenses. Interest per annum is simple to calculate and so is depreciation once a proper method has been decided upon. Operating expenses may involve some difficulties but expenses which are common to all alternatives do not affect the issue and may therefore be ignored.

As the "lives" of various alternatives within the range requiring consideration are usually expected to be the same, the annual cost basis is the one commonly used. It is simple and easily understood by the layman and avoids any ambiguous references to "capitalised values".

2.1.2. Capitalised Cost Basis

The principle of this method is to compare the total cost, over the lifetime of the plant, of the various alternatives. Instead of interest and depreciation the main items are now first cost and salvage value. The first cost is known, the salvage value can be estimated but as it occurs only at the end of the life of the plant the *present worth* of the salvage value must be used in the calculation. Similarly annual operating expenses must be converted into one lump sum (*i.e.*, "capitalised").

This method is therefore a more academic one as compared with the annual cost basis, but is useful in cases where there is no salvage value and it has the further advantage of converting small annual savings into a large lump sum which is more impressive and more likely to carry weight with a committee.

2.1.3. Unit Cost Basis

The unit cost basis method is useful when the life of the asset is short and depends not on time but on the use made of the asset, *e.g.*, electric lighting. In such cases the interest on the capital cost is negligible compared with the depreciation and the only proper basis of comparison of various alternatives is on the basis of cost per unit of output.

2.1.4. Procedure

Having decided on the basis on which a comparison is to be made it is necessary to

(1) collect all the relevant data, bearing in mind the object of the comparison;

(2) calculate and tabulate the various items of cost (omitting of course those which are common to all alternatives). If only a few alternatives are being considered it will be necessary to compare totals only,

but if a whole range of alternatives is being investigated, it may be more useful to plot a graph;

(3) the final stage is to compare alternatives and make a choice. If the costs work out fairly closely this may not be easy.

2.2. Costs to be Considered

The various items of cost which are to be tabulated may be roughly divided into two types:—

(1) Costs entailed in the plant or asset itself;

(2) Costs entailed in operating the plant or a set.

As the whole basis of comparison rests on these costs it is important that they should be carefully considered.

2.2.1. Costs entailed in the Plant itself

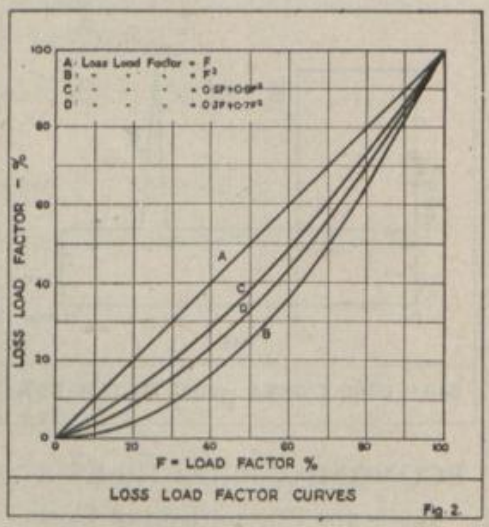
(*a*) *Interest*

In the case of electricity undertakings capital expenditure (except in the case of major replacements which may be financed out of a reserve fund) is paid for out of loans raised for the purpose. For the use of the money interest is payable; the rate of interest will of course depend on the state of the capital market, but if the loan has already been raised it will be known. If a loan has still to be raised it is usually possible to estimate fairly accurately what the rate of interest is likely to be.

The first item of costs to be considered is thus "interest" on capital and knowing the capital cost and the rate of interest, the interest charge is at once known and is a fixed amount each year.

(*b*) *Depreciation*

Next it is necessary to make provision during the life of the plant for the replacement of the capital because all plant has a limited life. The cost of making such provision is known by various names such as Depreciation, Loan Redemption or Sinking Fund. From the point of view of economics the object is, however, the same in all cases, namely to provide by means of regular payments, a sum of money which, together with the salvage value of the plant, will at the end of the useful life of the plant amount to the original cost of the plant. The money then available can be used to repay the original loans and new plant can be purchased out of a new loan; these, however, are matters of finance and do not affect the economics of the case.



LOSS LOAD FACTOR CURVES

Fig 2.

(*c*) *Useful or Economic Life*

The first step is to decide what the "life" of the plant is likely to be, and in applying principles of economics, it is the economic or useful life of the plant and not the physical life, which has to be determined. Long before the end of the plant's physical life, that is when the plant through wear and tear and accidents cannot function any longer, it may be desirable on the grounds of economy, improvement of service, or because greater capacity is required, to replace the plant and end its economic life.

What the economic life of any plant is likely to be is of course only an estimate and it depends upon a large number of factors including such considerations as the effect of improvements in design, new developments, etc. The extent to which such estimates can vary is shown by the following table:—

ESTIMATED ECONOMIC LIFE—YEARS

Land	60			
Buildings (brick, stone or concrete)	30	50	50–80	50–75
Wooden Structures	15			25–50
Generating Plant and Machinery	20	20		
Transformers		26		15–20
Distribution Switchgear		31		
Overhead Mains	25	37–42		20
Underground Mains	40	40	35	20–25
Meters	10–15	20		12–20
Vehicles	7–10	10		
Storage Batteries	7		15	11–20

For whole generating plants it is usual to assume an economic life of 20 or 25 years, with a life of 30 years for distribution plant as a whole, but when it comes to detailed comparisons between alternatives for various portions of such plants it may be necessary to assume other lives. For instance, storage batteries have a relatively short life.

(d) *Residual or Salvage Value*

For the purpose of calculating the annual depreciation charges it is necessary also to estimate the residual or salvage value of the plant at the end of its "life". The residual value may be positive or negative, the latter obtaining when the cost of removing the plant is more than its value as scrap. The residual value may be nil, for example in the case of cables, the cost of reclaiming which may exceed the value of the scrap copper and lead. In this event the cable would have to be left in the ground.

The total depreciation to be provided for is the first cost less the residual or salvage value.

(e) *Depreciation on Annual Cost Basis*

To arrive at the annual charges the total depreciation to be provided must be spread over the life of the plant. Now there are a number of ways of arriving at the annual charge, the three most common ones being:—

(i) Straight line method—the total depreciation is merely divided by the number of years of life and the resultant sum is put aside each year. It is obvious that at the end of the life of the plant more than the required amount will have been accumulated because of interest on the annual payments. The "straight line method" is therefore one which ignores interest and for that reason is inaccurate.

(ii) Reducing Balance Method—this method provides for repayment of the loan by instalments while at the same time providing for depreciation. The annual charges vary, however, to such an extent as to be of little practical use for estimating purposes and in any case electricity undertakings do not normally repay loans in instalments.

(iii) Sinking Fund Method — this method provides for equal annual payments which bear interest at the same rate as the original loan or at some other rate. It is the obvious method to use and is quite simple—the annual amounts are readily determined from tables such as those given in Appendix "A".

2.2.2. Costs Entailed in Operating the Plant

Having dealt with the costs entailed in owning the plant, namely interest and depreciation charges, it remains to consider how the costs of operating the plant enter into the economic picture.

Obviously when comparing alternatives, costs which are common to all alternatives need not be considered. For the range of problems encountered in the electricity supply industry costs such as operating,

maintenance, etc., are usually common to all alternatives, but instances may arise when totally different types of machines to do the same job may require consideration. In that case if the estimates for the cost of operating and maintaining the various types of machines are not the same, they must also be brought into the calculation.

Normally, however, the only costs to be considered are the costs of the losses in the plant, *i.e.*, its efficiency. In electrical plant the losses may be broadly classified as

(*a*) "fixed" losses which are independent of the load such as the iron losses, shunt copper losses, friction or windage, and

(*b*) the variable or series copper losses which depend on the load.

The fixed losses are readily determined, but when it comes to evaluating the variable losses allowances have to be made for the fact that the plant is subject to load variations and that the losses vary according to the square of the load. Now the load is varying all the time and as we are dealing with the future it is not even known very accurately how the load will vary. One or other of the following methods may therefore be adopted to evaluate the losses:—

(1) Using the mean current or load;

(2) Using the mean current or load multiplied by some constant;

(3) Estimating from a formula involving the load factor.

The mean current method is obviously inaccurate because it results in the losses being estimated too low. The second method assumes a load curve of a certain fixed shape and as the shape is by no means fixed the results are no more reliable than those of the first method.

The third method of estimating losses from a formula involving the load factor seems to be the one generally adopted and it results in the losses being expressed as a certain fraction of the losses at full load. This fraction is known as the "loss load factor".

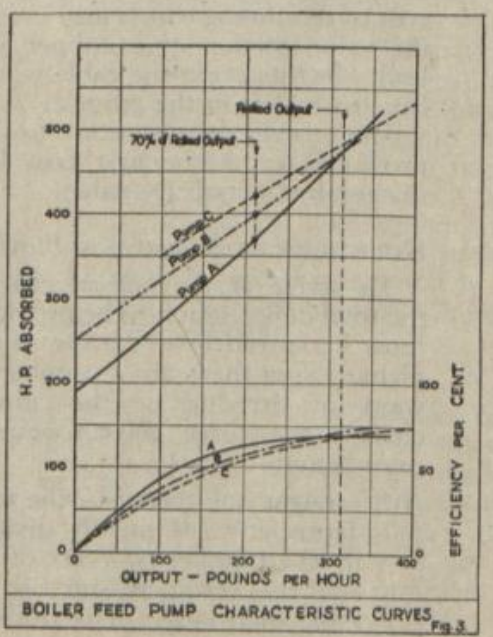
Consider for example the two load curves shown in Fig. 1. Both have a load factor of say "F" and the maximum load in both cases is say "I". In the case of the load curve "A" the losses would be the highest possible and would be proportionate to I^2F. On the other hand if the load curve was one like "B" the losses would be the least possible and would be proportionate to I^2F^2. The losses in case "B" are therefore "F" times the losses in case "A", "F" being a fraction. In case "A" the "loss load factor" is thus "F". In case "B" it is "F^2".

In practice of course the load curve is neither like "A" nor like "B" and lies somewhere between the two and assuming the actual curve to lie midway between the two we get a loss load factor of $0{\cdot}5F+0{\cdot}5F^2$. This assumes that half the consumption takes place at the maximum current.

Actually in practice the consumption at peak load is less than half so that the formula for loss load factor of $0{\cdot}5F+0{\cdot}F^2$ gives rather too high a value.

There have been numerous attempts to arrive at a more accurate formula and various formulae such as $(0{\cdot}3F+0{\cdot}7F^2)$, $(0{\cdot}2F+0{\cdot}8F^2)$, $(F^2+{\cdot}07)$ and so on have been quoted by investigators.

The loss load factors based on some of these formulae have been plotted in Fig. 2 on a base of load factor. It will be seen that the formulae $0{\cdot}3F+0{\cdot}7F^2$ seems to lie between the extremes and is therefore likely to be the one to give results closest to the actual losses.



3. EXAMPLES OF ECONOMICS IN THE ELECTRICITY SUPPLY INDUSTRY

In the electricity supply industry the type of problem that usually arises is one of finding the least expensive method of giving some efficient service and it resolves itself ultimately into having to choose one of a number of alternatives, *e.g.*:

(i) To choose the best from different sizes of the same type of plant;

(ii) To make a choice from different types of plant, *e.g.*, overhead vs. underground mains, rectifiers vs. converters;

(iii) To decide on which is the most economic of different qualities, *e.g.*, high efficiency vs. low efficiency.

Problems of the types described under (i) and (ii) do not arise very often and are usually decided by an outside factor not amenable to economic treatment, *e.g.*, the question of noise when considering rectifiers vs. converters or the aesthetic effect of overhead mains as compared with underground mains. We all know for instance that underground mains cost more than overhead mains and it is merely a question of whether the undertaking and in the ultimate the consumers are prepared to bear the extra cost of underground mains for the sake of preserving the beauty of the town.

The problem, however, is usually more simple than this and resolves itself into a choice between two or three alternative quotations for items of plant or equipment, all equally satisfactory in all other directions but different economically because of differences in price and efficiency. Some specific cases will now be dealt with.

3.1. Generating Stations

3.1.1. Choice of Plant

It is not often that one is called upon to select power station plant but when such cases do arise, it is very necessary to consider the economics of each case. The principles can be applied to boilers, generators, condensers, pumps and fans. The high capital costs of power station plant and the difficulty of raising sufficient loan funds greatly increase the temptation to accept the lowest tender offering probably the least efficient plant, and if fuel costs are not excessive, it may prove economically sound to accept the lowest. But it must be remembered that the plant will be expected to last at least 25 years and allowance must be made in the calculations for possible increases in fuel costs.

It may not be generally realised that a power station is by far an electricity undertaking's largest consumer. Take for example the case of the Table Bay Power Station whose auxiliaries in 1950 consumed roughly 43,000,000 units or 6 per cent of the units generated. This is about 3½ times as much as what the city's biggest consumer of electricity used in 1950 and at 1·1 lbs. of coal per unit represents about 24,000 tons of coal costing £38,000. If the units consumed by the auxiliaries could be reduced to 5 per cent of the units generated, there would be an immediate saving of £6,000, which amount, when capitalised at 7 per cent, means that additional capital expenditure up to a maximum of £86,000 would be economically justified in attaining the higher efficiency.

Auxiliaries in a power station, now almost universally electrically driven, run continuously for 24 hours per day and 365 days per year, although not every one of them and perhaps not always at full load. It is evident therefore that small improvements in the efficiency of the motors, pumps or fans can result in substantial savings in the cost of electricity consumed by them and additional capital expenditure to obtain the higher efficiency can be easily justified.

As an example, consider the case of three electrically-driven boiler feed pumps required for a new power station. Three alternative makes of pump and motor are offered and all equally satisfactory from the technical point of view. A graph of pump efficiency and power absorbed by each make of pump plotted on a base of pump output is shown in Fig. 3. The prices of the three alternative makes of pump are:

Pump A: £19,860
Pump B: £20,640
Pump C: £14,500

From the graph it is evident that at rated output there is not much to choose between the three makes of pump and at this output the much lower cost of pump "C" will outweigh the additional cost of

	Make of Pump	A	B	C
(*a*)	Total Price for three pumps	£19,860	£20,640	£14,500
(*b*)	Pump H.P. at 70% rated output	370	400	420
(*c*)	Motor efficiency	93·5%	93·5%	93·5%
(*d*)	kW. required by motor	296	319	335
(*e*)	Capital charges per annum.	£1,390	£1,445	£1,015
(*f*)	Cost of electricity consumed by two pump motors running 8,760 hours	£4,560	£4,920	£5,160
(*g*)	Total cost per annum (*e*)+(*f*)	£5,950	£6,365	£6,175

electricity consumed because of the lower efficiency of this pump.

It must be borne in mind, however, that boiler feed pumps rarely run at rated output continuously 24 hours per day, and of the three pumps to be installed, it would be safe to say that two of them would, over the annual period of 8,760 hours, run at not more than 70% of rated output. From Fig. 3 it is immediately evident that the choice of Pump "A" might well be economically justified. The calculations to prove this are set out in the above table. They are based on an economic life for each make of pump of 20 years, interest and sinking fund charges totalling 6% per annum and a coal consumption of 1·1 lb. per unit generated, coal costing 32/- per ton.

Assuming that all three pumps are made by manufacturers of repute, and are, apart from differences in efficiency, equally satisfactory from a technical point of view, the economic lives can be said to be the same and maintenance costs, which would be common to all three alternatives, can be ignored. All that is necessary therefore is to compare the sum of the capital charges and operating charges (represented by cost of electricity consumed) in order to make an economic choice.

It is evident from the table that pumps made by "A" would, under the conditions assumed, be the most economical choice.

If, however, the cost of coal were only 6/- per ton it would be found that pump "C" would be the most economical one, but if, on the other hand, the cost of coal should rise to 74/- per ton or more (and in Great Britain it is not much below this figure) it would not be a paying proposition to install the less efficient pumps made by "C" even if they were supplied free of charge.

Similar considerations apply of course to the choice of all items of plant in power stations.

3.1.2. Operation of Power Station Plant

The problem of the operation of power station plant in a manner calculated to result in the highest overall efficiency is a different type of problem.

It is not a matter of purchase of plant but is a problem of the best way to divide a certain load (which of course is continually varying) between a number of boilers or generators. The boilers or generators may all be of the same type and output or they may not.

Operating practice in this respect can be divided into two main methods:

(*a*) One is to run as large a number of boilers or generators as possible at constant load—usually at their most economical ratings—and let the rest of the plant cater for the load fluctuations.

(*b*) The other is to let all the plant share in carrying the load fluctuations.

For the former method it is claimed that because the bulk of the output is produced by plant running at its most economical rating, the plant as a whole is producing as efficiently as possible. Supporters of the second method, however, claim that the poor efficiency of that part of the plant carrying the whole of the load fluctuations is more than sufficient to offset the higher efficiency of the base load plant.

The problem is, however, amenable to a simple solution which can be proved mathematically. Suppose that in Fig. 4 the curves η_A and η_B represent the efficiencies of two boilers plotted on a base of boiler output. From these curves can be derived the curves "A" and "B" for the boiler inputs, using the relationship:

$$\text{Input} = \frac{\text{Output}}{\text{Efficiency}}$$

Now it can be shown mathematically that for minimum total input for a given

output from a number of generating units the individual units must operate at points of equal slope on their input-output curves, *i.e.*, at points where the rates of change of input are equal. The term "rate of change of input" is sometimes also referred to as "the incremental rate". This incremental rate varies over the whole range of output and for a graphical solution it is simpler to draw the "incremental rate curves" on the basis of output as shown in Fig. 4 by the curve "A_1" and "B_2". A horizontal line, such as $P_A - P_B$, drawn through these curves thus determines correlated values of output which will give lowest total input for the required total output. Each such horizontal line represents the most economical division of a certain total output, so that a scale of total output can be added to the graph of incremental rates, as indicated on Fig. 4. This scale is not uniform, it is therefore shown in Fig. 5 redrawn to a larger and uniform scale. From such a chart the load distribution between units of plant for a total output can readily be determined.

From such incremental rate curves the following can be deduced:

(i) When all units of a plant are alike (and therefore the incremental rate curves are coincident) the most economical method of operation is for all units to share the load equally.

(ii) When the units of a plant have different characteristics the total load should be so divided amongst them that the individual units operate at points such that the incremental rate is the same for all units.

If one of the units has an incremental rate curve which lies wholly above or below the incremental rate curves of the other units there is no point at which it can be said that all the incremental rates are equal. In such cases minimum total input is obtained if that particular unit carries all the load fluctuations while the other units operate at their respective points of lowest or highest incremental rates.

Now it will be appreciated that it may not always be easy to arrange for the most economical load distribution among units of a plant. With continually fluctuating load on say a number of boilers in a power station, the maintenance of the most favourable conditions of combustion is difficult unless some automatic control system is provided. While automatic load distribution controls can be applied to a number of similar boilers, no such system has apparently yet been devised for a number of boilers of different characteristics.

These are probably the reasons why the practice of base load operation, with one or two units carrying the fluctuations, is preferred in many instances and one usually finds that in such cases the more efficient units are run at a steady base load and the "swings" are carried by the less efficient units. This method of operation is, however, less economical than allowing the more efficient units to carry the fluctuations, as will be seen from the following considerations.

Suppose the boiler "B", whose characteristics are shown on Fig. 4, is replaced by a boiler "C" whose incremental rate curve "C_1" is shown dotted. This curve is practically horizontal, *i.e.*, the incremental rate over the range of output from 10,000,000 to 45,000,000 B.T.U.'s is fairly constant. Consequently the output of boiler "A" could be kept within the limits 37,000,000 to 40,000,000 B.T.U.'s while the output of boiler "C" ranged from 10,000,000 to 48,000,000 B.T.U.'s, and the requirement of minimum total input, namely that both units operate at the same incremental rate, would be complied with.

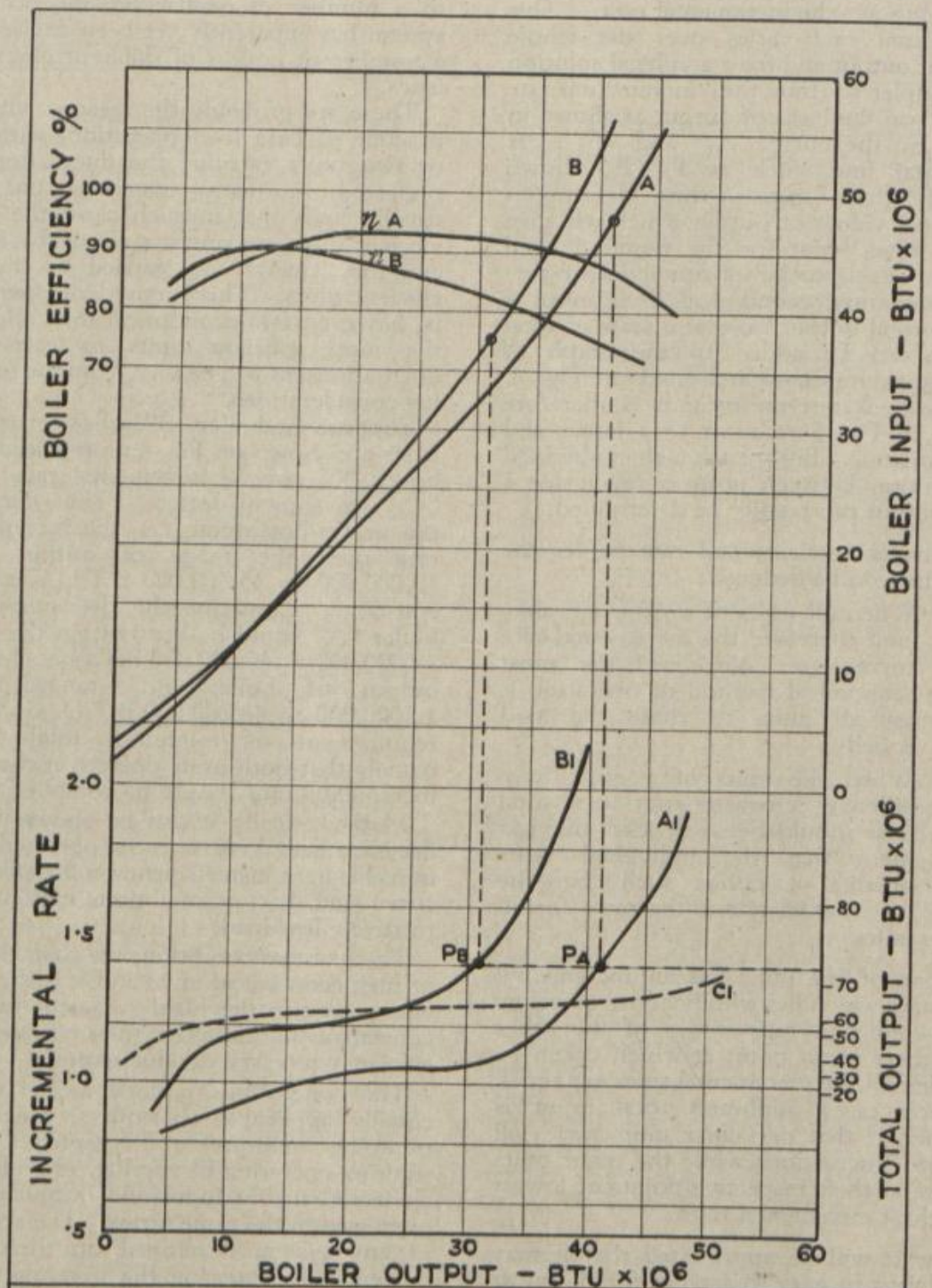
Mathematically it can be shown that a flat incremental rate curve is obtained from units having a high efficiency, a flat efficiency curve and having minimum efficiency at relatively low load.

The first two conditions are characteristic of high economical units and it is therefore wrong to run the highly efficient units at constant load and allow the units of lower efficiency to carry the fluctuations.

The conclusions reached are of course equally applicable to boilers, generators, pumping stations or complete power stations operating in parallel, provided the characteristics of input and output can be expressed in the same terms. The accuracy of any system developed on these lines depends of course on the basic data used for the determination of the incremental rates.

3.2. Distribution of Electricity

It is perhaps on the distribution side of an electricity undertaking that most opportunities occur for the application of principles of economics to the selection of plant and equipment. In a growing undertaking the distribution system is continuously expanding and the annual expenditure on underground cables, overhead lines, substations, transformers, switch-



TYPICAL CHARACTERISTIC CURVES FOR BOILERS. Fig. 4.

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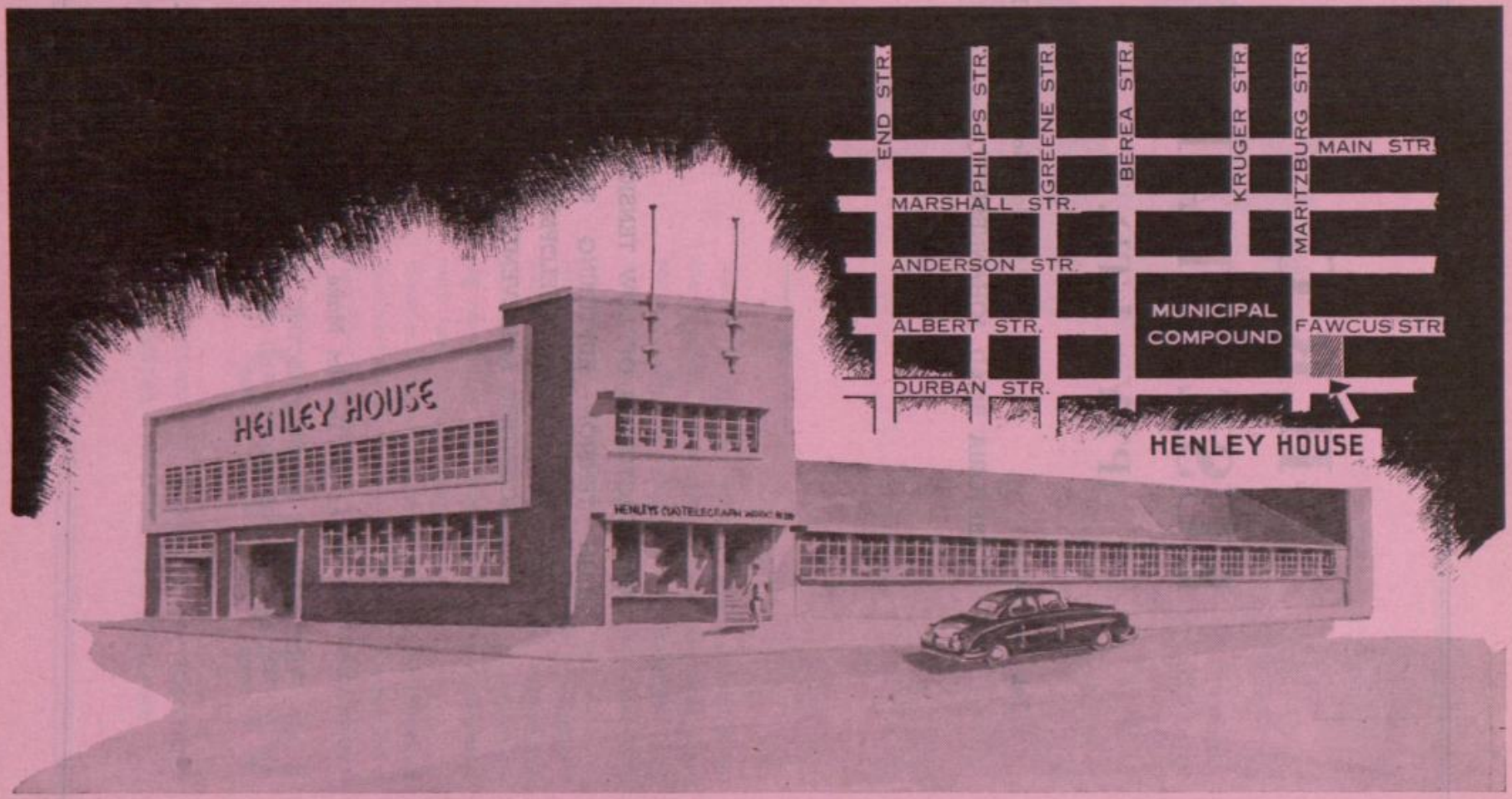

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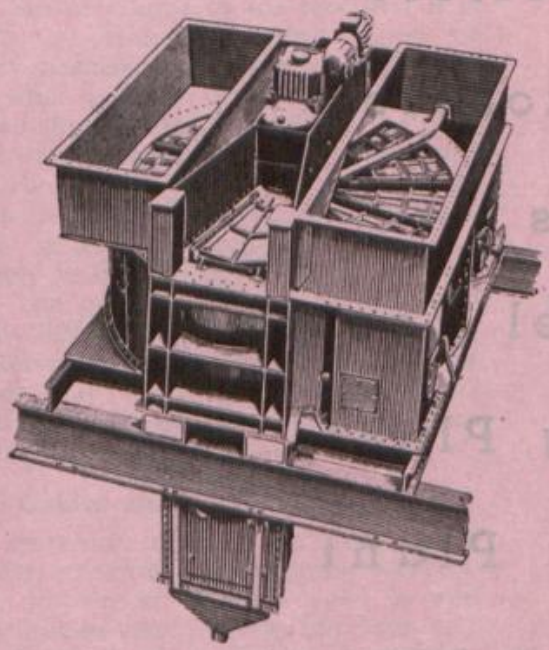

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gear and perhaps voltage regulators may be considerable, but it is probably safe to say that the question of making an economic choice is rarely considered. The reason lies of course in the fact that it is difficult to estimate to the degree of accuracy necessary to make an economic choice what the loads on a particular cable, overhead line, or transformer will be over the life of the particular item. The result is that the choice is usually made on the basis of installing cables, etc., in accordance with a general development plan and ultimately loading the plant to its thermal limit. The position is made worse nowadays by difficulties encountered in obtaining materials and plant at all with the result that not only is the plant loaded to its thermal limit but very often it also becomes very much overloaded.

3.2.1. Cables and Conductors

The existence of a law for determining the most economic size of cable or conductor, known as Kelvin's Law, is well known, but in view of what has been said above, it is not often applied in practice. The choice of the size of cable to be employed is usually based on current carrying capacity, *i.e.*, its thermal limit, or in a few instances, on voltage drop. If the economic size is smaller than the size determined by the thermal limit, obviously the latter must be chosen, but it is by no means clear whether, in the general case, the economic size is larger or smaller than the size determined by heating considerations, and it is instructive to consider under what conditions the economic choice or the thermal limit determine the size.

Kelvin's Law, as more generally stated, is that the most economical section of cable is the one which makes the annual cost of the energy wasted equal to the annual capital charges on that portion of the cost of the cable which varies with its cross-sectional area. It follows from this that the lower the annual cost of the losses, the smaller will be the most economic size. Now the annual cost of the losses depends upon the tariff or price per unit and the load factor of the load carried by the cable. In the case of undertakings taking a bulk supply on a two part tariff the demand charge will be found to account for the greater part of the cost of the losses and in that case the load factor, even if exceedingly low, would not reduce the total cost of the losses to so low a figure as to result in the most economical size of cable being smaller than the size determined by the thermal limits.

It is probably true to say that in the past the most economic size has always been larger than the size determined solely by current carrying capacity, but in view of the enormously increased cost of copper (now £210 per ton as compared with £50 per ton in 1939) and consequent increased capital charges it follows from Kelvin's Law that an increase in the cost of the losses will also be permissible and hence a decrease in the most economic section of cable.

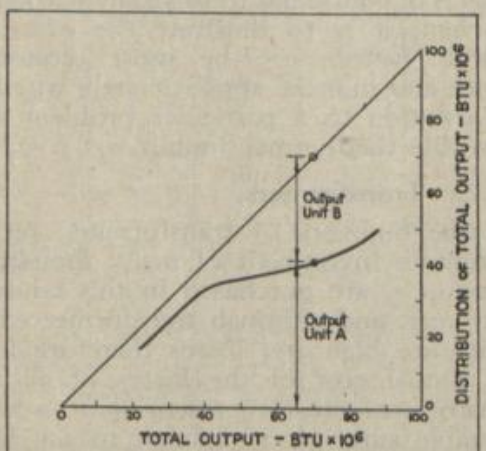

CHART FOR DETERMINING DISTRIBUTION OF TOTAL OUTPUT
Fig. 5.

Kelvin's Law can of course also be stated on the basis of current density instead of cross sectional area, in which form it is probably more useful, as the solution is independent of the current and the value of the current density gives an indication of the thermal effect.

As an illustration of the effect of load factor and the cost of supply on the most economic current density the chart shown in Fig. 6 has been prepared. The cost of copper cables depends, among other things, on the cross-sectional area and for the purpose of this chart a cost of £2·2 per square inch per yard, which is about the average today for that part of the cost, has been taken as a basis. A 4 per cent loan and a life of 25 years have been assumed, giving a total capital charge of 6·4 per cent per annum. The cost of the losses has been calculated on the basis of a two part tariff as well as on the basis of a flat rate per unit.

It is evident from the chart that if the supply is paid for on a flat rate basis, then at low load factors and consequently small absolute cost of losses, the most economic current density can rise to very high values, much higher in fact than the average maximum permissible current densities (from the point of view of heating) shown on the right of the chart.

On the other hand if the supply is paid for on a two part tariff, the fixed charge part of the cost of the losses, which is independent of the load factor, results in the most economic current density being very much less than the maximum permissible, except in the very large size of cable.

The purpose of the chart shown in Fig. 6 is of course not to solve any particular problem, it is to illustrate the effect of various factors on the most economic choice and indicate approximately whether the solution to a particular problem will lie within the thermal limits.

3.2.2. Transformers

Large numbers of transformers, representing an investment of many thousands of pounds, are purchased in this country each year, and although transformer efficiencies are high and losses therefore low, the annual cost of the losses of all the transformers must represent quite a considerable sum. It is difficult to say how many transformers are selected on truly economic principles; sometimes the iron losses may be capitalised, but probably it is only when really large transformers are required that a more detailed comparison between tenders is made on an economic basis.

In the normal course of events, when tenders are called for the common sizes of distribution transformers, the purchaser does not ask for particulars of iron losses, copper losses, magnetising current, etc. The offers received will be the manufacturer's standard designs, prices will be highly competitive and there will be not much to choose between them as regards efficiency. The small differences make it appear unlikely that any but the cheapest will be the most economic choice. Yet it is by no means certain that any one of the offers, taking into account the duty required of the transformers and the cost of supply, will in fact be the best choice from an economic point of view.

The manufacturer can hardly be blamed for this state of affairs. He does not know all the factors that enter into the question and being aware of the tendency to accept the lowest tender he is concerned only with offering the cheapest transformer which will meet the purchaser's requirements.

Once tenders have been received, and provided details of the iron and copper losses and magnetising current are known, a choice on economic principles can readily be made in the usual way, either by capitalising the losses or working out the annual charges (interest, redemption and cost of losses). In the circumstances the transformer so chosen represents the best offered, but the possibility remains that something better still might be obtainable. Admittedly the efficiency of the transformers is high and there seems little hope of improving on it, yet even a small improvement would be worth some additional capital expenditure.

Now it is well known that a large transformer has a better efficiency than a small one. There are definite reasons for this and it has been shown that if all the dimensions of a transformer are increased in the ratio "r" the output will be r_4 times as much, but the ratio of losses to output will be $1/r$ times its original value. Now supposing a transformer having equal iron and copper losses at full load is run at half normal voltage and half normal current. The output would be 1/4, each of the losses would be 1/4 and the efficiency would therefore be the same. It is apparent therefore that to obtain a better efficiency and therefore lower losses than obtainable from standard designs, a larger transformer underrun as regards voltage and current might be used. The larger transformer would of course cost more and it is here that economics will decide how far it is possible to go, taking into account the duty required of the transformer and the tariff on which the cost of the losses would be assessed.

It is difficult to give a concrete illustration of the benefits of underrunning transformers because manufacturers as a rule quote for the cheapest transformer and rarely give alternative prices for transformers designed with lower flux and current densities. An example is, however,

ECONOMIC COMPARISON BETWEEN VARIOUS OFFERS FOR A 500 kVA TRANSFORMER

Transformer Characteristics		A Low Iron Loss. Low Copper Loss	B Normal Iron Loss. Normal Copper Loss	C High Iron Loss. Normal Copper Loss	D High Iron Loss. Normal Copper Loss	E Very Low Iron Loss. High Copper Loss.
(*a*) Price		£788	£734	£719	£704	£769
(*b*) Iron Loss	watts	1673	1870	2020	1980	1580
(*c*) Full Load Copper Loss	watts	6209	6600	6600	6800	9240
(*d*) Total Full Load Loss	watts	7882	8470	8620	8780	10820
(*e*) Mean Copper Loss $(c)\times 0{\cdot}153$	watts	950	1010	1010	1040	1410
(*f*) Total Mean Loss	watts	2623	2880	3030	3020	2990
Total annual charges based on tariff of £5 per kW + ·275 pence per unit:						
Fixed charge $(d)\times$ £5		£39·4	£42·4	£43·1	£43·9	£54·1
Running charge $(f)\times \cdot 275\times 36{\cdot}5$		26·4	28·9	30·4	30·3	30·0
Capital charges p.a. 6·40%		50·5	46·9	46·0	45·0	49·2
TOTAL		£116·3	£118·2	£119·2	£119·2	£133·3
Total annual charges based on Flat Rate Tariff of 0·45 pence per unit:						
Running charges $(f)\times 0{\cdot}45\times 36{\cdot}5$		£43·1	£47·3	£49·7	£49·6	£49·1
Capital charges p.a. 6·40%		50·5	46·9	46·0	45·0	49·2
TOTAL		£93·6	£94·2	£95·7	£94·6	£98·3

shown in the above table of the economic choice of a 500 kVA distribution transformer from amongst five tenders, two of which (transformers "B" and "C") are offered by the same maker. The calculations are based on a load factor of 30 per cent, and the loss load factor of $(0{\cdot}3F+0{\cdot}7F^2)$. Two alternative methods of arriving at the cost of the losses are shown, one based on a two-part tariff of £5 per kW plus 0·275 pence per unit and the other on a flat rate of 0·45 pence per unit. Capital charges are based on a 4 per cent loan and a life of 25 years, with zero salvage value at the end of the life, giving a total capital charge for interest and sinking fund of 6·4 per cent.

It will be seen that in both instances Transformer "A", although the most expensive in first cost, is the most economic choice, because of its low iron and copper losses.

With increasing charges for cost of supplies it is evident that there are economic possibilities in using transformers operating at lower densities, apart from the consequent advantages of less noise and vibration. As to how far to go depends upon the circumstances peculiar to each case, such as load factor and tariff rate. The B-H curve for transformer iron changes shape in the region of 12,000 to 14,000 gauss so that a reduction of flux density below this range would probably not pay. It is, however, up to the purchaser to ask the manufacturer to quote for transformers with lower densities (or lower losses or higher efficiencies) and then make a proper economic comparison between the offers received.

3.2.3. Voltage Regulation

The cost of voltage regulation is another question which lends itself to economic investigation. The increasing loads on

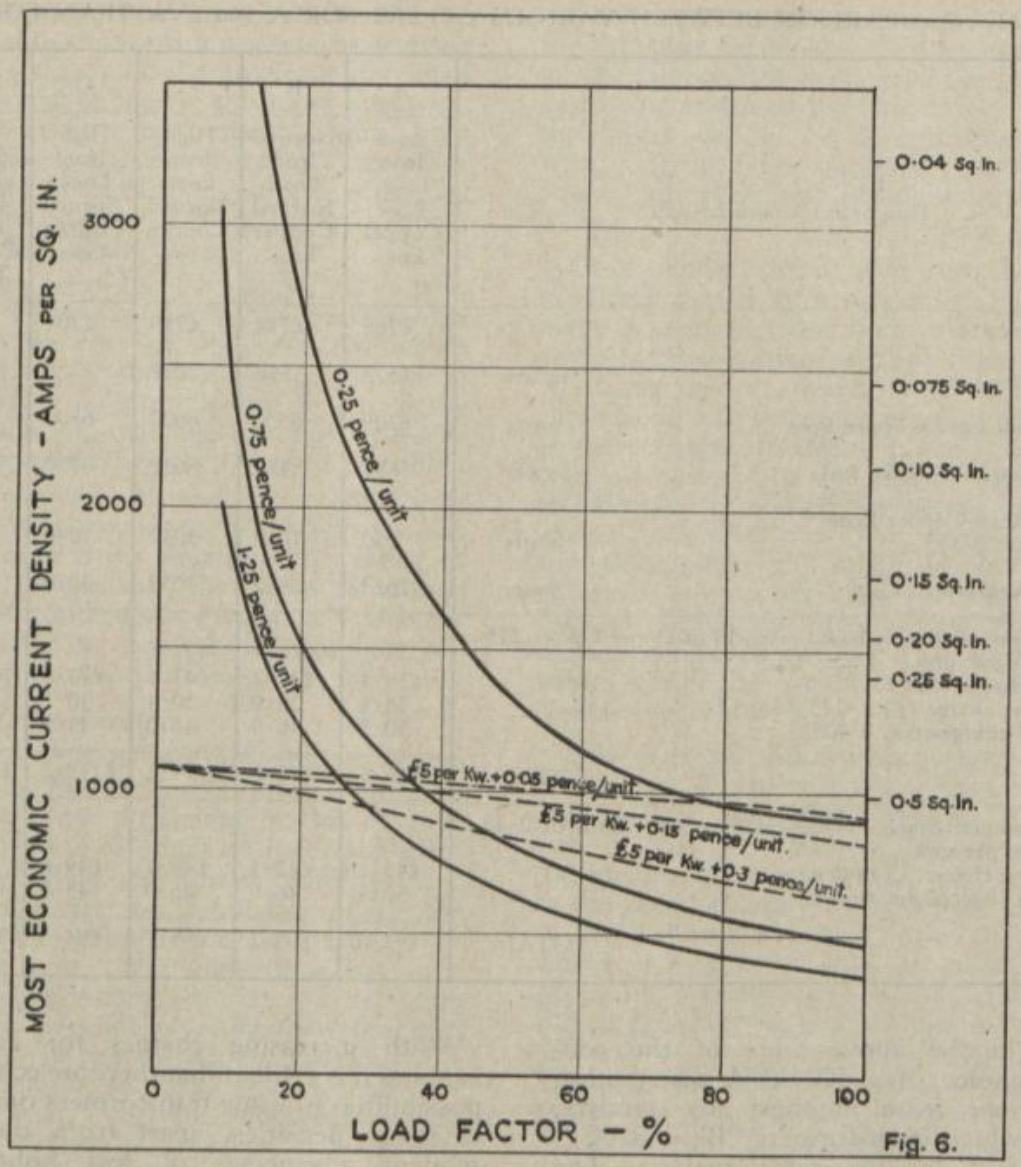

Fig. 6.

distribution plant bring in complaints of low voltage at peak periods, but apart from the inconvenience to the consumer, low voltage results of course in a direct loss of revenue.

The consumption of various services is of course differently affected by low voltage but a recent investigation made in Cape Town showed that if the voltage in certain residential areas fell to 200 volts for only two hours per day for six months of the year because automatic voltage regulation was not provided in the twelve substations feeding these areas, the loss of revenue would amount to something like £1,500 per annum. Allowing £250 for maintenance of automatic voltage regulating equipment it is evident that capital expenditure representing annual charges up to £1,250 per annum would be a paying proposition. On a 3½ per cent loan basis and a life of twenty-five years this would represent about £20,000 or £1,700 per substation. The practice has been to install transformers fitted with automatic on load tap changing equipment, which ten years ago cost about £260 per substation, and was therefore a very good investment. Unfortunately the price of such equipment has now gone up to £2,500 per substation, which of course changes the whole aspect of the problem.

3.2.4. Overhead Lines

Another problem now presenting itself is that of overhead line supports. Steel poles are unobtainable and concrete poles are becoming more expensive. The alternative wood pole has a shorter life but is so much cheaper that, except in areas where appearance is important, it is now an economic proposition.

A 30-foot concrete pole costs, say, £12 delivered but its great weight and the careful handling required bring the total cost of the planted pole to about £20. Against this the wood pole costs £2 delivered and say £5 planted. The life of the concrete pole may be 25 years, as against a life of say half that figure for a wood pole of the gum type.

A concrete pole thus involves a single expenditure of £20 while a wood pole involves the expenditure of £5 now and another £5 in 12½ years time. The present value of £5 to be spent in 12½ years time is £5 × ·65 or £3 5s., making a total of £8 5s. The wood pole therefore represents a saving of nearly £12.

3.3. Administrative Side of the Undertaking

On the administrative side of an electricity undertaking, economic considerations enter in such matters as tariffs, hire-purchase schemes, guarantees required for prospective consumers requiring supplies, etc. Each problem will have its peculiar circumstances and it is not proposed to go into details here.

3.3.1. Tariffs

On the question of tariffs it should be stressed that the aim should, in all cases, be simplicity. If an investigation suggests something complicated it will be better to modify the result and produce a simple tariff. The psychological aspect must also be borne in mind. Consumers seem to object to paying unless they get at least some "units" for their money.

One example showing how a simple provision in a tariff, when considered on economic principles, proves to be a loss to the undertaking, is, however, worth quoting.

For many years it has been part of the tariff of charges in Cape Town that the tariff rate applicable to supplies taken for motive power purposes, ranging from 1½ to ¾ pence per unit, is subject to a 10 per cent discount if the power factor is maintained at not less than 0·9 lagging. It is interesting and instructive to consider how this provision affects the consumer and the undertaking.

Assume, for example, a load of 100 kW at 0·7 power factor and 20 per cent load factor. The total cost of electricity supplied would be nearly £600 and the discount if the power factor were improved to 90 per cent would be £60. To correct the power factor the consumer would have to install 54 kVA of condenser capacity, costing say £250 including installation. Assuming a life of 20 years and interest at 3½ per cent the "present value" of the saving of £60 per annum is worth £852 to the consumer. In effect therefore the undertaking gives the consumer £602 for the benefit of improved power factor. It is nevertheless surprising to see how many power consumers are not interested in receiving this "gift" from their electricity undertaking.

Whilst in the past the improved power factor may have produced valuable results in the form of lower losses, better regulation, lower voltage drop and smaller size of distribution plant, today the only advantages are a slight reduction in distribu-

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ABBREVIATED INTEREST AND SINKING FUND TABLE

	3½ Per Cent			3¾ Per Cent			4 Per Cent			4¼ Per Cent			4½ Per Cent			5 Per Cent		
Yrs.	Present Value of £1	Present Value of £1 p.a.	Sinking Fund to Amount to £1	Present Value of £1	Present Value of £1 p.a.	Sinking Fund to Amount to £1	Present Value of £1	Present Value of £1 p.a.	Sinking Fund to Amount to £1	Present Value of £1	Present Value of £1 p.a.	Sinking Fund to Amount to £1	Present Value of £1	Present Value of £1 p.a.	Sinking Fund to Amount to £1	Present Value of £1	Present Value of £1 p.a.	Sinking Fund to Amount to £1
5	0·84197	4·51505	0·18648	0·83188	4·48326	0·18555	0·82193	4·45182	0·18463	0·81212	4·42073	0·18371	0·18371	4·38998	0·18279	0·78353	4·32948	0·18097
6	0·81350	5·32855	0·15267	0·80181	5·28507	0·15171	0·79031	5·24214	0·15076	0·77901	5·19974	0·14982	0·76790	5·15787	0·14888	0·74622	5·07569	0·14702
7	0·78599	6·11454	0·12854	0·77283	6·05790	0·12757	0·75992	6·00205	0·12661	0·74725	5·94699	0·12565	0·73483	5·89270	0·12470	0·71068	5·78637	0·12282
8	0·75941	6·87396	0·11048	0·74489	6·80280	0·10950	0·73069	6·73275	0·10853	0·71679	6·66378	0·10756	0·70319	6·59589	0·10661	0·67684	6·46321	0·10472
9	0·73373	7·60769	0·09645	0·71797	7·5077	0·09547	0·70259	7·43533	0·09449	0·68757	7·35135	0·09353	0·67290	7·26879	0·09257	0·64461	7·10782	0·09069
10	0·70892	8·31661	0·08524	0·69202	8·21279	0·08426	0·67556	8·11090	0·08329	0·65954	8·01089	0·08233	0·64393	7·91272	0·08138	0·61391	7·72174	0·07950
11	0·68495	9·00155	0·07609	0·66701	8·87979	0·07512	0·64958	8·76048	0·07415	0·63265	8·64354	0·07319	0·61620	8·52892	0·07225	0·58468	8·30641	0·07039
12	0·66178	9·66333	0·06848	0·64290	9·52269	0·06751	0·62460	9·38507	0·06655	0·60686	9·25039	0·06560	0·58966	9·11858	0·06467	0·55684	8·86325	0·06283
13	0·63940	10·30274	0·06206	0·61966	10·14236	0·06110	0·60057	9·98565	0·06014	0·58212	9·83251	0·05920	0·56427	9·68285	0·05827	0·53032	9·39357	0·05646
14	0·61778	10·92052	0·05657	0·59726	10·73962	0·05561	0·57748	10·56312	0·05467	0·55839	10·39090	0·05374	0·53997	10·22283	0·05282	0·50507	9·89864	0·05102
15	0·59689	11·51741	0·05182	0·57568	11·31530	0·05088	0·55526	11·11839	0·04994	0·53562	10·92652	0·04902	0·51672	10·73955	0·04811	0·48102	10·37966	0·04634
16	0·57671	12·09412	0·04768	0·55487	11·87017	0·04674	0·53391	11·65230	0·04582	0·51379	11·44031	0·04491	0·49447	11·23401	0·04401	0·45811	10·83777	0·04227
17	0·55720	12·65132	0·04404	0·53481	12·40498	0·04311	0·51337	12·16567	0·04220	0·49284	11·93315	0·04130	0·47318	11·70719	0·04042	0·43630	11·27407	0·03870
18	0·53836	13·18968	0·04082	0·51548	12·92046	0·03990	0·49363	12·65930	0·03899	0·47275	12·40590	0·03811	0·45280	12·15999	0·03724	0·41552	11·68959	0·03555
19	0·52016	13·70984	0·03794	0·49685	13·41731	0·03703	0·47464	13·13394	0·03614	0·45348	12·85938	0·03526	0·43330	12·59329	0·03441	0·39573	12·08532	0·03275
20	0·50257	14·21240	0·03536	0·47889	13·89620	0·03446	0·45639	13·59033	0·03358	0·43499	13·29437	0·03272	0·41464	13·00794	0·03188	0·37689	12·46221	0·03024
25	0·42315	16·48152	0·02567	0·39838	16·04320	0·02483	0·37512	15·62208	0·02401	0·35326	15·21734	0·02321	0·33273	14·82821	0·02244	0·29530	14·09395	0·02095
30	0·35628	18·39205	0·01937	0·33140	17·82924	0·01859	0·30832	17·29203	0·01783	0·28689	16·77902	0·01710	0·26700	16·28889	0·01639	0·23138	15·37245	0·01505
40	0·25257	21·35507	0·01183	0·22934	20·55099	0·01116	0·20829	19·79277	0·01052	0·18922	19·07727	0·00992	0·17193	18·40158	0·00934	0·14205	17·15909	0·00828
50	0·17905	23·45562	0·00763	0·15871	22·43449	0·00707	0·14071	21·48218	0·00655	0·12479	20·59306	0·00606	0·11071	19·76201	0·00560	0·08720	18·25593	0·00478

tion losses and some improvement in regulation, but it is quite certain that the cost of obtaining these small advantages, namely £602, is out of all proportion to their value to the undertaking.

4. CONCLUSION

There are of course numerous other instances in an electricity undertaking where the application of the principles of economics can help in determining general policy, selecting plant, framing tariffs, etc., but it is hoped that the examples quoted together with the explanation of the principles will be of assistance to those responsible for the running of undertakings and will also emphasise once more the fact that it is not always the lowest tender which is the most advantageous one. To purchase the cheapest is merely following the line of least resistance but if it can be shown that something which costs more to buy will actually save the undertaking some money, even the most hard-headed business men among the municipal councillors will have to agree that it would be foolish to buy on first cost only. In these days of rising prices and costs all undertakings are faced with the problem of finding ways and means to make ends meet without undue increases in tariff rates, so that every effort should be made to run the undertaking as efficiently as possible not only from the technical but also from the economic standpoint.

The one drawback against implementing the results of economic considerations today is of course the shortage of capital funds and shortage of materials, which may force upon undertakings the necessity of accepting less efficient plant and methods of operation and thereby accept future burdens for the sake of present-day economy in money and materials.

In conclusion the author wishes to express his thanks to his Chief, Mr. C. G. Downie, City Electrical Engineer, for having been given the opportunity of writing and presenting this paper to the Association of Municipal Electricity Undertakings and for his assistance in the preparation thereof.

PRESIDENT:

Thank you, Mr. Frantz. Gentlemen, before I throw this matter open for discussion, I want to warn you that we have a timing device. Every speaker will be limited to ten minutes, and immediately he starts to speak I will set off this device, and when it gets to nine minutes, you will find the red light will come on. If you continue over the ten minutes the bell will blow you out. Mr. Frantz's paper is now open for discussion.

Mr. C. KINSMAN, Durban:

Mr President: I would like to take this opportunity of expressing our thanks to Mr. Frantz for this paper he has given. At the outset, he said he felt he had no apology to make for dealing with the subject which he has today chosen for his paper; I think we all agree with him, and would like to congratulate him on his paper, particularly on the amount of study he must have given to it. I would also express our appreciation of the very thorough way in which he has prepared the précis of his paper. This is what we have sought for some time and I think Mr. Frantz has set an extremely good example of a short précis, which gives more opportunity for discussion of the paper. I am particularly grateful for his having given this paper, because we have felt for some time that the so-called ascendancy of the city treasurer over the engineer would not have reached the stage it has done had engineers given the time to the study of the economic side of their undertakings that they are giving today, and I think it is very much to be emphasised that the engineer is more than just an electrician on the staff of the City Treasurer's Department.

Dealing with the financial aspects of the paper, and although I can only speak for the position in Natal, I should like to make a few remarks. In Natal, the Provincial Ordinance lays down that where an asset is financed from loan funds there must be established, in addition to the usual sinking fund and interest charges, a renewals fund whenever the certified life of the asset is less than the period of the loan. This means that when the City Treasurer borrows money for a 50-year period and the certified life of the asset established out of loan funds is, say, only 25 years then there must also be established a renewals fund to which contributions must be made at the rate of four per cent per annum for 25 years. The result is that although the asset has been fully paid for at the

end of its certified life loan charges must go on for another 25 years.

Sympathy is gaining ground for the view that there should be some change of policy in the matter and that the local authority should establish its own consolidated loans fund financed in the first place by a public loan. It would then be possible to establish an asset with a life of 20 years by borrowing from the consolidated loans fund for 20 years and repaying the loan in the same period without the necessity for also contributing to a renewals fund.

On other details of the paper I have very little to say. I think the paper said that if the voltage were to remain 20 volts below normal for two hours per day for six months of the year, the loss of revenue would be £1,500 per annum. I do not know whether Mr. Frantz means the total loss of revenue or the nett loss of revenue. Actually it would appear to me that in a residential area the bulk of the consumption during that period, naturally the peak period, would be by heating appliances. One would imagine that the total energy consumption by such an appliance would at least be the same, irrespective of the voltage. In fact one would think that the longer the appliance took to reach a particular heat the longer period there would be for losses in radiation, so therefore the lower voltage would result in greater consumption. To check that I have had certain tests made but there is no time to go into those now.

Coming to the question of poles, Mr. Frantz says, and I agree with him, that the cost of steel poles, to comply with all the Municipal regulations, is prohibitive and that the concrete pole may last 25 years. I think he was well advised in saying "may last" because so much depends on the construction of the pole.

I don't think he is quite as optimistic as he might be about wooden poles. He gives them approximately half the life of concrete poles. In Durban we have already used for thirteen years wooden poles which would appear to be as sound and as stable as when they were installed. I think that 20 to 25 years can be expected from South African wood that is treated under the present process of creosote oil, but there are other processes, more chemical processes, which promise to give even a longer life.

Mr. President, there must be others who want to participate in this discussion and I would again just sum up by proposing a very hearty vote of thanks to Mr. Frantz for the time, care and thought he has given to this paper which must be of tremendous value to an engineer.

Mr. A. R. SIBSON, Bulawayo:

Mr. President, Gentlemen: I would like to join with Mr. Kinsman in expressing my appreciation and yours to Mr. Frantz for his extremely valuable paper.

There is just one point that might be of interest to you, Mr. President and gentlemen; Mr. Frantz gave us some details about the economic operation of boilers, and dealt with the question of the use of boilers as base load plant and showed, I think, fairly conclusively that, speaking generally, it does not pay to maintain a single boiler or a group of boilers on base load, allowing others to carry peaks. This I can confirm from my own experience. I would go further than this, and say that consideration should also be given to the question: when is it economic to bank a boiler, *i.e.*, to take it out of operation altogether? Now, with certain low load factor undertakings, there can be no doubt that the situation does arise during the early morning hours where it is probably not economic to maintain the whole boiler installation in service. That point has not been dealt with by Mr. Frantz. Possibly in Cape Town load factors are not as low as in the case of some other stations. We have found that owing to the load factor being usually somewhat in excess of 50 per cent per annum it is not economic ever to bank boilers, that is to say to bank boilers from day to day. Of course we have varying numbers of boilers in use from season to season, but throughout any short period of time during the season we have found that it is more economic to maintain all boilers in use and let them all share the load whatever it may be. This may not, however, be the case with some undertakings with lower load factors, and there are cases where it becomes economic to bank a boiler. I do not know whether Mr. Frantz can perhaps produce out of his hat a formula to tell us just when it is economic to carry out this procedure.

One other point before I sit down, Mr. President. Mr. Frantz stresses quite rightly the importance of making tariffs

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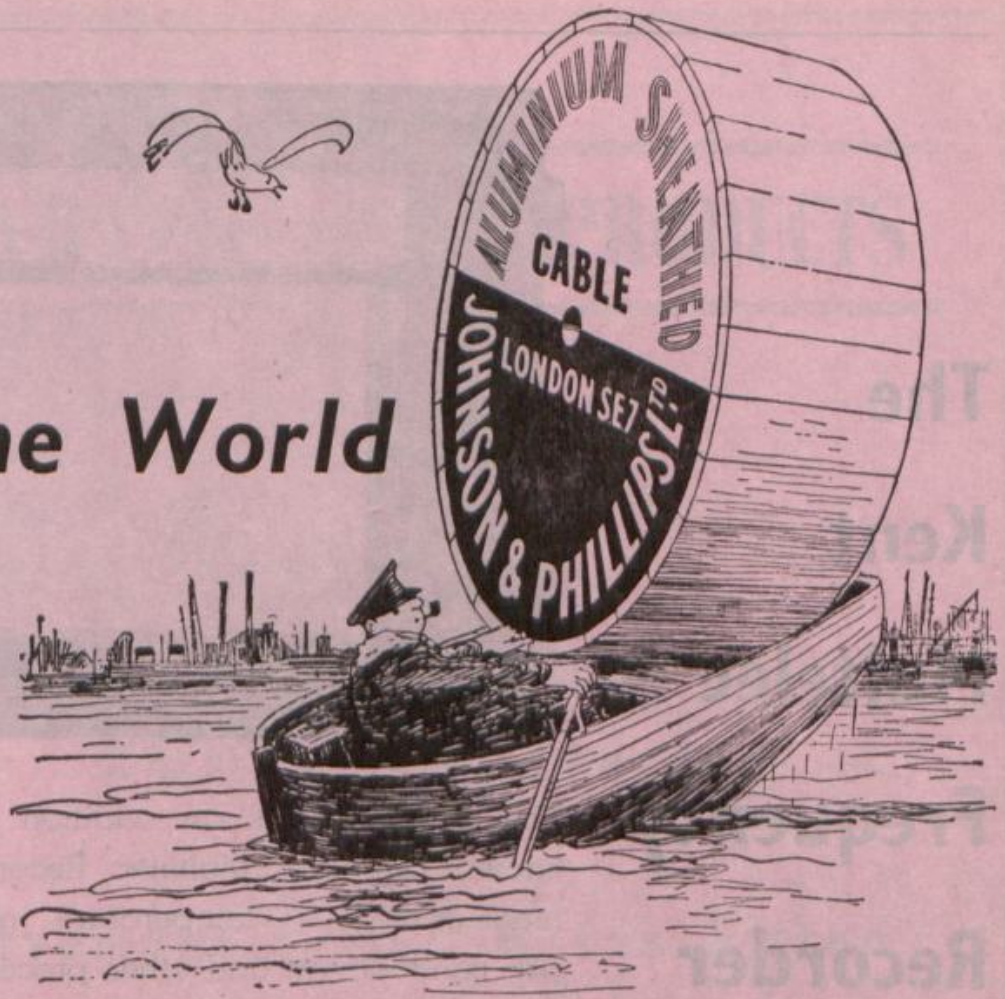

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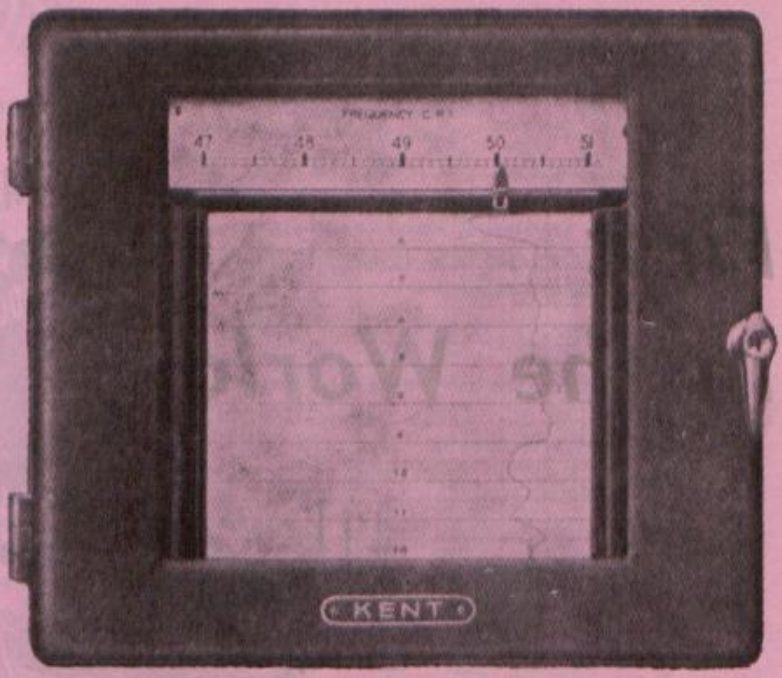

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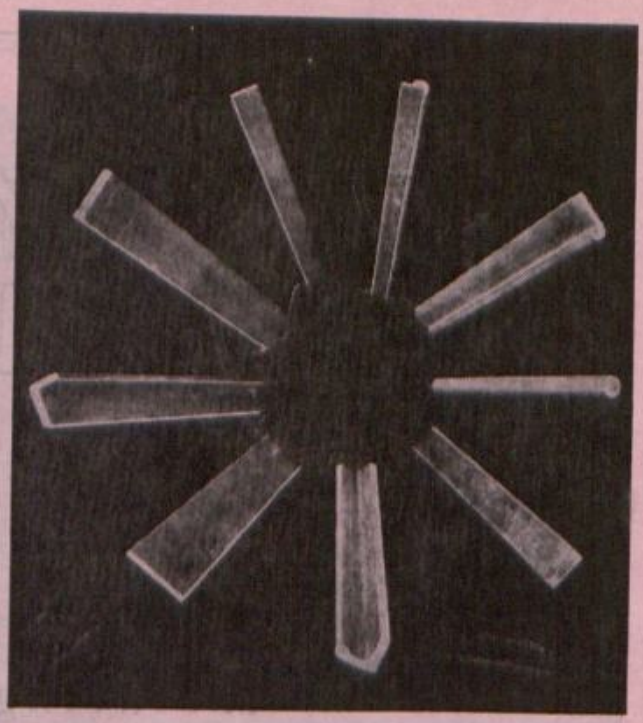

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simple, and he refers to the fact that the average consumer hates to pay money for some quite mystic benefit but prefers to pay for something which is as solid as electricity can be, that is, the kilowatt-hour. In general I think we agree with him, but it is not possible of course to apply this throughout the entire tariff structure. The existence of such a thing as a maximum demand tariff, for instance, immediately vitiates the idea of paying only for units, but there is in most undertakings a tariff, which is one of the oldest of tariffs, for providing supplies for the ordinary industrial user, and usually takes the form of a sliding scale with two or three different rates. In Bulawayo, for example, it starts at a penny farthing and goes down to a penny, and then to three farthings. This old flat sliding scale used to be used by all industrialists. In general this scale produces more revenue than the maximum demand scale, so much so that it is made rather difficult for consumers to obtain the maximum demand scale. We would require quite a considerable minimum charge and agreements for lengthy periods before the maximum demand scale was made available, and many of those who might benefit from the maximum demand scale do not, therefore, take it up but continue to employ the ordinary sliding scale.

Now this was all right for the sort of industrialists we used to deal with a few years ago, but we are now faced with the sort of industrialist who wants to put in, say, an experimental furnace, taking about 1,000 kVA, for a few hours each month, and he has a perfect right under our tariff arrangements to take the sliding scale and pay only for units consumed, if some steps were not taken to deal with the matter. It has occurred to me that it has become necessary to include in the sliding scales that are used for industrial supplies some sort of minimum charges based on the maximum demand, and what I have thought of introducing is an agreement which would entitle the industrialists to a supply at a flat rate without restriction up to 50 kVA, but where the demand exceeds 50 kVA the consumption would be subject to a minimum charge based on the kVA demand charge that the consumer would have to pay had he taken his supply under maximum demand tariff. I mention this because it rather flies in the face of Mr. Frantz's desire for simplicity. I am afraid that there are occasions when we are compelled to go back into the mists of obscurity in the application of electricity tariffs.

PRESIDENT:

Thank you, Mr. Sibson.

Mr. J. L. VAN DER WALT, Krugersdorp:

Mr. President, Gentlemen: The author made an appropriate choice for his paper, namely, "Economics", considering the difficult times we are living in. I think we could really call these times that we are living in the "spiral times or age" as we used to have the stone age. With the cost of raw materials rising continually as well as labour, it is more important to keep a watchful eye on the economics of our organisations today than was possible 10 or 15 years ago.

The author mentions that consumers in South Africa have been fortunate not to experience power cuts as they do overseas. Alas, sir, I am sorry to say that on the Reef we have been forced to follow the steps of fashion overseas and we are on the verge of experiencing electricity cuts during the coming winter, thanks to the discovery of gold in the good old Free State and of course our friends the Electricity Supply Commission.

There is one point on page 11. The author appears to contradict himself and I would like him to explain whether his statement is correct. In the second paragraph, page 11, he says: "It follows from this that the *lower* the annual cost of the losses, the *smaller* will be the most economic size." Yet in paragraph 3 it says: "An *increase* in the cost of the losses will also be permissible and hence a *decrease* in the most economic size." I would just like clarification on those two sentences, if possible, Mr. President.

It is a pity that the author, perhaps due to lack of time, had not an opportunity to go more fully into "economics in distribution". We know that due to the greater efficiencies and better load factors of power stations today, that the cost in generating has not been so marked as the cost in distribution. Our cost on distribution has really risen with spiral effect. The average cost of delivering power today is much

higher than it used to be a few years ago. This may be attributed to the following, *viz.*:

(1) Abnormal post-war industrial development in our young country, forcing undertakings to scrap their systems before they have reached the end of their economic life;

(2) hand in hand with it goes the development of new residential areas on the outskirts of our existing networks, in other words, further away from our points of supply, and then

(3) of course the well-known rise in cost of material and labour. The result of this was a rather haphazard method of development of most of our undertakings, no consideration being given to design. I do not think that the engineer is to blame for this because he had to cope with conditions changing so fast and in such a way that it was impossible for him to plan well ahead.

Economics play a great part in the pressure of distribution. The author pointed out in the paper that according to Kelvin's Law we could find the most economical size of the cable. This could also be applied to the most economical voltage pressure for your system from most economic current densities, and therefore the mean radius of distribution from each substation to keep the voltage within a prescribed limit. By these means substations could be placed at most economic radii from the centres, which would give the ideal condition. Admittedly we can very seldom realise the ideal conditions, but it is a very useful yardstick to place substations in preliminary design.

The author also mentions the shortage of capital funds. Here a thought was brought to my mind: development of new residential areas. In some residential areas the ground belongs to the Council, and the Council is the property owner. In other cases it is private individuals or companies that establish new townships and I find that it is becoming necessary today with the increased cost of material, and the shortage of capital, to lay down a definite agreement with the property owners, whether it is your Council or the private companies or an individual, that development as far as electricity is concerned should take place in definite zones, and the second zone should not be opened up before a certain portion, *i.e.*, a certain percentage of the first zone has been built upon. Older agreements usually mention the fact, say, when 60 per cent of the first zone is sold. We have found that it does not take a very long time to sell 60 per cent of the first zone, but it takes many many years longer to get say 20 per cent of that zone built up, with the result that the second zone is opened up and a lot of dead capital is still lying in the first zone. It is therefore advisable to lay down in the agreement that the second zone should not be opened up unless a certain percentage of the first zone has been built upon and that percentage could be determined to make the first zone a payable proposition.

Mr. President, I am also in agreement with Mr. Kinsman in connection with the revenue loss due to decreased voltage. I had the same line of thought as he had and I would be very glad if the author could now briefly during the discussion indicate to us how that loss of revenue accrues and then more fully, probably with an example illustrated through the proceedings. I think that would be appreciated by many engineers.

Then, Mr. President, I would also like to add my appreciation and congratulations to the author for his excellent paper. He has given us matter for thought, good guidance in economic principles to be applied in design and acceptance of material and equipment. Thank you, Mr. President.

PRESIDENT:

Thank you, Mr. van der Walt.

Mr. C. R. BURTON, Kimberley:

Mr. President and Gentlemen: I wish to congratulate Mr. Frantz on the excellent paper he has presented to this Convention.

The comments I wish to make refer to Section 2.2.1.c, "Useful or Economic Life", where Mr. Frantz says: "It is usual to assume an economic life of 30 years for distribution plant as a whole". Mr. D. H. Kendon in his recent chairman's address to the South Midland Centre I.E.E., Birmingham, bears out this statement when he said "Distribution assets have in the past been assumed to have a life of about 30 years, but since overhead lines and other plant can be satisfactorily maintained

out of revenue" (as they are in most South African Municipalities) "their life could well be lengthened to 40 years".

These statements have been confirmed in Kimberley, which has been giving a public supply for over 50 years, and where small 5,000 volt cables laid 48 years ago are being replaced in many parts by heavier 11 kV cables. These cables are being relaid in certain areas which will remain 5 kV, or are being used for low tension services. Transformers of the same age are carrying an overload without giving trouble, while copper and light steel poles from small low tension overhead lines are being used *again* for street lighting.

During the last ten years the Municipal consumption in Kimberley has, however, increased from 8,000,000 to 31,000,000 units per annum and consequently considerable loans, to lay down a new 11 kV network and also a change over of the low tension network from three phase three wire to standard three phase four wire, were found necessary to cater for the future, apart from ordinary area development.

The Cape Provincial Administration has given its necessary sanction for the loans to be raised but has limited the redemption period for distribution equipment to 20 years and in some cases to 18 years. An attempt was made by the Kimberley City Council to obtain an extension to 25 years but without success, the final letter from the Provincial Administration stating that the period was fixed in conformity with the periods given to all other local authorities for similar work. When the Council asked how the period was arrived at it was informed, *inter alia*, that it was "not the policy of the Provincial Administration to furnish reasons for its decisions".

The matter is, however, of considerable importance to undertakings which are in the early stages of development, where a distribution system is being laid down to cater for future requirements, as a short loan period has the effect of making the consumers of the present not only pay for the consumers of the future, but also for the anticipated additional requirements of those consumers.

When one considers that consumption will inevitably increase considerably with the years, particularly if the tariff is reasonable, and that in consequence the capital cost per unit sold will be considerably reduced, it seems absurd to inflate the cost per unit during such period of rapid development.

Unnecessarily high tariffs have a marked detrimental influence on the rate of development.

To illustrate the effect of varying loan periods the following are the percentages which will cover interest (at 4 per cent) and redemption on loans for the periods stated.

18 years	7·9%
20 years	7·4%
25 years	6·4%
30 years	5·8%
35 years	5·4%
40 years	5·1%

In 1940, at the beginning of the period of rapid expansion in Kimberley, the annual capital charges were only some 4 per cent of revenue and the total loan indebtedness was negligible, as the greater part of the distribution system had been paid for many years previously, a considerable proportion being from annual capital appropriations from revenue. Today the capital charges of the distribution system have risen to 15 per cent of revenue, due to the great expansion taking place and to the greatly increased cost of equipment.

If the redemption period of the recent loans was 35 years instead of 18-20 years the loan charges would only be 10½ per cent instead of 15 per cent of the revenue and this saving would, incidentally, almost pay for the increased cost of coal delivered.

The effect of a short redemption period on an old established undertaking is marked, but the burden on a comparatively young undertaking must be crippling and will stifle progress, particularly after seven to ten years of rapid post-war expansion, and at a time when it is hoped that generating plant capacity will no longer be the limiting factor of supply and expansion.

The high price of equipment today is intensifying the problem, but I am convinced that we should do all we can to encourage and to cater for the increasing use of electricity, in order that tariffs shall not have to be materially increased in the coming years. In so doing we shall play our part in resisting the present increasing spiral in the cost of living. The next

generation should be in no worse position than our own to pay its fair share for the amenities we are providing for them now as we must hope that by the time our children "take over" international sanity and economic stability will have returned in a certain measure.

We are all aware that in many instances the incidence of increased loan charges is spasmodic and unless there is, for example, an adequate tariff equalisation fund, it may be particularly hard to balance the budget for a limited period of years without the undesirable expedient of temporarily increasing tariffs. We want the Provincial Administration to be reasonable in giving longer periods for loans to assist us in those difficult years. During the more favourable periods we can carry out certain extensions from revenue but we desire local autonomy for the undertakings we serve and in whose development we are so vitally interested.

Another aspect of this problem of excess provision for the future by urban undertakings is the possibility of some form of nationalisation which, although it may be thought unlikely at the moment, is a definite possibility in the future. In Great Britain municipal undertakings were acquired at book indebtedness only and not at real values. Over prudence therefore proved to have been a poor policy from the Municipal point of view.

I therefore urge this Convention to consider passing a suitable resolution concerning the loan period for distribution equipment and to instruct the Secretary to notify the Cape Provincial Administration of the terms of such resolution.

PRESIDENT:

Thank you, Mr. Burton.

Mr. J. E. MITCHELL, Salisbury:

Mr. President and Gentlemen: I would like to express my thanks and congratulations to the author, not only for the paper itself and for the time and thought that he has put into it but also because of his choice of subject.

This Convention, it should never be forgotten, is a gathering of electrical engineers and councillors, and whereas engineers may take delight in listening to, and discussing papers full of technical terms, I am afraid that councillors, in such instances, only show a polite interest.

The author has entitled his paper, however, "Economics in the Electricity Supply Industry", and the very word "economy" is, I am sure, enough to make every councillor alert and attentive.

"Here", says the councillor, "is something to do with £ s. d. and that I do know something about." The author is not even satisfied with whetting the councillors' appetites with the single word "economy": he has gone further and used the plural sounding word of "economics". "Not just one economy," rejoice the councillors, "but many: this really is something in our line."

I am glad to see, however, that the author does not let them get entirely out of hand, and puts some sort of brake on this enthusiasm by mentioning *false* economies, and tells them not to be deceived into thinking that the cheapest is the most economic or, to get down to basic English, costs the least money.

Now, to get down to the paper itself, I would like to deal with the three methods of depreciation on an annual cost basis mentioned by the author, namely the straight line, the reducing balance and the sinking fund methods, and I am pleased to note that he advocates the latter.

I would like the author, however, to give consideration to another method. Where an undertaking is expanding rapidly, and plant is no sooner installed than it is more or less loaded, there is no doubt that the sinking fund method is correct, but when considering either a slowly expanding undertaking or a hydro-electric scheme, where the full use of the asset is likely to be delayed, some thought should be given to a system which, for the lack of a better name, could be called the increasing payment system.

At the beginning of the life of the asset, which it is expected will not be up to its full earning capacity for some considerable time, the early years' loan charges could be comprised of almost entirely the interest, and the depreciation charges, or the amount set aside for repayment of the loan, which is, in effect, what the depreciation charges are, could be gradually increased so that the larger payments could be made when the undertaking was best able to afford them, and not the reverse

procedure, which takes place when the reducing balance method is used.

There are so many facets to this paper that it would not be very difficult to find something to comment on in every paragraph, but I will confine my attention to two points, and the first of these is "economics in the operation of power station plant".

The author advocates the use of incremental rate curves to determine the most economic load distribution between units of plant, and in doing so is critical of the method of loading the most efficient plant to its economic rating in order of merit and allowing the least efficient units of plant to carry the fluctuations in load. The mathematical proof that the loading of plant units should be such that the incremental heat rates are equal is open to serious objection, as the incremental rate curves are derived from performance curves which are based on steady load conditions. A manually controlled stoker fired boiler carrying a widely fluctuating load can be expected to give a considerably lower efficiency than a similar unit carrying the same load at a steady rate and when this factor is taken into account, with others, which I shall mention, I feel that in practice the proposed method of loading would not yield any advantage and might well result in a reduction in the overall thermal efficiency obtained from the plant.

One of the most serious losses incurred in power stations carrying a fluctuating load, is that due to the running of unnecessary plant whether it be boilers, turbines or pumps. When each plant unit is loaded to its economic rating in turn, and in order of merit, it becomes immediately apparent when a unit can be shut down on falling loads, whereas when incremental rate loading is adopted no immediate indication is given to the operatives when a unit is no longer required, and so extra losses can be incurred for this reason.

Another difficulty to be encountered in the application of incremental rate loadings to power-station plant is the uncertainty of the actual incremental rates of the units of plant in operation. These rates will vary widely with such factors as the cleanliness of condensers and boiler heat transfer surfaces, not to mention such indeterminates as the efficiency of individual plant operatives under whose control are such factors as the combustible in ash loss and excess air losses on boilers. If any attempt is made to cater for these variables in the loading schedule, the complexity of the problem is found to require the full time services of a competent engineer who must have an intimate theoretical and practical knowledge of the plant under his control to determine the ideal loads of the plant units. Such persons are difficult to find, and would, in my opinion, be better employed in the active supervision of the operation of the plant with a view to reducing the major controllable losses.

Since many power station engineers are by no means certain of the relative importance of these controllable losses on the plant, this point may be brought home to them by the preparation and issue of simple heat-rate correction curves for the turbo-alternators, and efficiency loss curves for the boilers under their control. The major controllable factors on the turbine are the back pressure, initial steam temperature and the final feed temperature. These curves enable the importance of such variations from design conditions to be assessed and show the extreme importance of the maintenance of low back pressures, with the effect of feed heat as the next most important variable.

A similar curve can be made available to show the relative importance of the controllable boiler losses. These include the combustible in ash loss, the excess air loss as indicated by the percentage of carbon dioxide in the flue gases, the flue gas exit temperature, and the percentage moisture in the coal as fired. In the operation of stoker-fired boiler plant, the over-riding importance of the combustible in ash loss is clearly indicated, and a change in the percentage of carbon dioxide content of the flue gases can be converted into tons of coal per hour by a moment's calculation. Fuel conditioning by the addition of moisture can often have a major effect in reducing the combustible in ash loss, but operatives are often in doubt concerning the losses incurred by the addition of moisture to the coal. If samples of ashes having various percentages of combustible are available for comparison, stokers can immediately assess the amount of combustible in ash discharged from a boiler

to within two to three per cent. By the use of these curves, the gain in efficiency obtained by conditioning the coal with the consequent reduction of the combustible in ash, can be compared with the loss in efficiency brought about by the addition of moisture to the coal. The importance of the correct conditioning of coal can thereby be made apparent to the boiler operators.

There is, of course, another method which would achieve the same object and major economies would result, and that is an incentive coal bonus to be paid to the power station operatives.

I could instance pre-nationalisation undertakings in the U.K. where this achieved a great success, but until, as advocated by Mr. Eastman in his retiring address recently, electricity undertakings, although being retained in Municipal ownership, are considered as separate commercial undertakings, and do not have to consider the impact of such an internal arrangement as this at the power station on the City Treasurer's and Town Clerk's departments, I am afraid it is impracticable.

I should be pleased to have further details of the boiler plant to which the performance curves in Fig. 4 refer. It is usual for boiler plant to have an increasing thermal efficiency with load until the economic rating is reached at approximately 80 per cent of the maximum continuous rating. In these units, however, the maximum efficiency appears to have been reached on boiler "A" at approximately 48 per cent of maximum load, and on boiler "B" at approximately 40 per cent of maximum load. This has the result that the units will usually be operating on the drooping portion of the performance curve and on such plant it would be necessary to consider seriously the advisability of adopting incremental rate loading. This is, however, a very unusual condition in my experience, and for this reason I am interested to learn further details of the type of boiler plant used by the author.

My second point for comment is on the author's statement on page 14, paragraph 3.2.4 in regard to overhead lines.

The Salisbury Municipal Electricity Department, as I think most of you know, manufactures, under its own patents, concrete poles, and despite the fact that the reinforcing steel, which it has been forced to buy recently from the Continent, is three times the recently increased Union price, and the cement price double the Union price, a 28-ft low tension pole can be made for £6 10s. each. By means of a power operated pole auger and derrick, operated by three natives and a European, up to twenty of these poles can be planted in a day at a cost of £1 4s. per pole, which figure includes transport up to ten miles from the store, and all overheads on the machine, plus labour, fuel, etc., and I suggest that where a power operated derrick is used, weight is not a factor needing much consideration.

Thus, as I say, with ingredients double and treble the Union price, concrete poles can be planted in Salisbury at less than £8 per pole, against the author's figure of £20.

Somebody, it seems to me, is making a handsome profit somewhere, for on my calculations, a low tension concrete pole should be able to be planted in the Union at less than £5, and is therefore a very much more economic proposition than a wood pole on the author's own showing.

As I said earlier, there are many other comments that could be made and also, as the author states in his conclusion, many other aspects of economics in the electricity supply industry that he has not even touched on, but I feel I have taken enough of the Convention's time, and will conclude with my best thanks to the author for writing a paper of absorbing interest, and without doubt a mental meal of many courses.

PRESIDENT:

Thank you, Mr. Mitchell.

Mr. J. C. FRASER, Johannesburg:

Mr. President and Gentlemen: The subject so ably presented in this paper is of momentous interest at the present time.

Due to the steep rise in labour and equipment cost, which the electricity supply industry, in common with other industries, has had to meet in recent years, there has manifested itself in this country the necessity for increases in electricity supply tariffs.

Already a considerable number of smaller municipalities and several larger ones have succumbed to this trend.

Realising, as all responsible officials in our industry do, the important part cheap electricity plays in modern life, both in the house and in industry, and the particular importance of cheap power to a country like ours, in the process of unprecedented industrial development, it is only natural that many of us have been giving our attention increasingly to the economic aspect of electricity supply both at the design stage and in the day-to-day operation of our undertakings.

The present paper is therefore performing a signal service, in summarising the basic principles of electricity supply economics, and in drawing attention to the large amount of work already done in this field and accessible through numerous sources in literature.

I do not propose here to discuss the basic principles touched on in the paper, which will have served its purpose if it has stimulated our interest and whetted our appetite for further study of this intricate subject.

I would rather point out the wide scope of application of these principles in practice.

In power station design economic considerations have led to the adoption of higher pressures and temperatures.

In the Orlando Power Station at present being extended in Johannesburg the designed steam conditions are 625 psi pressure and 820°F. temperature, as compared with 365 psi and 700°F. in Johannesburg's older city generating station. Overseas the tendency is toward ever increasing pressures and temperatures, in this country however due to the comparatively low price of coal, steam pressures and temperatures much in excess of 625 psi and 820°F. are not likely to prove economical in the foreseeable future.

On the distribution side application of economic calculations is legion, though perhaps the application of basic principles in this field is more difficult than in most cases.

To determine the cost per unit of units lost in distribution is no simple matter as the position is complicated by the necessity of adding the cost of transmitting the losses to the apparatus in which they are lost. Estimating loss-load factors is also not possible with any high degree of accuracy.

On the whole taking account of all difficulties, the cost of units lost in any particular piece of apparatus, can probably not be estimated with an accuracy better than 20 per cent.

This does not however detract from the value of an economical analysis of a given problem provided the alternatives considered are compared on the basis of the same basic data, and that differences in the annual cost of two schemes are not considered significant unless they exceed say 5 per cent of the total.

Thus in Johannesburg it has been the practice of adjudicating tenders for transformers on the basis of a "capitalisation" formula, which reads:

Total Annual Cost =

$$\frac{7 \cdot 05}{100} C + \frac{1}{82 \cdot 2} \left(Fe + \frac{Cu}{3} \right)$$

where C is the tendered price in £, Fe are the iron losses and Cu are the copper losses in watts.

This formula is based on a cost of ½d. per unit lost and a loss-load-factor of 0·333 and an economical life of the transformer of twenty years. Using different data, which gives a total annual cost some 10 per cent lower than calculated on the above formula, the order of tenders on the annual cost basis is reversed in some cases, but only if the differences between the tenders are less than 2 per cent.

Therefore, where the difference between alternatives is of the order of less than say 5 per cent of the total annual cost, these differences could be disregarded and adjudication could be proceeded with on the basis of first cost alone.

Problems like the selection of transmission and distribution voltages, the choice of alternative network layouts, methods of voltage regulation, the choice

of economical conductor cross-section could and should be decided on economic grounds, subject always to the proviso of proper safeguards for maintaining a satisfactory standard of service, and public safety, which can not be as a rule justified on purely economic grounds.

To quote an example of a different kind where economic considerations justified initial expenditure far in excess of a possible minimum, the Johannesburg Electricity Department purchased some time ago a fork lifting truck to facilitate handling of stores in the stores yard and in the workshops. Three alternatives were examined: (i) to continue handling of stores by hand; (ii) to purchase a petrol-driven truck at a cost of about £900; (iii) to purchase an electrical battery driven truck at a cost of about £2,000.

It was found that both alternatives (ii) and (iii) were more economical than (i). Alternative (iii) proved the most economical of all in spite of the very much higher first cost if at least four hours of daily running could be counted on. For a lesser use the petrol-driven truck was the more economical.

I would like to point out, however, that in order to provide basic data for economic studies suggested in the present paper, a rather large amount of preliminary research into the cost of electricity generation and distribution is necessary as well as a study of load curves and loss-load factors. Averages, like the average cost per unit sold are of little use. The following figures, which were obtained from an analysis of costs in the Electricity Department in Johannesburg may be of interest.

The cost of losses in the H.V. distribution system was found to be approximately £2 2s. per kW M.D. plus ·11d/Unit.

The cost of losses in the L.V. distribution system was found to be approximately £3·5 per kW M.D. plus ·14d./Unit.

The first of the above figures is the average cost per unit at the station busbars, while the second is at the hypothetical terminals of the H.T. distribution system.

A rational costing system, giving a functional subdivision of costs is a primary necessity to enable a proper cost analysis to be made.

An analysis of the annual system-load curve in Johannesburg produced the following data: loadfactor 42·8%, loss-load factor 20·9%. Working on the formula for the loss-load factor given in the paper, $\cdot 3F+7F^2$ the loss-load factor would have been estimated at: 25·7%. This means that for these conditions at least the formula given is producing values for the loss-load factor, which are about 25% too high; $\cdot 2F+\cdot 8F^2$ would have produced a better value.

On the other hand an analysis of a daily load curve on one of the distribution load centres with a purely domestic load showed that the load factor was ·40% and the loss-load factor ·24%. These figures give close agreement with the suggested formula.

The above proves my point that errors in a rough estimate of the loss-load factor can be of the order of 20–30%

In conclusion I would again emphasise that careful economic study of electrical supply problems pays dividends in the long run, provided slavish adherence to formulae is not attempted, and a measure of ordinary common sense is brought to bear on the problem.

PRESIDENT:

Thank you, Mr. Fraser. Gentlemen, we will now adjourn for lunch and resume at 2.30 p.m.

Convention resumed at 2.30 p.m.

PRESIDENT:

Gentlemen: We will not continue the discussion of this morning's paper this afternoon. It now gives me great pleasure to call on Mr. Smith, Electrical Engineer, Boksburg, to give us his paper on Meter Testing.

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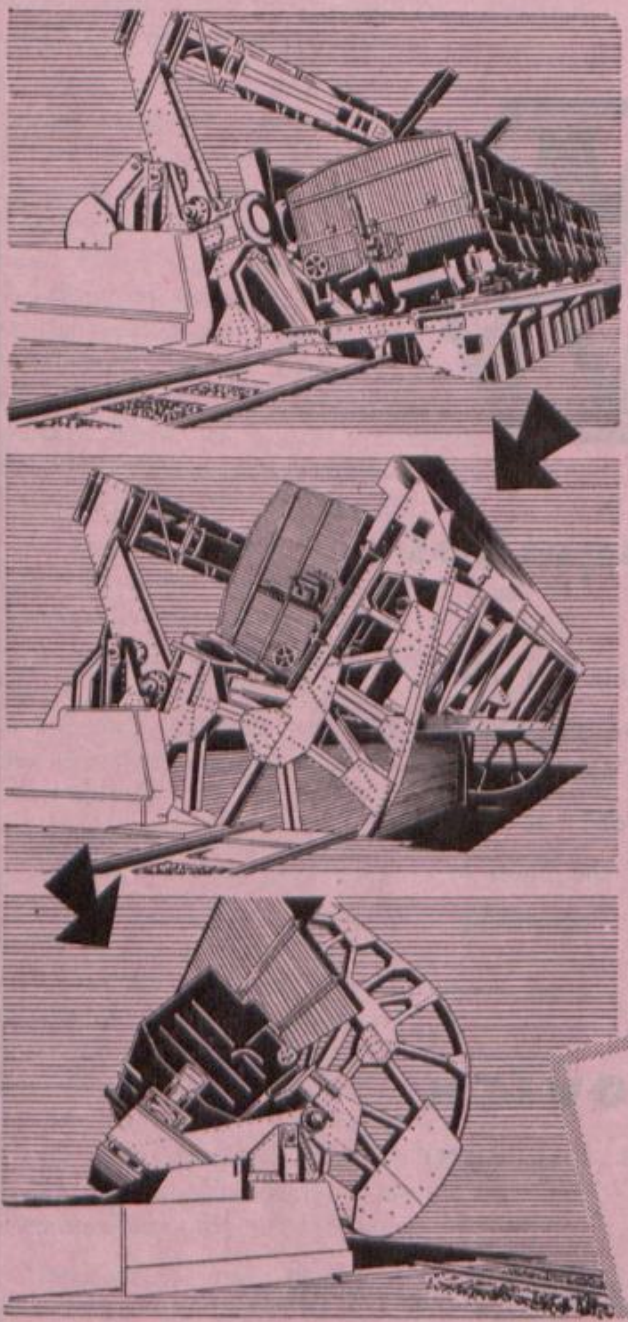

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THE REPAIR AND TESTING OF METERS

By
E. L. SMITH M.(S.A.)I.E.E.,
A.M.I.E.E.

Contents

1. Introduction.
2. Meter Repair.
3. Testing.
4. Meter Testing.
5. Instruments.
6. Conclusion.

Introduction

South Africa has in recent years witnessed the astonishing development of the use of electric current in all phases of South African life. No longer is electricity considered a luxury. It is now considered absolutely essential to the well being of the people. This great development has increased the necessity for accurate methods of measurement of electrical energy, and the testing and maintenance of electricity meters is now a recognised profession.

The proposed introduction of the Meter Testing Code has brought to the notice of all engineers the value of meter testing and has aroused a great amount of interest throughout the Union and engineers have established routine testing and others have improved their existing testing section, which is, in the author's opinion, a matter for congratulation, and will no doubt result in a great improvement in meter-engineering practice.

The intention of the paper is to be of some assistance to small undertakings who may be able to set up meter repair and testing in a simple way at a low cost, and at the same time satisfy the provisions of the proposed Meter Testing Code.

Small undertakings of towns with European populations of less than 10,000 will have from 200 to 2,000 meters in circuit which have to be tested every six years, which means that from approximately 35 to 350 meters to be overhauled and tested in the course of one year. This number can be easily dealt with by the Engineer himself and the equipment required can be simple and cheap.

Undertakings with populations of from 10,000 to 20,000 who have to deal with 350 to 700 meters per year may organise as the smaller municipalities or they may establish meter testing in conjunction with installation and other test work.

Undertakings with European populations of from 20,000 to 60,000 would tend towards making the meter department the electrical testing section responsible for tests on a wide variety of apparatus including meters, instruments, protection, transformers, oils, lamps, cables, etc., etc.

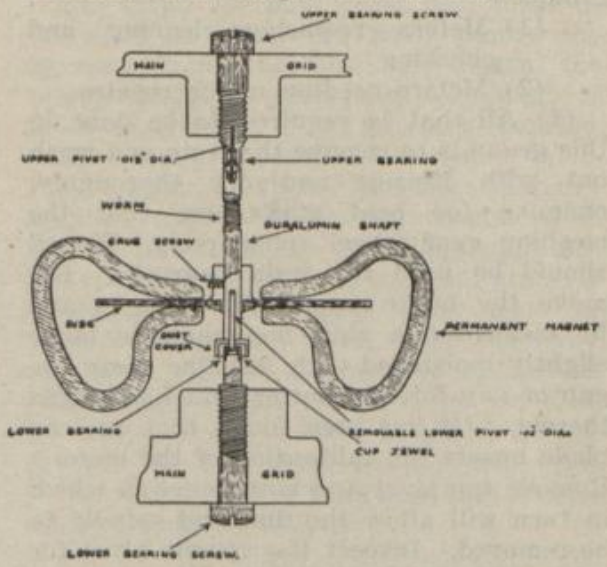

Fig. 1. — Single phase A.C. kilowatt hour meter.

The large undertakings would have a specialised meter and instrument, repair and test department, with other departments dealing in transformers, cables, lamps, etc., these branches having in charge a fully qualified engineer. It is the author's intention to deal more especially with meter repair and testing appertaining to undertakings with populations up to 60,000 inhabitants.

Meter Repair

The majority of meters are of the single phase A.C. house service type, the repair of polyphase meters is similar, and although D.C. metering is rapidly disappearing in this country it will also be dealt with. In the past little thought or care was given to meters. They were placed in the most inconvenient places imaginable, such as kitchens, above stoves, above water sinks in the sculleries, in cellars,

etc., and received no further attention until they stopped, were damaged due to lightning, overload or otherwise, or got into such a condition they had to be replaced. Fortunately in recent years more particular care has been given to the handling, transporting and installation of meters.

The main components of an A.C. meter are current and potential coils, spindle and disc, brake magnet, registering train, bottom jewel bearing and top pivot. (Fig. 1, with registering train removed.) The overhauling of meters can be classified into two groups.

(1) Meters requiring cleaning and checking.

(2) Meters needing major repairs.

(1) All that is required to be done in this group is to remove the train and wash out with benzine and dry thoroughly, examine for bent staffs, see that the meshing gear wheel spins freely. No oil should be used for train bearings. Remove the brake magnet or magnets and by means of a thin non-magnetic blade slightly moistened with vaseline clear the gap of any foreign matter that has lodged therein. (It has been found that an iron blade upsets the calibration of the meter.) Remove top pivot and bottom jewel, which in turn will allow the disc and spindle to be removed. Inspect the spindle pivot for wear and if necessary burnish or renew the point. The sapphire jewel bearing is next examined for rough or cracked surface. This is done by using the point of a fine sewing needle and working carefully round the cup of the jewel, the point of the needle will catch if there is a crack or rough spot. Should this be the case then the jewel should be replaced with a new one. The top pivot assembly is then examined and if the the pin be bent or damaged, renew it, clean out the cup or reservoir in the top of the spindle and refill with pure vaseline. In some makes of meters the spindle and disc can be removed without disturbing the brake magnet.

All parts are reassembled, care being taken that the train gear wheel meshes correctly with the worm on the spindle, about half the depth of the teeth should engage. The meter is now ready for test. It is the author's opinion that in this class from 20 to 24 meters can be dealt with in a working day of 8 hours.

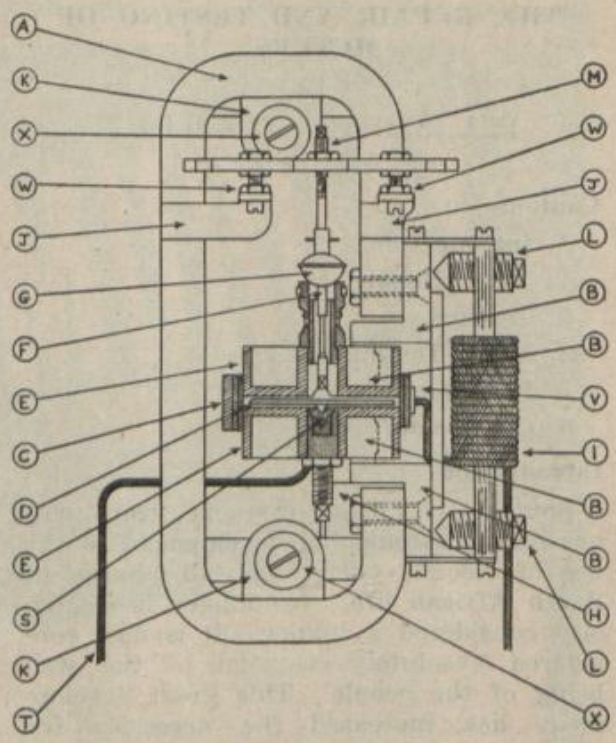

Fig. 2. — Direct current meter.

A. Permanent magnet.
C. Metal band with cork lining.
E.E. Brass castings (nickel plated and coated with insulation) forming top and bottom of the mercury chamber.
G. The balance weight.
I. The correction coil.
K.K. Fixing lugs welded to the magnet. These take the place of the hook-shaped clip used on earlier patterns.
M. The top bearing of the armature spindle.
T. Connection from mercury chamber to terminal.
W. Nuts for adjusting the height of the counter bracket. This bracket must be set perfectly level.
B.B. Top and bottom pole pieces.
D. The armature.
F. The armature spindle. The point of the arrow indicates the position at which it should be held by pliers when removing the balance weight.
H. The screw in the upper end of which is inserted the jewel which forms the bottom bearing of the armature.
J.J. The side brackets carrying the counter bracket. In meters of the latest type, these are welded to the magnet.
L.L. Adjustable studs in the bar carrying the correcting coil.
S. The jewel forming bottom bearing for the armature. It is cup-shaped and very highly polished.
V. Connection from correction coil to insulated contact stud in the metal band "C."
X. Insulating bushes through which pass the screws "U" for fixing the meter in its case.

(2) Due to overload, lightning, rough handling or to dirt getting into the meter due to a broken glass or cover, more extensive repairs are necessary. The parts are removed as in (1) and also the potential and current coils. The checking in (1) is carried out but in this case the train in completely dismantled, the gears and staffs cleaned with benzine and burnished with a brasswire brush, the bearings cleaned with sharpened pegwood. The potential coil may be open circuited due to lightning, and this usually happens at the end of the coil; a spare assembly should be available for quick replacement. The larger undertakings can easily rewind the coils, but small undertakings should have spare coils on hand.

The current coil may have broken down due to a flashover or overload and is dealt with on similar lines as the potential coil.

Under this class of overhaul it is estimated that from 12 to 14 meters can be overhauled in a day, excluding coil rewinds and 4 meters including rewinding of coils, the coils being rewound in an automatic coil winder.

New Meters

The author's undertaking checks and tests all new meters before putting them into service, with a special examination of the jewel surface and pivot point which may have been damaged by the impact of the spindle pivot while the meter was being transported. It has been found that about 60% of new meters are outside the 2% ± allowed for in the by-laws, but that the majority or 95% are within ± 5%. Also almost all meters so adjusted have also to be adjusted on the ·5 power factor test.

Although the author's undertaking tests all meters on ·5 P.F. because it is a standard practice, he is of the opinion that this test is not absolutely necessary for domestic loads.

In all cases of meter repair a strong air blower is useful for blowing out dust and drying, etc.

D.C. ampere-hour meter repair

The overhauling and repair of D.C. meters requires greater skill and care, and a longer time is required in the overhauling as compared with A.C. meters.

The main parts of a D.C. mercury motor meter are:-

Permanent magnet or magnets, mercury chamber, rotor, jewel and pivot, registering train, and a correction coil or bar (see Fig. 2 with train removed). Should a new meter not start the fault may be due to insufficient mercury in the chamber; see that the chamber is full and rotate the rotor or armature (taking great care as the rotor is easily bent) with the fingers by means of the balance weights to eliminate any bubbles in the mercury. Also check the registering train for meshing with the worm gear on the spindle.

For major overhaul great care must be exercised. Remove the train, empty the mercury from the chamber, loosen the balance weights, which also form part of the locking device of the mercury chamber, remove top pivot bar, and magnets (placing a keeper on them) and take mercury chamber apart. Carry out checks as in A.C. meters with the following additions. The rotor should be quite true and properly amalgamated. The pole caps must be insulated from the metal poles otherwise the meter will be slower due to current taking another path than the one provided. Use only a small voltage of about 6 volts to test the insulation on the pole caps. If the magnets have weakened they can be remagnetised as follows:-

Remove the whole element from the case and wind from 20 to 30 turns of flexible wire (about 225/40 s.w.g.) round the magnet or magnets, pass a D.C. current of about 500 to 800 amperes by connecting it to the 220 V. D.C. supply momentarily; this jolt will boost the magnet. The fuse in this circuit should not be greater than 20 amps. A demagnetising current of 15 amps in the opposite direction will help to stabilise or age the magnet, and will only reduce its strength by about 5%.

Replace the element in its case and allow it to run for a time to remove air bubbles. Further stabilising can be achieved by passing a short circuit current through the meter. If this is done two or three times the magnets will be stabilised and the magnets will have weakened by only 2%, subsequent short circuits will have no effects.

The mercury can be cleaned as follows:-

Make a funnel of blotting paper, the

hole of which should be kept small. Filter the mercury two or three times through the filter, this will remove most of the larger particles of dirt. Then squeeze the mercury through chamois leather, then wash with a diluted solution of nitric acid, one part acid to 4 to 5 parts water. Wash again with plenty of water to remove scum. Wash with a weak solution of caustic soda to remove acid and finally wash with water to remove all alkali. Dry in an oven taking care to keep mercury clean. Very large undertakings distil the mercury but this method is too expensive for small undertakings.

A.C. testing equipment

In a test department any particular test conditions should be readily obtained so that the apparatus under test can be subjected to conditions in actual practice. Therefore the design of the equipment

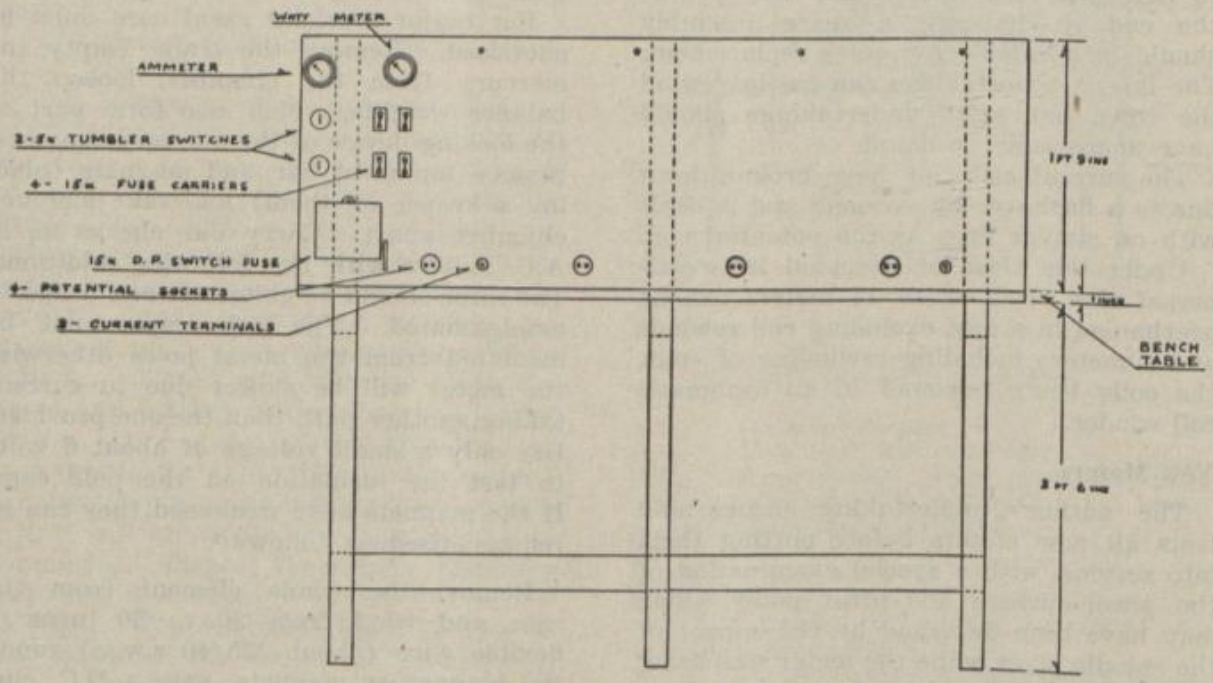

Fig. 3. — Test bench for single-phase A.C. meter-testing equipment.

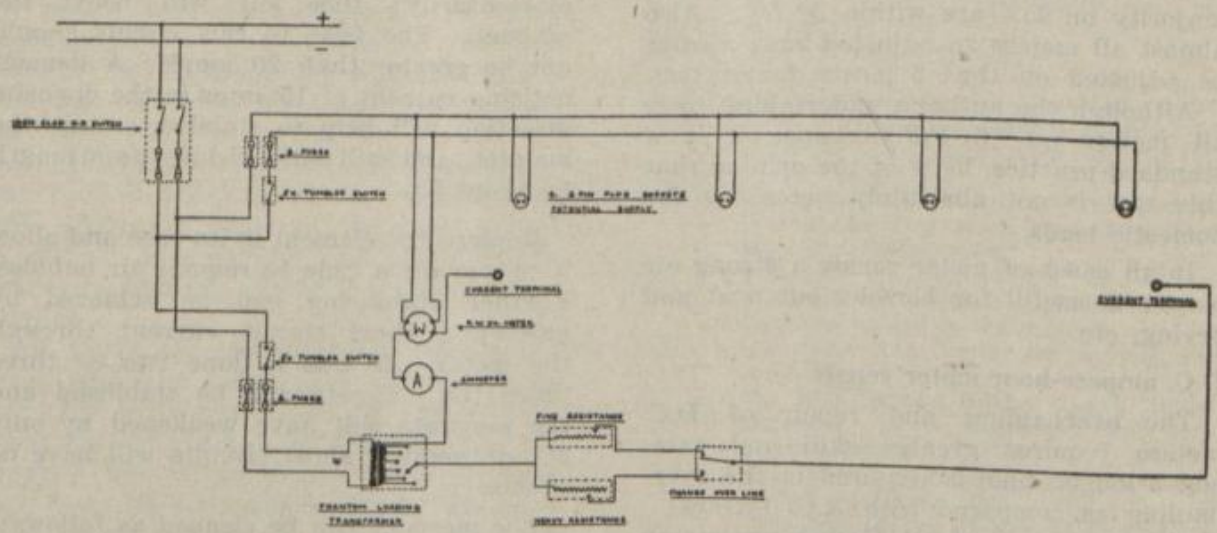

Fig. 4. — Schematic diagram of simple A.C. test bench.

should be such as to produce actual working conditions for any meter test. However, this is not economical for a small undertaking to embark upon and therefore equipment that will ensure accuracy within wider limits is justified in their case.

Small undertakings dealing with up to 350 meters a year require only a test board as shown in Fig. 3 and can be constructed of wood, wired and equipped as in Fig. 4. The components are a 15 amp two pole iron clad switch with fuses, two 5 amp tumbler switches, one to control the potential circuit and the other the current circuit. A transformer to provide the phantom load which can be constructed cheaply and details of which are given later in this paper. One fine and one coarse rheostat, a set of changeover links, an ammeter and a specially tested K.W.hr. The ammeter and K.W.hr. meter to be of 25 amp range with a wide scale for the ammeter. A range of 25 amps is considered sufficient, but larger undertakings may find it necessary to go up to 50 amps and replace the K.W.hr. meter with a rotating sub-standard. The above setup will satisfy most of the needs of a small undertaking, even to the testing of polyphase meters as single phase meters.

This board does not allow for a 10% increase in voltage in the potential circuit to test for creeping. The author is of the opinion that this can be ignored in small undertakings as it is unlikely that there will be over voltage. However, if expense is no object an auto transformer to give 10% over voltage should be incorporated.

The cost of such a board should not exceed £20 made up of test board £5, i.c. switches, fuses and tumbler switches £1, a phantom loading transformer can be made from a C, CM or BM current transformer and can be bought secondhand at a low cost, say £5 for completed transformer. Rheostats can be made up for about £2/10/-, a K.W.hr. meter £3, and ammeter £3, terminals, etc., 10/-.

Undertakings testing from 350 to 700

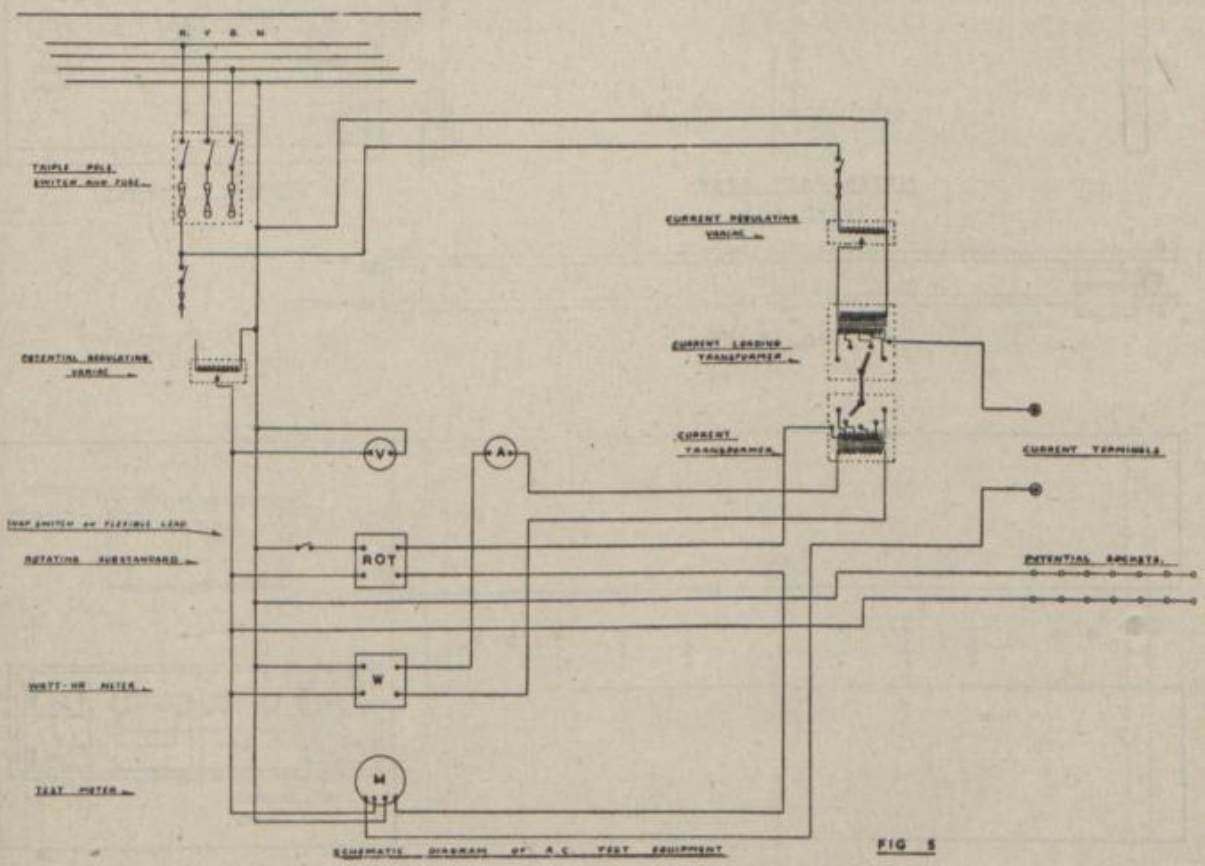

Fig. 5. — Schematic diagram of A.C. test equipment.

meters a year would probably improve on the test board previously described. Such a board is shown in Fig. 5, which includes potential variacs to vary the voltage of the voltage circuit and a current variac to give fine adjustment to the current. This test board would also be provided with a rotating sub-standard and a reliable sub-standard grade single phase watt-meter.

Means are provided for changing over the potential circuit to another phase so that a power factor near to 0·5 lagging can be obtained.

The cost of such a board including sub-

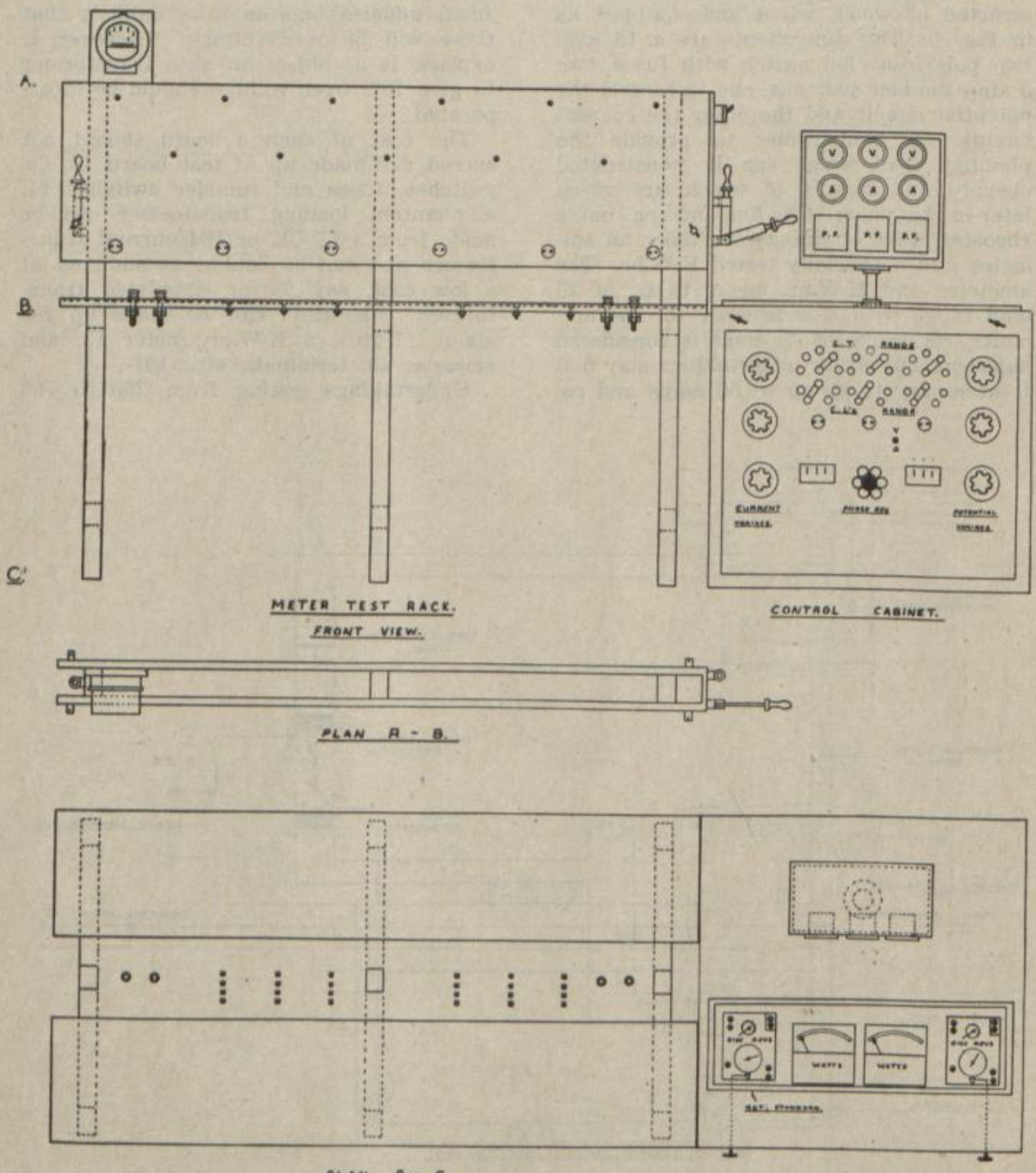

Fig. 6. — Meter testing equipment in use in the meter department.

standard instruments will be in the neighbourhood of £200.

Two variacs at £10 each	£20
Rotating standard	60
Wattmeter	70
K.W.hr. meter	3
Current loading transformer ..	5
Variable current transformer ..	10
Voltmeter	5
Ammeter	3
Test board with switches and fuses	15

The undertaking with which the author is associated deals with approximately 1,000 meters a year and, therefore, it was decided to install a utility bench for 3 phase testing so that actual 3 phase conditions could be obtained for 3 phase meters and other apparatus. The equipment was also designed so that other apparatus can be tested, such as voltmeters, ammeters, electrical instruments, etc. When 3 phase testing is not being done, three single phase tests can be carried out, by using a third rotating standard on another test rack, but usually only one single phase test is done, as there is only one tester in the test room. A separate board has been constructed to test protective gear as heavier currents are used for these tests.

The main consideration consistently kept in view was flexibility without making the equipment too costly. Two racks back to back as shown in Fig. 6 capable of carrying a total of 26 single phase or 12 polyphase meters were incorporated.

The physical appearance of the supply and control equipment is a wood cabinet placed next to the racks. The cabinet has two removable sides to allow of easy admittance to the interior. The front panel is of bakelite, carrying on one side three current control variacs, and on the other three potential control variacs, all arranged in vertical order. Along the top centre are three sets of link studs for changing the C-T ranges on each phase, and immediately below three sets of link studs for loading ranges. Two 3 pole switches, three 5 amp 2 pin sockets and the phase-shifting transformer control knob complete the layout. On top of the cabinet is a wooden case with a bakelite front panel on which

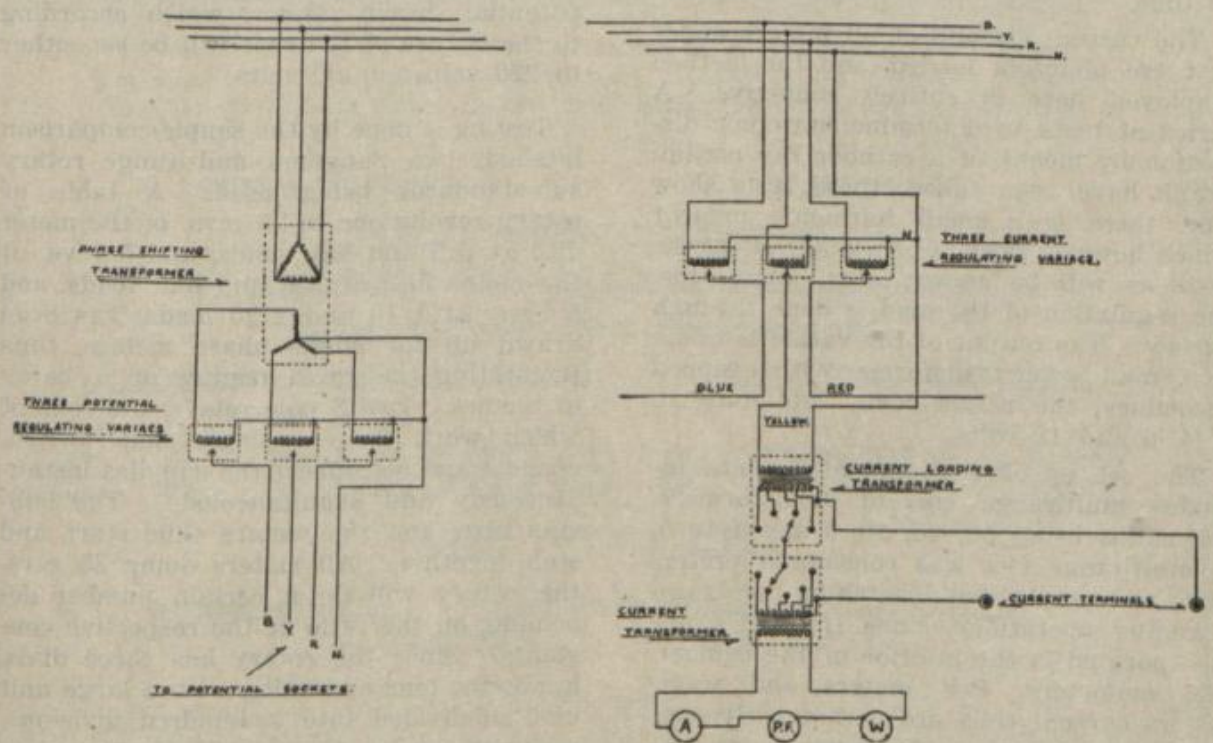

Fig. 7A. Fig. 7B.

Diagram of single and poly-phase meter testing equipment.

are mounted three voltmeters, three ammeters, and three power-factor meters, the whole mounted on a hollow swivel base. A glass-covered well in the top of the cabinet contains two rotary sub-standards and two sub-standard wattmeters.

Power factor adjustment is made by means of a phase shifter. An induction motor was obtained, the winding calculated and the transformer built in our workshops. The phase shifter is wound delta/star, no provision being made to delta the secondary, the voltage ratio is one to one. The output from the transformer is fed to three variacs, and thence to the potential circuits (see Fig. 7A).

This supply is made available on the standardising bench for C-T and wattmeter testing. The variacs giving a slight step up of potential, 270 volts per phase to neutral and 467 volts phase to phase can be obtained. The two voltages constantly employed are 220 and 110, the former for single phase and 3 phase 4 wire meters, and the latter for maximum demand meters and certain 3 phase 3 wire meters which use potential transformers on site, a small number of 3 phase 3 wire 380 volt meters are also tested from time to time.

The current circuits of all meters under test are phantom loaded, and the method employed here is entirely inductive. A series of tests to determine harmonic distortion by means of a cathode ray oscillograph have been taken, these tests show that there is a small harmonic present which however does not seriously effect the tests as will be shown later. Here, too, the regulation of the load is done through variacs. The output of the variac is taken to a small power transformer with a tapped secondary, the ratios being 220 volts, to 2, 4, 6 and 12 volts.

The set up of the current circuits includes multirange current transformers, the ratios being 50, 25, 10, 5 and 1 to 5. A multirange C-T was considered preferable to complicated switching or ratio changing operations, since the C-T's are incorporated in the interior of the cabinet. The ammeters, P-F meters and wattmeters current coils are permanently connected as secondary burdens, extra impedance burden being connected in the yellow phase circuit to compensate for the lack of a wattmeter current coils. The three C-T's were built in our workshops, special precautions being taken to maintain the ratios within close limits on the two lower ranges. The tappings are taken to the front panel, terminating in studs arranged in an arc, with a strap to a centre stud, and adjacent centre stud with accompanying arc of 4 studs being connected to the tappings of the loading transformer (see Fig. 7B).

It will be noticed that the C-T range and the loading range can be altered independently of each other. Since it is advisable to work the variacs at the highest possible voltages output for any load, a loading range is chosen to obtain this effect for any batch of meters. Remembering that the load is inductive and largely made up of the meter series coils, a batch of twelve 50 amp meters will require a lower setting of the variac than a batch of twelve 10 amp meters using the same loading range on the loading transformer. A lower voltage output from the loading transformer will therefore be used for the 50 amp meters than for the 10 amp meters, thus maintaing a high output voltage from the variacs. This does not apply to the potential circuit variacs, which according to the nature of the case will be set either to 220 volts or 100 volts.

Testing is done by the simple comparison method, two Sangamo multirange rotary sub-standards being used. A table of rotary revolutions to 25 revs. of the meter disc at full and half loads, and 5 revs. of the meter disc at full and half loads, and 5 revs. at 1/10 and 1/20 loads, has been drawn up for single phase meters, thus facilitating the rapid testing of a batch of meters. Two 3 pole relays, the coils of which work from a single snap switch, connect and disconnect the supplies instantaneously and simultaneously. The sub-standards and the meters thus start and stop together. All meters doing 25 revs. the rotary will do a certain number depending on the ratio of the respective constants. Since the rotary has three dials, hundreds, tens and units, with a large unit dial subdivided into a hundred divisions, readings can be taken to ·01 of a complete revolution. The appropriate range on the sub-standard is used.

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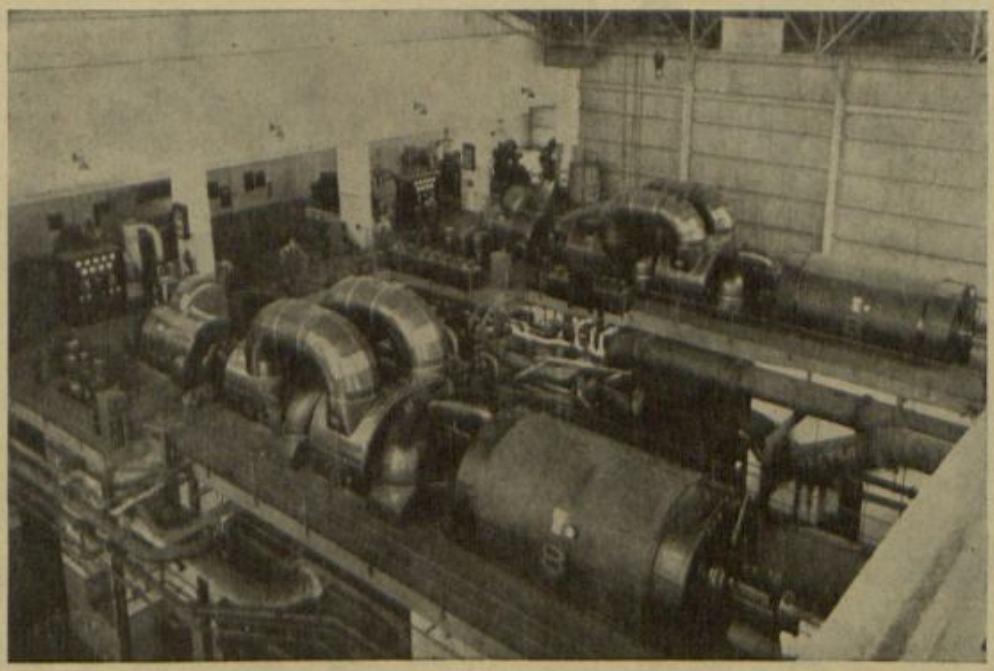

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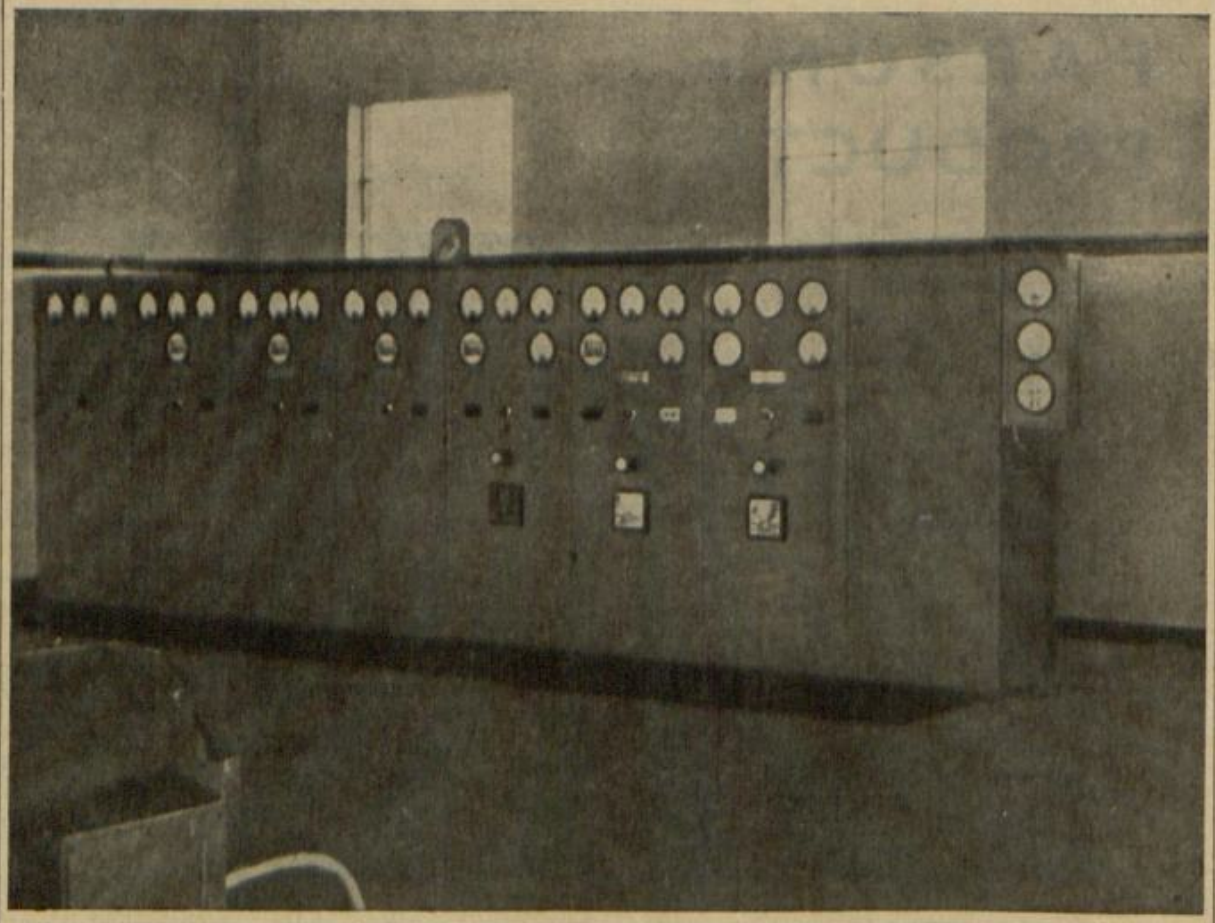

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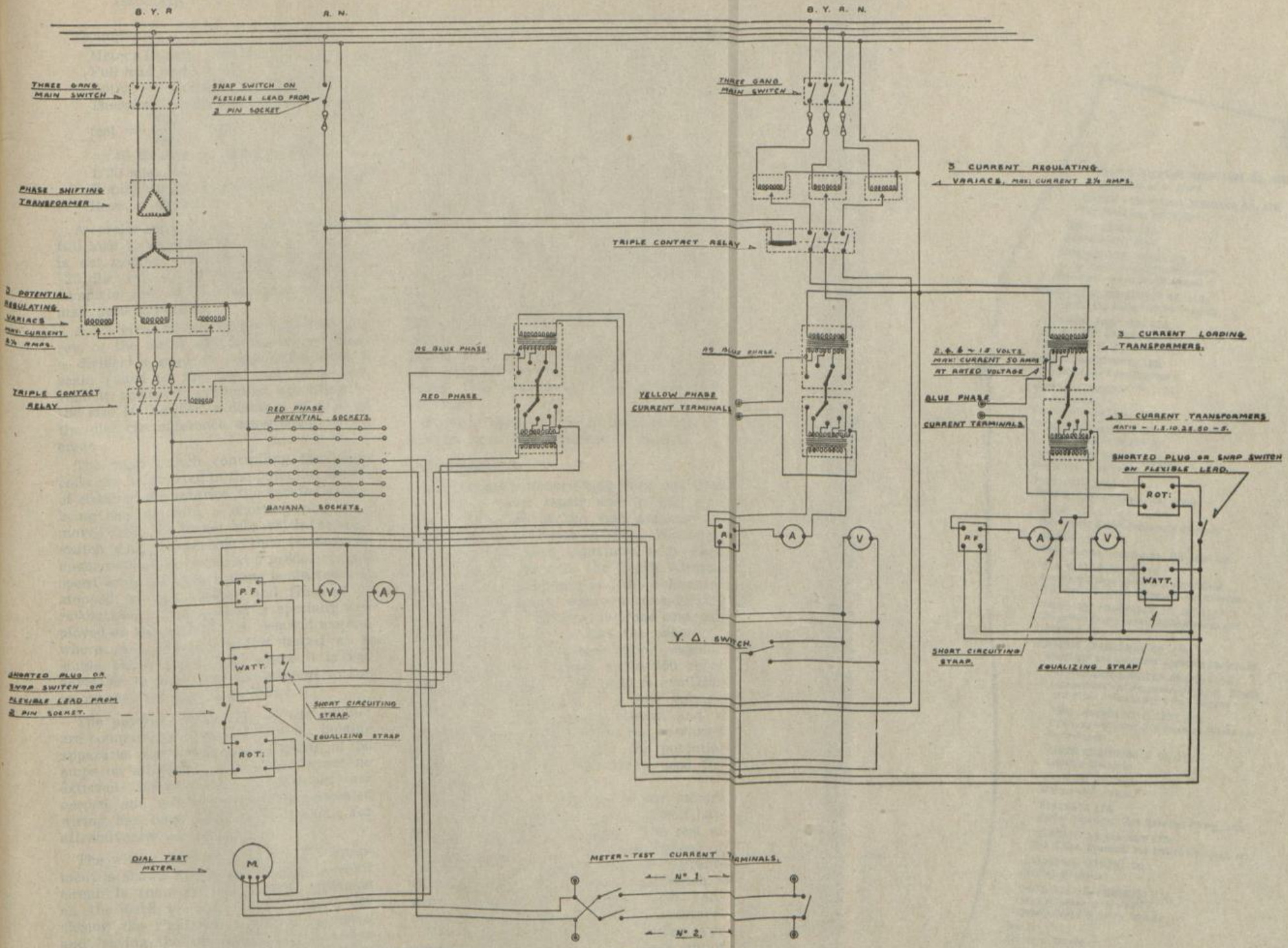


Fig. 8.—Three phase wiring diagram of meter test bench in use in the meter

Example:-

Meter: 10 amp. (400 R.P.U.).
Full load revs. = 25.
Rotary = 10 amps (750 R.P.U.).
Therefore for 25 revs. of meter under test = $\frac{750}{400} \times 25$
= 46·88 revs. of sub-standard.
1/20 load revs. = 5.
Rotary range = 1 amp (7500 R.P.U.).
Revs. = 93·75.

A preliminary 5 rev. test is made at full load to ascertain that the meter error is not greater than an amount equal to ·25 disc rev. at 25 revs., as otherwise a complete rev. of the disc plus or minus may pass unnoticed.

A 1% error at full load is a quarter of a rev. of the meter disc, while at low loads a divider is used in conjunction with a scale (fixed to the test rack in a convenient position), graduated according to the size of the disc, a distance of 1/20 of the disc circumference being equal to 1% error.

The snap switch controlling the relay coils can be inserted in the potential circuit of either of the rotaries, the vacated socket being shorted with a shorting plug (removed from the socket into which the snap switch plug is inserted), thus leaving the meter under test to run at a predetermined speed while the rotary alone is started and stopped at any number and fraction of revolutions. This method is specially employed on Sangamo K.V.A. demand meters, where each element is first tested as a single phase meter, and where it is not advisable to disconnect the current to the meter even for short intervals.

The physical dimensions of the cabinet are compact, being 3′ x 3′ x 2′ 8″, holding apparatus for a maximum loading of 50 amps on all phases. With the layout no external instruments or controls are needed, and as far as possible concealed wiring has been maintained, making for attractiveness and efficiency.

The wiring diagram of the above equipment is shown in Fig. 8. The red current circuit is connected to current terminals on the back to back meter racks. By closing the righthand single pole switch and leaving the two single pole switches (on the lefthand side) open, both sides of the rack can be used for testing a large batch of meters. However, a smaller batch can be tested on either side of the rack by leaving the righthand single pole switch open and closing either one or both of the lefthand single pole switches.

To prove the above equipment

A test was taken on a batch of 10 amp single phase meters by means of the above board at an ambient temperature of 80°F and at loads of 1/2 and 1/20 loads under the most excessive inductive conditions possible, and calibrated within 1% ±.

The second series of tests was carried out under actual working conditions, e.g. on a lamp load connected directly to the mains at an ambient temperature of 75°F. The deviation from the first calibration curve was between ·04 to ·1% ±. The batch of 11 meters included modern and old types of meters, but all of the same make. The tests were by timing and dial readings.

Further tests are to be carried out on various sizes and numbers of meters.

D.C. equipment

The author's undertaking does not deal with D.C. meter repair and testing, and this is the case of the vast majority of undertakings in South Africa. However, the author has been acquainted with other tests laboratories (viz. the South African Railways and Harbours and the Johannesburg Municipality), where a considerable amount of D.C. testing is done and the equipment is more or less the same.

A source of low voltage supply capable of giving a high current up to 200 amps (and if necessary to 500 amp) is available either from a battery or a low voltage dynamo for the current circuit, and a steady voltage supply which can be varied from 100 to 500 volts for the potential circuit. A small dynamo being used for this supply.

In the case of mercury motor meters a current supply from a 6 or 12 volt battery is all that is necessary. The rest of the equipment includes an assortment of variable resistances of various current-carrying capacities, a reliable stop watch, a good sub-standard ammeter (and voltmeter for watthours meters) are necessary.

The ammeter which has a series type shunt is used and which is made up of

shunts rated at 1·5, 3·0, 7·5, 15, 30, 75, 150 and 300 amperes.

A wiring diagram of a D.C. test bench is shown in Fig. 9. An alternative steady potential supply from a M.G. set is shown in Fig. 9a, and a battery supply in Fig. 9b.

A.C. Meter Testing

There are four methods of testing alternate current meters.

(a) Comparison (or dial testing).

(b) Rotating sub-standard.

(c) Time testing on held loads.

(d) Strobascopic testing.

The last named is used almost entirely by manufacturers for mass testing of meters and used very little if at all by municipal undertakings and is simply viewing the speed of the disc of the meter through a strobascope which has been set to give the correct speed of the meter at a particular load; if the meter is correct the disc appears stationary; if fast, it will appear to go forward slowly. If slow the disc will appear to go backwards.

(a) **Comparison method (or dial test)**

This method is a comparison between the dial reading of a specially calibrated watthour meter and the dial reading of the meter or meters under test. This method can be adopted by small undertakings where time is no object. The test is carried out over a long period of time and load can be varied, i.e. it is not necessary to hold the load on any special value. This test is as under actual working conditions, but there is always the uncertainty that the meter might be erratic, that is it may stop for short periods during the test and be fast during the remainder of the test and yet show a good average test. This method of testing meters over all loads is only recommended for small undertakings who cannot afford more costly instruments. The check meter has to be recalibrated fairly frequently.

(b) **Testing by means of rotating sub-standard**

This method is the most favoured and is generally the method used, especially where speed is essential.

A rotating standard is a specially designed K.W.hr. meter, but instead of having a registering train as in a K.W.hr. meter the spindle is elongated and attached to a revolution counter which gives the revolutions of the disc of the standard. Rotating standards for single phase work have generally two voltage ranges, viz. 110 and 220 volts, three phase standards have three, 110, 220 and 380 volts, the current ranges are 1, 5, 10, 25 and 50 amps and if required 100 amps range can be incorporated. The 1 amp element is protected by a fuse. The readings on the dials of the standard can be reset to zero by means of a press button. The test compares the revolutions of the meter under test with the revolutions of the standard. The standard is started and stopped by means of a snap switch in the voltage circuit. In this test a fixed number of revolutions of the meter (a period of not less than 90 secs. should be taken) are checked against the revolutions taken by the rotating standard and the error calculated from.

$$\frac{\text{Actual revs.} - \text{Revs. meter should do}}{\text{Revs. meter should do}} \times 100$$

It is essential for the sub-standard to be tested from time to time and if the undertaking has not the means of carrying out this test, it should be sent to a test laboratory for calibration.

The above method has the advantage of speed and the load need not be held at a fixed value.

(c) **Time testing on held loads or the watt-meter method**

This method requires a sub-standard watt-meter(s), ammeter(s), voltmeter(s), power factor meter, means of varying the load to a fine degree, means of holding it steady and a very reliable stop watch.

In testing K.W.hr. meters the measurements are carried out in watt seconds per revolution and therefore it is necessary to arrive at the watt-second constant per revolution of the meter for testing purposes. On each meter's name plate is given the revolutions per unit; a unit is 1,000 watts for 1 hour or 3,600 seconds,

$$\text{the watt sec. constant} = \frac{1000 \times 3600}{\text{Revs. per unit}}$$

As an example let it be assumed that the meter is 10 amp 220 volt size and

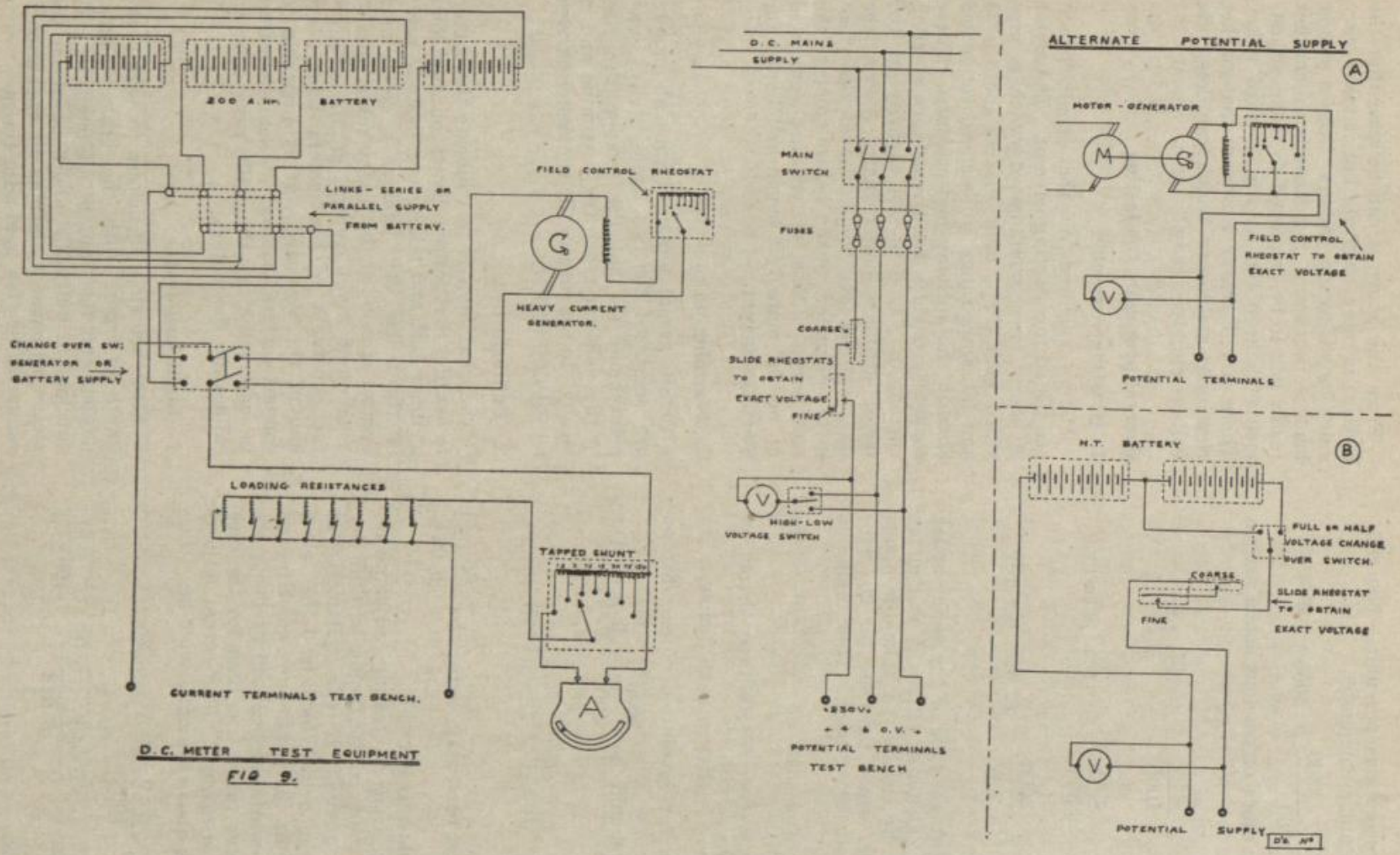


Fig. 9. — D.C. meter test equipment.

does 1200 revolutions per unit. The watt second constant of the meter

$$= \frac{1000 \times 3600}{1200} \times 3000 = K.$$

The testing times on various loads are as follows:-

$$1000 \text{ watts} = \frac{3000}{1000} = 3 \text{ sec. per rev.}$$

$$500 \text{ watts} = \frac{3000}{500} = 6 \text{ sec. per rev.}$$

$$250 \text{ watts} = \frac{3000}{250} = 12 \text{ sec. per rev.}$$

and so on.

The percentage error of the meter under test can be calculated either by wattmeter readings or by timing, i.e. take the above meter at 500 watts the time for 20 revolutions is say 121·2 secs. This timing is equivalent to a load of $\frac{3000}{121 \cdot 2} \times 20$ = 495·05 watts. Percentage error = $\frac{500 - 49 \cdot 05}{500} \times 100 = 0 \cdot 99\%$ slow, or the time for revolution of the disc on 500 watts should be $\frac{3000}{500} = 6$ secs. per revolution. The actual time taken $\frac{121 \cdot 2}{20}$ = 6·06 secs. percentage error = $\frac{6 \cdot 06 - 6}{6 \cdot 06}$ = 0·99% slow as above.

For very accurate testing, adjustments have to be made to the timing to allow for wattmeter errors. If the wattmeter is 0·2% + the actual load is 0·2% lower than shown on the wattmeter, which means that if the watts applied had been correct it would have taken less time for the disc to do one revolution. The actual adjustment on the above example would be

$$6 \cdot 06 - \frac{0 \cdot 2 \times 6 \cdot 06}{100} = 6 \cdot 048$$

$$\text{true \% error} = \frac{6 \cdot 048 - 6 \cdot 0}{6 \cdot 048} \times 100$$

= ·7% slow.

From the above it can be seen that the method is more accurate but it takes very much longer to test meters. Also a steady load is necessary and sometimes another tester has to be employed to make adjustments to keep the load at a fixed value. There are however now on the market electronic stabilisers which can keep the voltage supply steady.

General procedure for testing

1. **Starting current**

Meters repaired on the repair bench are tested for starting current. The meter is placed on a small board which is provided with three plug sockets for 10, 25 and 50 amp range of meters (standard sizes in the author's undertaking). These sockets provide a fixed resistance starting current of 1/200 of the capacity of the meter at unity power factor. Thus the meter is checked for faults as described in (1) of meter repairs before going to the test bench. New meters are connected up on the main test bench and tested for starting current.

2. **Warming up**

Before actual testing begins all meters are energised for two hours at 1/4 load beforehand so that the temperature rise of the coils can reach the maximum and is steady. In the meanwhile the tester carries on with other work.

3. **Full load test**

The next step is to calibrate the meter to within the desired limits on full load at unity P.F. and taking as a basis 25 revs. of the meter disc against a determined number of revs. of the rotary sub-standard. This number will depend on the ratio of the constants of the meters under test and of the standard. It is advisable to connect meters, having the same constant in one batch as this will save time in calibrating the meters.

4. **Light load test**

After bringing all meters to within the limits of error with the brake magnet adjustment the load is adjusted to 1/20 full load at unity P.F. and if necessary the meter adjusted by means of the friction compensator (low load adjustment).

5. **Full load 0·5 P.F.**

Returning to full load a 0·5 P.F. lag test is taken and any adjustments made by the quadrature loop.

6. **Re-check**

It is now necessary to re-check full load unity P.F. and 1/20 load unity P.F. and if the meters have altered on these loads due to adjustments on others, the procedure must be repeated until all three loads are within the desired units of error.

7. **Test on all loads**

Starting with 1/20 full load at unity P.F. the errors of the meters are checked at 1/20, 1/10, 1/4, 1/2 and full loads at U.P.F. A similar procedure is adopted for 0·5 lag on 1/4, 1/2 and full loads.

8. **Creep test**

The meters are now tested for creep with 10% over voltage in the potential circuit.

9. **Dial tests**

A check is taken on the dials as it may happen that an incorrect dial has been supplied with the meter or may have been mixed whilst under repair. The meters are placed on various loads and checked with a specially calibrated meter over a period of two hours.

10. **Insulation tests**

Finally the meters are given an insulation test between circuits, and if the cover is of metal between circuits and cover.

Polyphase testing

Polyphase meters are tested either by time testing on held loads or by the rotating sub-standard method as for single phase meters. The question however is should a polyphase meter be tested as single phase or as a polyphase under actual conditions and also if they have to be used with instrument transformers, whether to test with or without them.

The author's experience has been that the older types of meters have shown an appreciable amount of interaction between the elements of a polyphase meter, and therefore it was customary to test polyphase meters as polyphase meters and if used with current transformers the meters were tested with them.

However, recent tests on a few makes of modern meters have shown that interaction is very much less than in the older type. A sample was taken from a number of 110 v. 5 amp 3 phase 3-wire meters to be used with instrument transformers and a series of tests taken as under.

As a

(1) Single phase direct connected meter.

(2) Three phase direct connected meter.

(3) Single phase with C.T. connected.

(4) Three phase with C.T. connected.

the results were as follows:

Test 1.

Loads.

	1/20	1/10	1/4	1/2	3/4	Full
Direct single phase U.P.F.	·8+	·4+	O.K.	·2+	O.K.	O.K.
Direct single phase 0·5 lag	1·8+	·8+	·3+	·4+	·2+	·2+

Test 2.

	1/20	1/10	1/4	1/2	3/4	Full
Three phase unity P.F.	·3+	·2+	O.K.	·2+	O.K.	O.K.
Three phase 0·5 P.F.	1·7+	·8+	·2+	·3+	·2+	·2+

Test 3. Loads.

	1/20	1/10	1/4	1/2	3/4	Full
Single phase with C.T.	·7+	·3+	·1+	·2+	·1+	·1+
Single phase with 0·5 P.F.	2·1+	·9+	·3+	·4+	·2+	·2+

Test 4.

	1/20	1/10	1/4	1/2	3/4	Full
Three phase C.T., 0·5	·3+	·2+	O.K.	·2+	O.K.	O.K.
Three phase C.T., U.P.F.	·8+	1·2+	·4+	·3+	·2+	·2+

The above tests together with others carried out in the past have shown that the modern polyphase meter for all practical purposes can be tested as a single phase meter, and if C.T. operated can be tested without them and the meter when put into service will be within the usual limits of error of plus or minus 2%. These tests were carried out with 40 V.A. type C. current transformers.

In spite of these tests, however, the author intends to carry on testing polyphase meters under service conditions, especially as there are great numbers of bulk consumers who should have the benefit of any doubt. However, small undertakings can safely test polyphase meters as single phase, as it would not be economical to provide a three phase test board.

The test procedure on 3 phase 3-wire meters is the same (except for minor details) as for 3 phase 4-wire meters and is as follows.

1. All voltage coils are energized with full voltage for two hours, and for three-quarters of the heating up period about 1/4 load is passed through the current coils, for the last 1/2 hour the current is increased to full load.

2. Single phase is then used to balance the red phase against the blue phase of a two element meter, and in the case of 4-wire meters the white against the blue. This is done by paralleling the voltage coils and connecting the current coils in series but in opposition to each other. When properly balanced no movement of the disc with full load flowing should be discerned.

3. For full load calibration of the meter all phases are brought into use. First the red and blue phase voltage coils are connected between their respective phases and neutral, and current loading transformers similarly connected. Full load current at unity P.F. is then fed through the meters, and predetermined comparison tests against the rotary sub-standard are carried out. As only one adjustment is altered, the sum of the rotary readings divided by two is the correct answer.

4. The load is next dropped to 1/10 full load, and each element is tested in turn, the current through the "idling element" current coil (but not the voltage coil) being switched off. The speed of the meter with 1/10 load is equivalent to 1/20 total load of the combined phases. Each element is adjusted to 1·0% fast; a final test is made with both elements equally energized.

5. The load is returned to full and the power factor adjusted to 0·5 lag, then each element is calibrated 1% fast in turn. A final check is made with both elements loaded.

6. Curves for unity and ·5 lag power factor are plotted, the test loads being 1/20, 1/10, 1/4, 1/2 and full load. If necessary the test procedure is repeated and adjustments made to straighten out the curve.

7. Three phase 3-wire meters have their voltage coils connected red to white and

blue to white phase connections.

8. The meter is given a dial test as for single phase meters.

9. The meter is tested for creeping, the voltage being raised 10% above normal. If the mechanical condition of the meter is good, the meter should pass this test.

10. Meters are given a dial test also as for single phase meters.

K.W. demand meters are tested as for normal meters, the departure being in testing the demand indicating mechanism. If this is of the mechanical type the testing is automatically done while calibrating the electrical elements of the meter, but if it is of the thermal electrical type special tests for accuracy of reading at different power factors and for mechanical operation of the pointer are carried out apart from the routine testing of the meter.

Current transformers are tested for error against sub-standard A.C. type current transformers by means of the "Spill Over" method, a description of which is given by J. L. Ferns in his book "Meter Engineering, 1935 edition."

D.C. testing

Mercury motor or ampere hour meters

Mercury motor meters are constant voltage meters; that is, the train wheels and gearing have been designed for the voltage marked on the name plate. Should the voltages vary the consumption shown by the monthly meter readings will not be in accordance with the amount of energy in kilowatt-hours used by the consumer. Should the voltage at the consumer's end drop below that for which the meter was calibrated the consumer loses, should it rise above, the supplier loses.

There are three methods of testing mercury motor meters, and for these methods a 5 amp 220 volt meter is taken for example.

1. Comparison of dial readings of meter under test with a specially calibrated meter.
2. Consumption test.
3. Timing on held loads.

In all cases the meters are run for an hour on full loads to warm them up and to get steady running conditions.

1. This test is simply a comparison of the dial readings of the meter under test and a specially tested ampere hour meter. In this test there is no need to hold the load at any special value. The load can vary and after a period of time the dial readings are compared. Should the error be 2 or 3%± the meter can be adjusted by means of correction bar or coil. For a large error it will be necessary to change the "change" wheel on the meter train.

2. **To test by consumption test**

Set the current to 5 amps, switch off the current and take the dial reading or readings if there is more than one meter. Hold the current steady for say half an hour, then the consumption on the dial should read $\frac{5 \times \frac{1}{2} \times 220}{\cdot 55} \times 100 = 1 \cdot 8\%$ fast.

It can be seen that the above methods take a considerable time for tests. They can be used in small underakings, especially (1), but the second test method is not recommended as it becomes very tedious and heart-breaking on light loads.

3. **Time testing on held loads**

This method is one used in larger test stations.

The meter is run on full load for an hour to warm up. In the inside of the meter, fixed to the dial is a litt'e tablet giving the constant of the meter; very rarely if ever does this constant hold good for a meter that has been dismantled and repaired and therefore this constant can be ignored and a test immediately taken to determine the new constant.

The constant is found in the following manner.

The current is kept steady while a number of revolutions is timed by a stop watch; the time taken should be between 1½ to 2 minutes. Say 40 revolutions at 120 seconds.

$$\text{Constant} = \frac{\text{amperes} \times \text{seconds}}{\text{revolutions}}$$

$$= \frac{5 \times 120}{40} = 15 \cdot 0 \text{ in the case of a}$$

Ferranti meter and say

$$\frac{5 \times 36}{40} = 4 \cdot 5 \text{ for a C. and H. meter.}$$

The heavy adjustments for mercury motor meters are carried out by means of changing a wheel on the dial (known as a "change" wheel) with one with the right number of teeth to correspond with the constant. In the Ferranti meter this is found by:

Number of teeth of change wheel

$$= \frac{7200 \times A}{V \times K \times B}$$

A = rotor revs. for 1 rev. of change wheel driver.
B = voltage on name plate.
C = revs. of change wheel for per unit (10).

$$= \frac{220 \times 15 \times 10}{72000 \times 50} = 109.$$

For a C.H. meter $k = \frac{3600 \times 1000 \times A}{B \times X \times V}$

A = number of teeth on spindle.
B = number of revs. of change wheel spindle per unit.
V = voltage.
K = ampere hour constant.

therefore $X = \frac{3600 \times 1000 \times 8}{400 \times 4{\cdot}5 \times 220}$

= 72 teeth.

The number of teeth on the spindle engaging with the change wheel and the number of revs. of the change wheel spindle per unit vary according to the size of the meter.

The meter is then tested on 1/2, 1/4, 1/10 and 1/20 of the rated capacity of the meter and any slight adjustments can be made by means of the correction coil or bar.

Tables giving the change wheels for the different constants for the various sizes and voltages of meter can be obtained from the makers of the meters.

Kilowatt hour meters

These are tested in the same way as A.C. watt hour meters, but particular care must be taken to keep the voltage steady at the value shown on the name plate.

(Note. — Mercury ampere-hour rotary sub-standards are now available.)

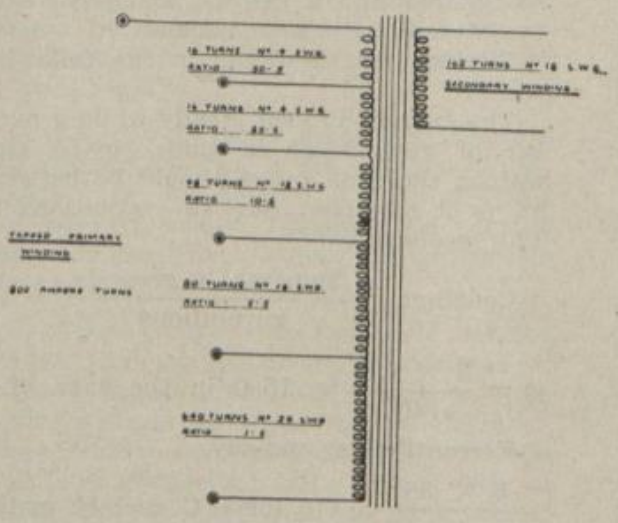
Instruments Required for Metering

The instruments here quoted are for meter testing only and not general test work.

1. **Small Undertakings.** Population of up to 10,000.
   No special sub-standard instruments are needed, but the board should incorporate:
   (a) Good commercial grade K.W.hr. meter which would have to be tested fairly frequently by a recognized A or B station.
   (b) A commercial first grade ammeter.

Construction of current transformers.

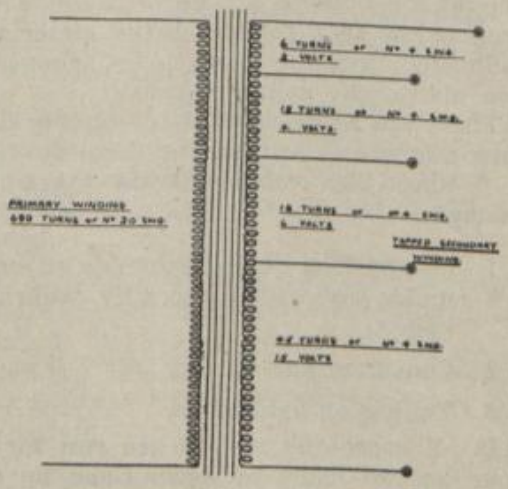
(1)



A.

Construction of current loading transformers.

(2)



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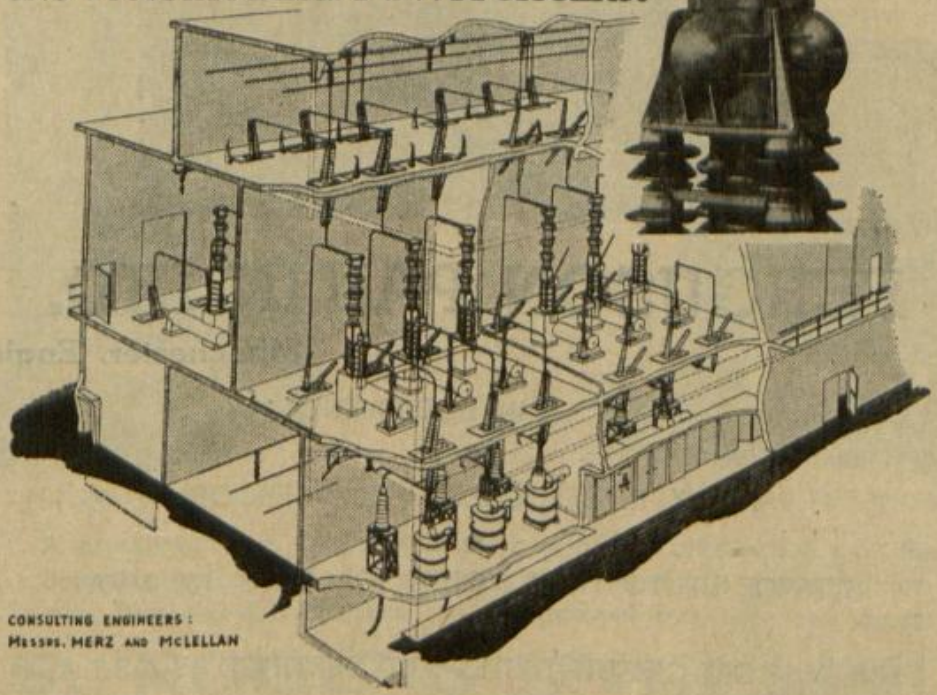

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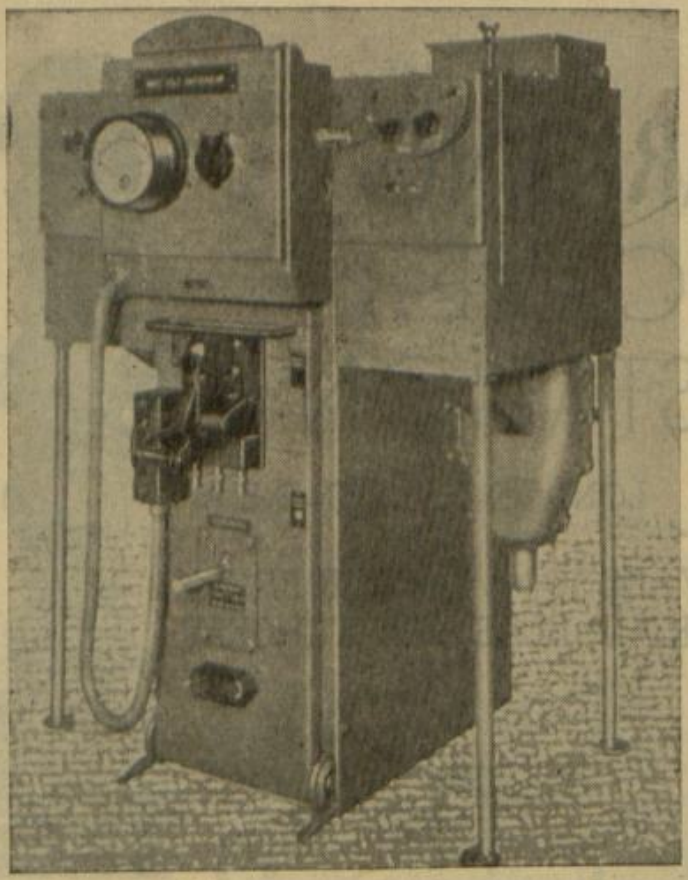

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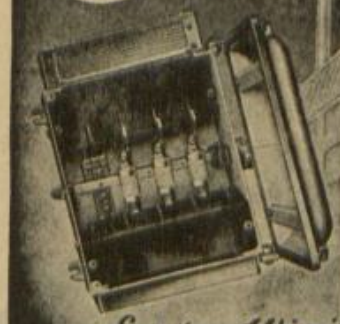

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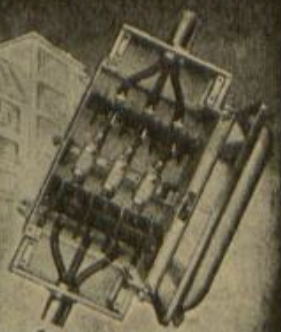

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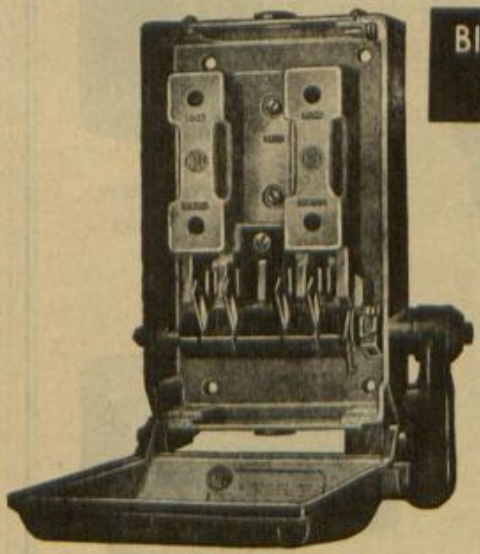

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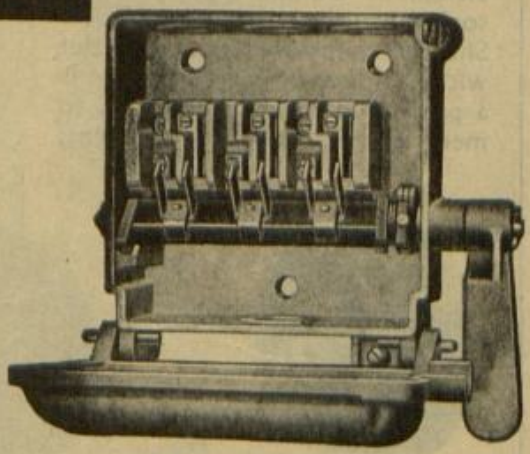

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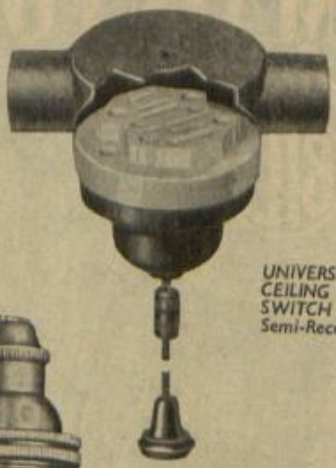

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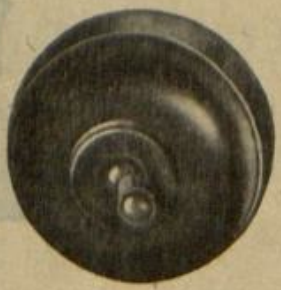
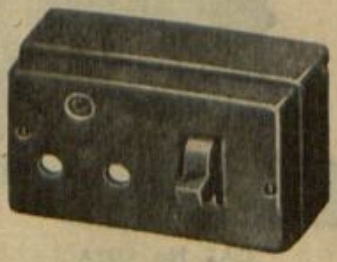
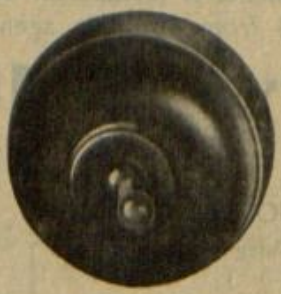




"QUAIL-SHUTTER" Switched Socket-Outlet



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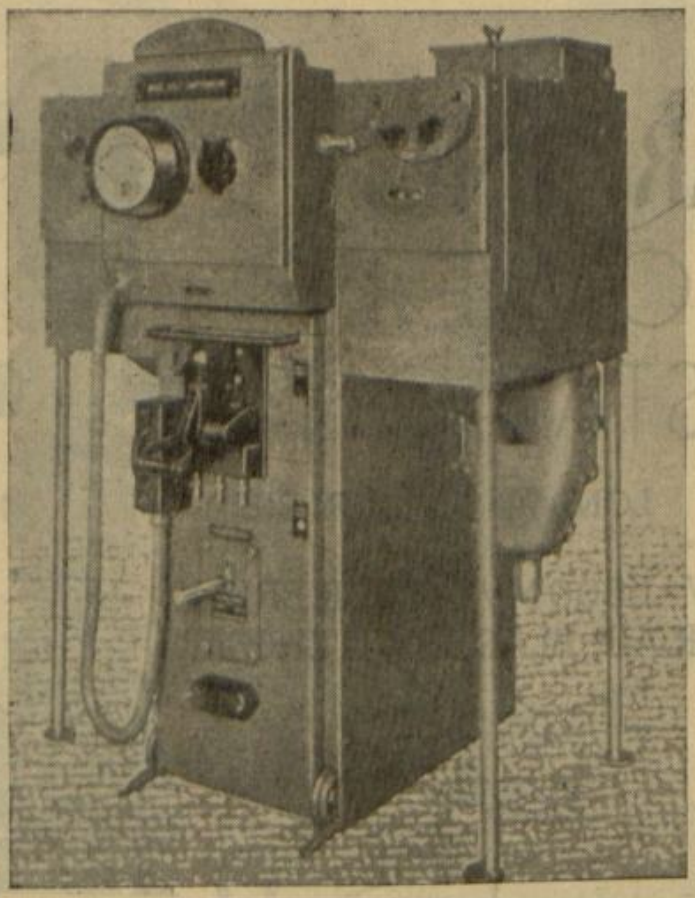

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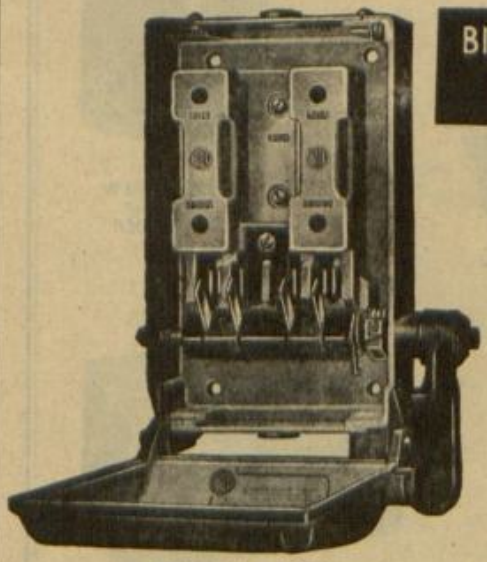
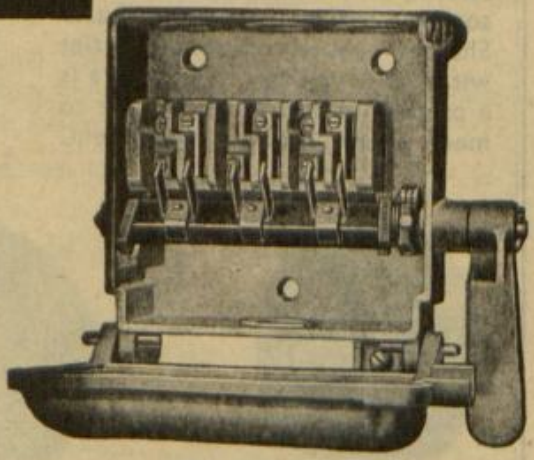


CAT. No. U32A



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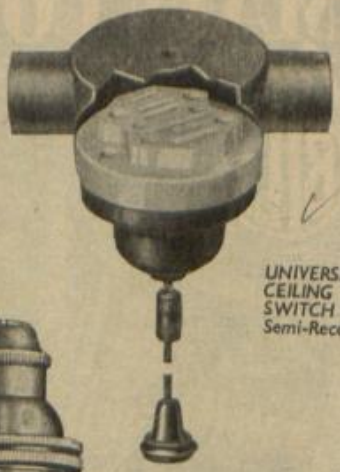

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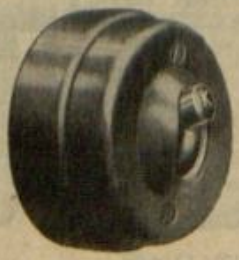
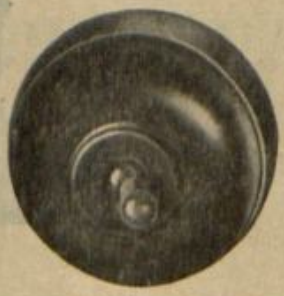
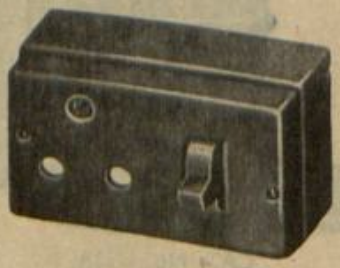


"SNIPE" Surface Switch

Q.M.B. Surface Switch





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2. **Larger Undertakings.** Population of 10,000 to 20,000.
   (a) K.W.hr. meter.
   (b) First grade ammeter.
   (c) First grade voltmeter.
   (d) Rotating sub-standard.
   (e) A sub-standard wattmeter.
   (f) A good split second stop watch. (Useful to have but not necessary.)

3. **Undertakings** with populations of from 20,000 to 60,000.
   (a) As listed in 2.
   (b) Extra rotating sub-standard.
   (c) Extra single phase sub-standard wattmeter.
   (d) 2 extra first grade ammeters.
   (e) 2 extra first grade voltmeters.
   (f) 3 single phase power factor meters first grade.
   (g) 2 sub-standard grade ammeters having ranges for 5 and 10 amps.
   (h) 1 sub-standard voltmeter, ranges of 150, 300 and 600 volts.
   (i) 1 sub-standard power factor meter 3 phase 4-wire.
   (j) 1 type A.L. sub-standard current transformer having ranges of 5, 10, 25, 50 to 5 amps.
   (k) 1 single phase type A.L. potential transformer having suitable voltage ranges according to the voltages on the undertaking's system.
   (l) 3 phase rotating sub-standard and a 3 phase sub-standard wattmeter would be useful but not necessary.

The sub-standard instruments, apart from the rotating standards, should be of the shielded type and be according to B.S.S. 89: 1937. The voltmeters should have a resistance of about 30 ohms per volt at 25°F. The first grade commercial instruments should also be according to B.S.S. 89: 1937, and the voltmeters should have a resistance of 150 ohms per volt.

The rotating sub-standard should have two voltage ranges, viz. 110 and 220 volts and ampere ranges of 1, 5, 10 and 25 amps. Larger undertakings may have rotaries which incorporate a 50 and 100 amp range as well.

Transformers

The current transformers incorporated in the board were made in the authors workshops. For the current transformers laminated cores $1\frac{1}{4}'' \times 1\frac{1}{4}''$ were used and the flux density calculated at 50,000 lines per square inch. The primary has a tapped winding of 16, 16, 48, 80 and 640 turns and the secondary 162 turns, giving a ratio of 50, 25, 10, 5, 1 to 5 amperes. See Fig. 10A. The current loading transformers has 690 primary turns and the secondary tapped at 6, 12, 18 and 45 turns (see Fig. 10B) and has a core area of $1\frac{3}{4}'' \times 1\frac{1}{2}''$.

The formula used in the construction of the transformer is $T = \frac{E \times 10^8}{F \times A \times 50 \times 4 \cdot 44}$

T = Turns.
E = Voltage.
F = Flux density.
A = Area of core.
50 = Frequency.
4·44 = 4 changes per cycle multiplied by the form factor of 1·11.

The quantity and grade of iron used in the above transformer is "permalloy" having 78·5% nickel 21·5% iron.

Good laminations to be used for the construction of test board transformers are given hereunder:

American Hipernick ..	50% nickel, 50% iron.
British Mumetal	76% nickel, 17% iron, 5% copper, 2% cr.
(1) Permalloy	78·5% nickel, 18% Fe, 3% mo, ·5% mr.
(2) Permalloy	78·5% nickel, 21·5% Fe.
Silicon Steel	4% silicon, 96% Fe.

Hipernick has a high resistivity, a low hysteresis loss, and its saturation point is high, this iron is probably the best on the market.

Conclusion

All meters to be used on the municipal system are given a municipal number and a history card as shown in Fig. 11 is made out. Test sheets are not made out for every meter, only on special tests is a test sheet made out. The history card however shows the average percentage ± of the meter.

METER Nº 73946	MUNICIPAL Nº 6539
MAKE	Sangamo
AMPS 25 L.R.	VOLTS 220

DATE	HISTORY
7-8-39	initial test. calibrated +1·0%
18-4-45	routine test. calibrated +1·0%
9-12-49	increased loading. calibrated +1·0%

Fig. 11. — Meter History Card.

Particulars of damage, etc., are also entered on the card.

When a meter is drawn from the test room the history card of that meter is passed to the office clerk who files it in the particular file allocated to the stand where the meter is to be installed (all stands have a file for all particulars, correspondence, change of meter slips, complaints slips, installation forms, etc., etc., dealing with that particular stand). When a meter is brought in for repair or for test, the history card is returned with the meter to the test room for all details as to reasons for return, etc., to be entered thereon.

All meters are now sited outside dwelling houses in a steel cabinet, either on the front or back verandah, or in a meter chamber built into the foundations of the house. When a house is far back from the front boundary a brick meter chamber is built on the boundary of the stand near the entrance.

The high cost of repairing and testing meters as shown in previons discussions on the proposed meter testing code need not be so in practice. Small undertakings as stated could work the testing of meters with their usual routine work and consideration should be given for large undertakings to employ girls (under the guidance of a few expert meter testers) for the repair and testing of meters.

The above paper was completed before the proposed Meter Ttesting Code was issued.

I wish to thank Mr. C. P. Marais, Meter Engineer of the Pretoria City Council, Mr. Jobbling of the Electricity Supply Commission, and Mr. Williams of the Bureau of Standards for scrutinising and their comments on this paper.

Mr. SMITH **Concluded**:

Since the beginning of this year we have taken a number of tests of all meters as found and it has been very interesting to note that of meters that have been in service for about twenty years, nine per cent only have shown a tendency to be slow on light loads and fast on the higher loads, and therefore the indication and evidence seems to point that the period of six years as laid down in the Meter Testing Code is too short a period.

PRESIDENT:

Thank you, Mr. Smith.

Mr. J. T. WILLIAMS, South African Bureau of Standards:

Mr. President and Gentlemen: I would like to congratulate Mr. Smith on tackling the problem of the small municipalities. As you know, the large majority of the members of this Convention are from small municipalities, something like eighty-five per cent of them, and we know that they have only a relatively small number of meters; most of them have not yet tackled the problem of meter testing and Mr. Smith's paper can go a long way towards helping them to decide what to do about it. The problem of the Bureau in drawing up this Meter Testing Code was to find out how the meters of the small municipalities could be tested economically. The proposal originally put forward was that there should be centralised testing stations to which all the meters of the small municipalities should be sent. Now it appears that

most of the engineers would very much rather test their own meters, apparently they don't trust the Railways to convey any of their property. This is all to the good, of course, and it eases quite considerably the problem of how to organise the whole thing.

There are one or two difficulties the small municipalities would be up against, the difficulty for instance of testing the three phase meters. The Class C station envisaged by the Code is only a single phase testing station. It would mean that the three phase meters would have to be sent away. Mr. Smith has put forward the suggestion that they should be tested as single phase meters, and I think it is a suggestion which merits consideration, at any rate for the small municipality which is in the difficult position of having to send meters for a very long distance. I see that Mr. Smith in his paper has rather anticipated the suggestion made earlier of using semi-skilled staff for testing meters. I do not know what the position is with the trade unions, I can hardly see that there should be any considerable objection to doing the same thing here. Presumably meters would have to be repaired by trained staff but the testing should not be beyond the powers of girls or people who have had only a little training.

Mr. Smith suggested that in the majority of small undertakings the engineer should be able to carry out all the tests that are necessary. I am not sure about that. In many cases the engineer is also the civil Engineer and has to attend to a lot of other things and in fact he can hardly be called an engineer at all. However, it is not a terribly onerous task for the majority of these undertakings. Eighty-five per cent of them would have to test less than 250 meters a year, five meters a week. I am quite sure that the engineer could spare sufficient time to test five meters in a week. The staff difficulties as far as the bigger undertakings are concerned must of course be given much more careful consideration but I am sure that the proposal made to increase the period of certification to ten years will solve most of these staff difficulties.

PRESIDENT:

Thank you, Mr. Williams.

Mr. J. E. MITCHELL, Salisbury:

Mr. President, Gentlemen: I cannot remember having ever attended a conference of engineers or an institution of engineers at which a paper on meter testing has been read and discussed that has not led to the expression of many divergent views and ideas in this particular field.

Meter engineers as a class are usually individualists with decided ideas of their own and as experience is possibly the greater teacher in the field of instrument engineering, opinions differ according to the type of work that has been met with in the undertakings where the engineer has gained that experience.

I would like therefore to compliment the author firstly on his excellent paper which can easily be considered a work of reference, and also for his courage in coming forward, expecting as he must a certain amount of controversy in regard to his own ideas, and if I, in coming forward with my comments on the paper appear to differ considerably from him, I hope he will realise that these are just my own feelings as against his, and if he feels there is any use in them he can use them.

The paper generally gives a very full account of meter testing and repairing as applied to various sizes of undertakings, but the general principle set out in his paper, namely, that the accuracy of the meter which, when all is said and done, is a measure of what the consumer has to pay, should be dependent on the size of the undertaking, is in my opinion not only wrong but unethical. If on buying a pound of butter, say in Brandfort, the purchaser found that he was half an ounce short, I doubt whether he would take as an excuse that Brandfort was not as large as Johannesburg and therefore its scales need not be as accurate. I would suggest therefore that consumers in small undertakings have just as much right to accurate meters as those in the larger undertakings, and if the original idea of sending meters for testing cannot be carried out, then I suggest that all test rooms should be equipped with substandard instruments.

Passing from general comments to details; firstly to repairs and overhauls. Mr. Smith suggests that meters on return should be divided into two classes, but I think that is undesirable. In my opinion all meters

returned for overhaul should be retested and completely overhauled. Some of the methods Mr. Smith has suggested for repairs and examinations I am opposed to. For instance, examining jewels and pivots with a sewing needle; because although this method was popular in test rooms years ago, I think today they should have microscopes to see exactly what is happening.

The author also gives his ideas on lubrication of meters and this, as everybody knows, is a very controversial subject. I think it is better to keep to the makers' recommendations. I am certainly not in favour of filling the top bearing with Vaseline because I think this is surely inviting the meter bearing to become sticky after two or three years in service.

The author gives the percentage of new meters found to be outside plus/minus two per cent error to be sixty per cent of those delivered, but I would suggest that by careful selection of meters from reliable manufacturers and proper packing before leaving the factory, this figure should not be greater than five per cent, because that is the figure we get in Salisbury. I would suggest if the author continues to have that number of meters outside those limits he should change his supplier.

The design and type of apparatus to be used in the test rooms is dealt with by the author but I feel that this is to a certain extent a matter for the individual test rooms, since meter testing equipment may have to line up with other apparatus required for tests of relays, switchgear, generating plant, etc., but I do not consider that cheaply made loading transformers are desirable, as they usually lead to unknown inaccuracies.

In regard to equipment for carrying out creep tests, I consider this again essential for the very reason that I expressed earlier on that all meters should be accurate irrespective of the size of the undertaking.

Turning to the meter tests, I agree that the long-period dial test methods can only give you an average of intermittent errors, but I would say that it is still a most excellent method for undermanned testing stations. A batch of twenty-five amp. meters, for instance, takes about two days to test, but the tester has only to connect up and read the meters, and the rest of the time can be spent on repairs. Two check meters are used in series and the average taken, these need only be checked once a month. Revolution testing is not in my opinion speedy, as each meter has to be given individual attention, and the testers' time is wholly occupied. This method, however, is accurate and is particularly useful for testing mixed batches. The standard should be checked at least once a month. Time testing by means of a stop watch is excellent, and if more than one stop watch is used, can be rapid; but I consider the length of this test should on no account be based on time but on the actual number of revolutions taken, say twenty revolutins on high loads and five revolutions on low loads. A substandard watt meter is required and the rest of the instruments need only be first grade. A final dial run of approximately ten revolutions of the last dial should be taken to check counters. Three phase meters I think should be treated three phase, for despite the author's figures, I cannot agree that single phase testing is satisfactory. Four wire meters should be tested with three watts meters, or three phase four wire substandards or three single phase substandards. The two watt meter method leads to errors on four wire meters. Again, due to the fact that I consider all meters should be accurate, I cannot agree with the list of instruments suggested by the author. For small undertakings I feel that one must have a good grade rotating substandard with a first grade ammeter and voltmeter, the substandards being tested at monthly intervals. For larger undertakings I suggest a stop watch is essential to enable the undertaking to check the rotating substandard against their own wattmeter, and the wattmeter should be checked at six-monthly intervals. The substandards could be single range instruments with three class A.L. C.T.'s used on in each phase for testing polyphase meters. I cannot see the necessity for a class A. P.T.

Finally the author mentions the keeping of meter history cards which, of course, is excellent, but I would suggest that after the work involved in reporting and testing the electricity meters to a high degree of accuracy it is no hardship to record the meter test as a whole for future reference.

As I said at the beginning, when any meter engineer delivers a paper on meter testing, he is opening a field where there is a very

wide divergence of ideas and all I have tried to do is to show where the author's differ from mine. If I have been able to give the author and the Conference any ideas which they may feel are useful, I shall be very pleased; but I can say that copies of the author's paper will be circulated throughout my own test room, where I am sure it will prove of great use, although as indicated through this paper, I may amend it to some extent.

PRESIDENT:

Thank you, Mr. Mitchell.

Mr. H. M. S. MULLER, Kakamas:

Mr. President and Gentlemen: I am speaking today as a member who has got himself from the foundation of this structure to the associate class. The associate class is possibly the embellishment of the top of the building, and is not very indispensable today, but I speak from years of experience and I have often given thought to this question of meter testing.

When this first came in, an argument was raised that if at the assizes the merchant has to have his scales periodically tested, why should not anything as important as an electricity meter, or a water meter for that matter, be tested. I cannot understand that argument, because it is no argument. After all the merchant has the incentive to dishonesty, in electricity we have none. The engineer is just as anxious as anybody else to co-relate his output with what is sent out of the station. Now, taking meters at large over many years and many kinds and giving close attention to it and not taking this matter lightly, it can with reason be said that the factor of error is always to the advantage of the consumer. How often have I not been compelled even under stress of work, to send men around with a detectoscope or something of that sort and then they will find, perhaps because the consumption did not appear right on a three phase meter, that possibly for months one of the potential coils was out. Therefore it is always the consumer that benefits. But we cannot get away from the fact that sooner or later the smaller municipalities must also fall into line. I am today speaking chiefly of the smaller municipalities. The big departments have their meter testing routine and they have their men. My learned friend has just said that the engineer is so busy that he could hardly give his time to it. I would agree in part, and I would also go so far as to say that I am dubious of some of these tests, and that in time, say, five, six, seven years or perhaps shorter, that a better idea would be to compel a municipality, but by persuasive means, to send such meters to a central depot for testing, because I do not think that a smaller municipality could today undertake such work and it would appear to be important to us.

In the opening paragraph Mr. Smith mentions something which is very intriguing. He says: ". . . to set up meter repair and testing in a simple way at a low cost". That, gentlemen, should be our watch word, but take a small municipality, if they set up a department like that, a meter testing department, then one thing is certain, to make their tests authentic and make it worthwhile, and to be able to satisfy the consumer, they must have well compensated gear. That is the first essential. I contend climatic conditions could influence the test. We know that when sending a meter over a distance, by the time it gets there you would not find that very fine test that you are aiming for. Now I have seen that Mr. Smith has very interesting test figures. It would serve no purpose to read these out, but he could certainly print them for our information. Unfortunately there is one fault to be found with that and that is he concentrates on one make of meter, and I fear he must not state the name of the meter. That looks too much like commercialism, but if he had several kinds of meters installed and he found that his factor of error over several years was very small, I would agree with that because I have also found that, and as I have stated before, if there is any error it is on the consumer's side. We naturally also wish to have our pound of flesh. Never have we asked for a drop of blood.

I wish to congratule Mr. Smith on his paper.

PRESIDENT:

Thank you, Mr. Muller.

I think we will leave the discussion of the paper now and continue with it tomorrow.

We will continue with the bussines of the Convention. When Mr. Fraser is ready we will deal with the report on the C.I.G.R.E. In the meantime I will give

you the report on the work of the South African Standards Institution.

SOUTH AFRICAN STANDARDS INSTITUTION

The work of the South African Standards Institution has continued although on a much reduced scale. The position at the moment is that the Institution will continue to function until the necessary amendment is made to the Standards Act.

In regard to the Specification for Creosoted Wooden Poles for Telephones, Electric Light and Power Transmission Lines, this has been amended and will be published immediately. It will be remembered that this specification was withdrawn owing to the need for providing a suitable impregnating material that is available in sufficient quantities to meet the demand. It will therefore now be possible to obtain creosoted wooden poles to this specification with the Bureau Mark as a standard of quality.

Your representation will, therefore, be continued on the Standards Institution until such time as the amendment has been made to the Standards Act.

REPORT ON THE C.I.G.R.E. FOR 1950

By

MR. J. C. FRASER

CONFERENCE INTERNATIONALE DES GRANDS RESEAUX ELECTRIQUES

Mr. President and Gentlemen: I have pleasure in reading extracts from the Report of the C.I.G.R.E. for the year 1950 and also from the Third Annual General Meeting held in Johannesburg on Monday, 12th March, 1951.

The full report and minutes will be published in this Convention's Proceedings.

I am indebted to Mr. L. H. Black, Honorary Secretary of the South African National Section, for the information contained in this review.

REPORT FOR 1950

Membership:

During the year there were the following changes in membership:—

Personal Members enrolled	1
Personal Members resigned	1
Collective Members resigned	1

The membership now stands at:—

Collective Members ...	18
Personal Members	9
TOTAL	27

General:

The Thirteenth Conference was held in Paris during the year, and was attended by representatives of forty-two member countries, the total number of participants being 1,252. The South African National Section was represented by the chairman, Mr. A. M. Jacobs, who also attended as the representative of the Minister of Economic Affairs.

A total of 144 papers was presented and discussed and these, together with the record of the discussions, will shortly be published; as already announced, copies of the Proceedings may be purchased by members at a price of 7,500 francs per set.

No papers were presented to the 1950 Session by the South African Section; it is hoped, however, that members will endeavour to contribute to the next session in 1952, and in this connection a recent recommendation of the Administrative Council in Paris is of interest. This is to the effect that in addition to papers of an original nature, others of a purely informative type might be offered to the Study Committees for incorporation in their general reports. The following Study Committees are functioning at the present time:—

Committee No. 1 on Insulating Oils.

Committee No. 2 on High Voltage Cables.

Committee No. 3 on High Voltage Circuit Breakers.

Committee No. 4 on Protection and Relaying.

Committee No. 5 on Insulators.

Committee No. 6 on Bare Conductors and Mechanical Design of Overhead Lines.

Committee No. 7 on Pylons and Foundations.

Committee No. 8 on Lightning and Surges.

Committee No. 9 on Extra High Voltage A.C. Transmission.

Committee No. 10 on High Voltage D.C. Transmission.

Committee No. 11 on Telephone and Radio Interference.

Committee No. 12 on Insulating Materials.

Committee No. 13 on System Stability, and Load and Frequency Control.

Committee No. 14 on Carrier Current Transmission.

Committee No. 15 on Insulation Co-ordination.

Committee No. 16 on Reactive Phenomena and Wave Distortion.

Members contemplating the preparation of papers are invited to apply to the honorary secretary for information as to the form in which these have to be submitted.

Balance Sheet:

Details of Income and Expenditure during 1950 are given in the following statement:—

INCOME AND EXPENDITURE FOR YEAR ENDING 31st DECEMBER, 1950

* Includes one subscription in arrears.

Dr.			Cr.		
Drafts on Paris: (Subscriptions)	£44 4 9		Balance at 31st December, 1949		£5 9 3
	42 3 8		Subscriptions:		
	10 5 10		18 Collective Members	£94 10 0	
		£96 14 3	9 Personal Members	10 10 0*	
Bank Charges		1 11 4			105 0 0
Credit Balance		12 3 8			
		£110 9 3			£110 9 3

MINUTES OF THE THIRD ANNUAL GENERAL MEETING HELD IN JOHANNESBURG ON MONDAY, 12th MARCH, 1951.

Present:

Mr. A. M. Jacobs (Chairman),
Messrs. W. Fenwick,
J. C. Fraser,
W. L. King,
J. S. Trelease,
I. de Villiers,
W. P. Wagstaff,
L. H. Black (Honorary Secretary).

(Apologies for absence were received from Professor Bozzoli and Messrs. Bradford, Dalton and Dolan.)

1. REPORT AND BALANCE SHEET

The Report and Balance Sheet for 1950, previously circulated, were adopted.

Amplifying the Report, the chairman gave a short account of the 1950 Session of the Conference, and after commenting briefly on the general organisation of the meetings, he drew attention to the desirability of South African participation in future Conferences, expressing the hope that members having occasion to visit Europe would endeavour to be present at the next Session in 1952. He considered that South African experience in certain fields would be of considerable interest to the Conference; and mentioned in particular the work which had been done on lightning protection of overhead lines and on telephone interference occasioned by the use of mercury arc rectifiers. The extensive use of rectifiers by the South African Railways might also

provide material for an interesting contribution.

2. ELECTION OF CHAIRMAN AND EXECUTIVE COMMITTEE FOR 1951

Mr. A. M. Jacobs was unanimously re-elected chairman for 1951. The constitution of the Committee for 1951 is therefore as follows:—

Mr. A. M. Jacobs (Chairman),
Professor G. R. Bozzoli,
Messrs. G. Bradford,
J. C. Fraser,
A. W. Lineker (*ex-officio*),
J. S. Trelease,
L. H. Black (Honorary Secretary).

3. OTHER BUSINESS

The substance of a circular letter from the vice-president, dated 1st March, 1951, regarding possible subjects for discussion at the 1952 Conference was read to the meeting, and it was agreed that the full text be circulated to all members. This is accordingly attached as Appendix A.

On the proposal of the chairman, a vote of thanks was accorded to the retiring member of the Executive Committee, Mr. J. A. F. Mitchell.

On a motion of Mr. Fraser, seconded by Mr. de Villiers, a vote of thanks was unanimously accorded to the chairman for his services to the section during the past year.

A vote of thanks, proposed by Mr. Trelease, was accorded to the honorary secretary.

The meeting then terminated, and was followed immediately by a meeting of the new Executive Committee.

N.B. Subsequent to the meeting, Professor Bozzoli has reported that following the discussion at the Second Annual General Meeting he raised the question of support for the section in the Council of the S.A. Institute of Electrical Engineers; the members of the Council expressed interest in the activities of the section, and a number have undertaken to endeavour to secure greater South African representation at future Conferences.

Appendix A

CONFERENCE INTERNATIONALE DES GRANDS RESEAUX ELECTRIQUES (C.I.G.R.E.)

112 Boulevard Haussmann, Paris.

Matters to be discussed in 1952

Paris, March 1, 1951.

Dear Sir,

In our circular-letter of December 21, 1950, we asked our National Committees to let us know which most important questions could be, in their opinion, profitably discussed before our 1952 Session and on which, consequently, it would be desirable to have papers presented from various countries.

The answers received show that the main subjects to be reported and discussed would be as follows:—

I. Insulators

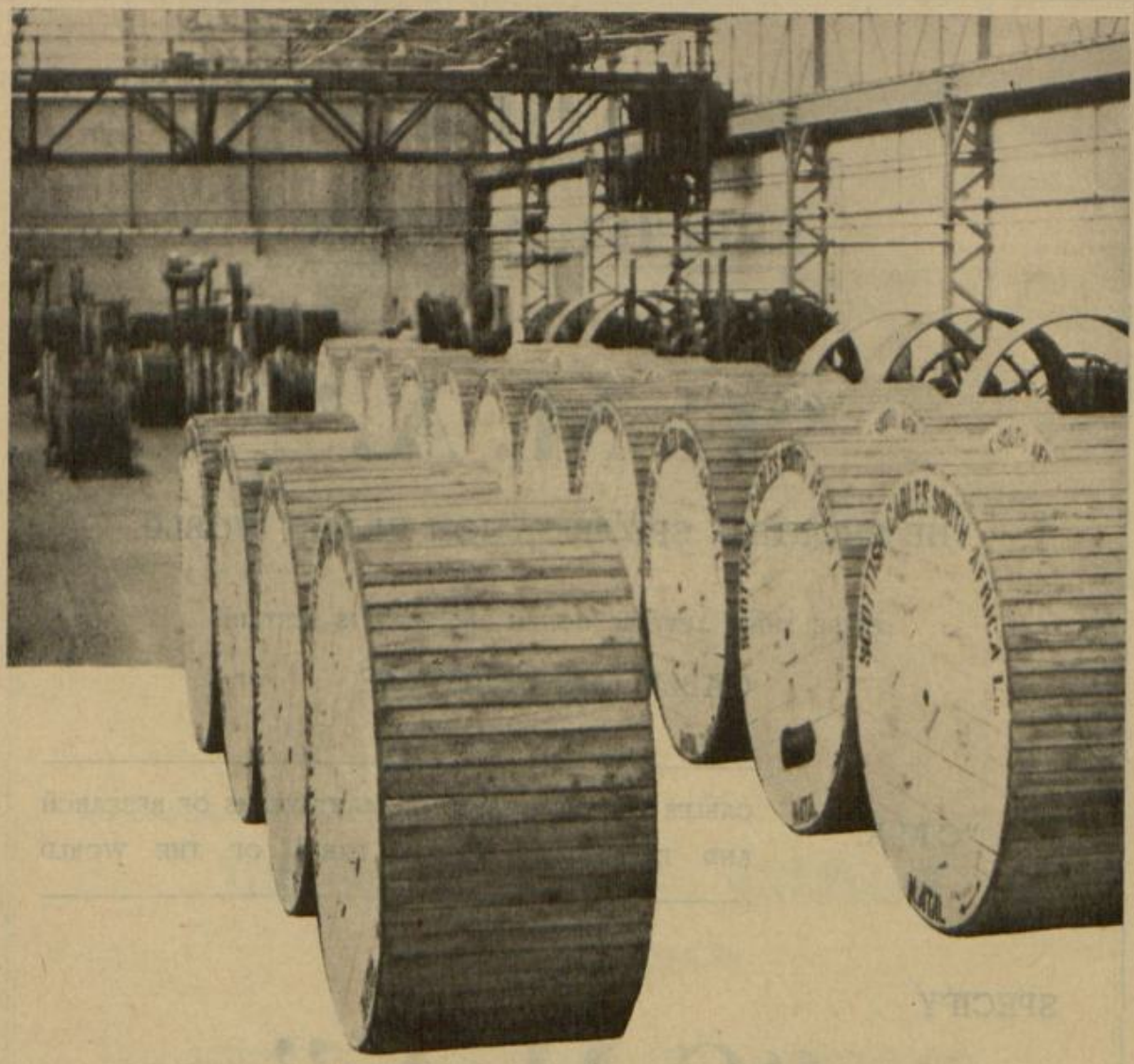
1. Ageing or depreciation of insulators in service, coupled with methods of detecting damaged insulators.
2. Efficiency of arc horns and grading rings:
   (*a*) for the protection of line conductors.
   (*b*) for the protection of the insulators themselves against damages caused by power arcs initiated by transient over the voltages or by surface pollution.
3. Live-line washing of insulators: techniques employed, frequency and effectiveness of cleaning, safety precautions, etc.

II. Teletransmissions

Teletransmissions by guided waves to be applied to 380 kV lines.

III. Network Stability

1. Methods of improvement of long distance transmission systems such as series capacitors, voltage regulators, breaking resistors and intermediate synchronous capacity.
2. Load and frequency control, a résumé of practices in countries



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such as the United States where a good deal of frequency and load control has been applied with increasing refinements. Other countries undoubtedly would have papers to offer in this field which would be particularly appropriate.

3. Allocation or dispatching of load in an interconnected system to obtain maximum economy. This is a field which is now under study in the United States and undoubtedly in other countries also.

IV. **Transformers**

1. Dielectric tests on site determining the condition of insulation in installed transformers.
2. Circuit connection and measurement technique in surge testing.
3. The measurement and reduction of noise omission including installation condition.
4. Mechanical considerations for large transformers including short-circuit forces.

We understand that perhaps it would be possible for you to have some interesting papers written on the above matters?

Yours faithfully,

J. Tribot Laspiere,

General Delegate and Vice-President.

PRESIDENT:

Thank you, Mr. Fraser. Are there any questions, gentlemen, to be asked in connection with the report by Mr. Fraser.

We still have a little time before the break for tea, so I will give you the report on the Safety Precautions Committee.

REPORT ON SAFETY PRECAUTIONS COMMITTEE

Following my report at the last Convention held in Pietermaritzburg, the final draft of the regulations is now in the hands of the translators.

Several authorities suggested that the regulations should be re-arranged along the lines of the recommendation put forward in the previous report of the committee. The new edition follows this form in that each type of equipment has been covered, both as regards its requirement and its installation in one section instead of in two sections as in the first edition.

This has reduced to a considerable extent the amount of cross referencing both in the regulations and by the user, and results in a document more easily followed.

In re-arranging the intention was to do so without altering the sense of the regulations.

During this period it was obvious that certain alterations were necessary, in some cases to clarify requirements and in other cases, in view of later information received about further amendments to the regulations of the Institution of Electrical Engineers, London; and the S.A.B.S. specifications.

The alterations of particular interest are as follows:—

The first number in the draft of the second edition which was circulated for comment of the regulation with the new number, following for example, 210—38 is the old number and 1202 is the corresponding number in the new edition.

210-38 (1202).

Acceptance of Cape Town's suggestion that six socket-outlets may be installed on one circuit under certain conditions.

1202 exemption (ii) has been inserted reading: "In any domestic installation a maximum number of six socket-outlets installed in any one room may be carried on one sub-circuit."

110-35 (607B)

This regulation prohibited reversible connectors although lampholder plugs were permitted under 210–11 (607A). This anomaly has now been removed and 607A reads:—

> "Lampholder plugs of approved design may be used in connection with any appliance taking not more than one ampere, but shall not be used where the voltage exceeds 250 volts, nor where exposed metal is required to be earthed."

202–06 (1405B).

This is a new clause extracted from the 12th Edition I.E.E. and calls for further tests on sections if the total resistance of the installation is less than 0·5 megohms.

204–28 (401R)

On the suggestion of Cape Town requesting screwed tubing in roof spaces

under shingle roofs as well as under thatched roofs, appropriate alterations have been made to these regulations.

204–31 (vii) (405H)

This has been modified to comply with Cape Town's suggestion that it appears unnecessary to insist on insulated material when a metal tube would be suitable. The clause thus permits metal or other non-absorbent, non-cumbustible conduits.

204–36 (409B).

The note has been modified to omit all reference to low insulation value in metal-sheathed mineral-insulated cables.

205–15 (401S (iv)).

An additional clause calls for screwed conduit in all roof spaces where wiring is run in conduit. This was suggested by Cape Town.

211–03 (707)

Discussions with the S.A.B.S. who prefer the use of "stove" made the Amendments Committee resuscitate "cooking appliance" in preference to "cooker" (cooking appliance being the more general term and would include stock pots, fish fryers and stoves).

New (1223C).

An additional clause prohibiting standard lampholders in heavily fused circuits and follows 12th Edition I.E.E.

New (1409).

New clause from 12th Edition I.E.E. calling for test to verify continuity of all ring circuits installed in accordance with Regulation 210–39 (1203 (iii)).

105–03 (401 E (i)).

I would refer you to the A.M.E.U. bulletin in regard to the use of aluminium tubing.

In order to provide for suitable fittings being used for aluminium conduit this regulation has been modified to read.

> "All conduit accessories and fittings shall be metal unless otherwise approved and of approved design and material suitable for conduit for which they are used." The words "and material" have been added.

210–13 a (602 E) (see last year's report).

This has been further modified to read as follows:—

> "Those parts of a lampholder in a bathroom which are within six feet of a bath or drain or other earthed metal shall either be constructed of or shrouded in insulating material so as to prevent a person from inadvertently touching any metal part of the lampholder or of the lamp cap."

211–15 (B) (1219B)

This clause has been modified by the ommission of "metal clad or other approved" and now reads, "electric water heaters shall be controlled at the distribution board or other convenient position by a switch".

The new edition of the regulations will be published by the South African Institute of Electrical Engineers and will be obtainable from the Institute.

It is anticipated that the new copies will cost about five shillings to six shillings.

In conclusion I would like to thank the members of the sub-committee and other members of the committee, particularly the chairman for the assistance that I have received. Most of this work was done by the drafting sub-committee, and then submitted to the main committee of the Safety Precautions Committee for approval and adoption.

The regulations have now been printed in draft form and when the translation has been done, copies will be ready for issue. Your executive have discussed ways and means to be followed for the adoption by your Councils and the promulgation in the provinces; immediately your executive have formulated a definite plan I will inform you of the position. I do not know whether Mr. Perrow is with us at the moment, if so perhaps he would like to add to the report I have given you.

Mr. E. VIVIAN PERROW, Chairman of the Safety Precautions Committee:

Mr. Downey has presented a very comprehensive report on what has happened in connection with the second edition of the Standard Wiring Regulations and it is not my intention to elaborate very much on what he has said.

These Regulations are now in draft form, ready for the printers and I would call attention to an important point which has been adopted and that is instead of issuing

notes on the Regulations separately, as was previously the case, these notes now appear under the particular Regulation to which they refer, so that the one volume will contain all the information that has been approved by the Safety Precautions Committee.

It is also to be noted that the Regulations in their new form have been completely sectionalised for easy reference and this arrangement will, I feel sure, appeal to your members.

Needless to say, when these Regulations are put into force and it is found that further amendments would result in more satisfactory operation, the Safety Precautions Committee would be pleased to consider your suggestions in due course.

At this stage, Mr. President, I would like to say how much the Safety Precautions Committee appreciates the work which the representatives of your Association—you in particular Mr. President—Mr. Fraser, Mr. Kane and Mr. Hart, have done in assisting the work of this Committee. The Amendments Sub-Committee consisting of Mr. Alexander, Electricity Supply Commission, Mr. Kane and Mr. Hart, Johannesburg Municipality, and Mr. Gibson, contractors' representative, have done a really good job of work and are to be congratulated on the result of their efforts.

PRESIDENT:

Thank you, Mr. Perrow.

MR. C. R. HALLÉ, Pietermaritzburg:

Mr. President: I think we should propose a vote of thanks for the work done by the Safety Precautions Committee. It is certainly putting a breath of fresh air and common sense into lots of old regulations and helping us through our everyday tasks. You can see from the report that they have really got down to it and put in some yeoman service. I propose a vote of thanks to the Safety Precautions Committee for their very excellent work.

Agreed.

Mr. W. H. MILTON, Electricity Supply Commission, Johannesburg:

I would just like to add for record purposes that the price of the Regulations has been fixed at 6s. 6d. The price has necessarily been increased above the old price by reason of the cost of printing, also by reason particularly of the copy which is printed in Afrikaans. I would also like to place on record before this Conference that the Institute of Electrical Engineers has adopted these regulations so that they have been adopted officially.

CONFERENCE ADJOURNED TO THURSDAY MORNING AT STELLENBOSCH

Conference Resumed at Stellenbosch—10th May, 1951.

PRESIDENT:

Ladies and Gentlemen: It is my pleasure and duty to introduce to you Councillor Blake, Deputy Mayor of Stellenbosch and Chairman of the Electricity Committee of Stellenbosch. It is hardly necessary for me I think to introduce him to you, because I found when I arrived here that he is a delegate to this Convention so I formally call on him to open the proceedings at Stellenbosch.

Councillor G.P. BLAKE, Stellenbosch:

Mnr. President, Dames en Here: Ek wil net verskoning maak dat die Burgermeester nie vandag die opening hier kan waarneem nie. Hy is nog moeg. Hy was Grahamstad toe op 'n kongres daarso, en as 'n mens al 'n bietjie aangaan in jare soos hy kan jy nie so aktief deelneem in alles nie, dus moet ek maar in die bres spring om hom 'n bietjie te help.

As chairman of the Electricity Committee of my council I have very great pleasure indeed in welcoming you all to Stellenbosch. I was most anxious that you should pay us a visit and your coming to Stellenbosch is a source of satisfaction to me. I have many reasons for my pleasure at seeing you here, because the commodity, namely electricity, which is supplied to us through your efforts is one without which we cannot immagine our lives today. Electricity is put to very many uses. It makes life pleasant even in the humblest homes and on the other hand it is a power which drives and operates from the smallest to the most powerful machine in our industries. This friend and servant of ours, electricity, however, is very dangerous. Playing or tampering with it through ignorance has often caused death. Those producing and distributing electricity

must be highly trained and responsible people to whom we owe a great deal of gratitude. To prove the importance which electricity plays in our economic lives it is interesting to note how electricity has taken the place of the old steam engines, the internal combustion engines and even the railway today cannot electrify their busy sections fast enough. To demonstrate the necessity of electricity the Stellenbosch Municipality undertook during 1914 the installation of a couple of old second-hand engines to start the generating of electricity. At first very few people were interested but gradually the demand grew until during the year 1921 when the demand was 135,000 units for the whole year. It has been a great blessing for Stellenbosch when in 1929 we changed over from the self-generating plant to Bulk Supply from the Electricity Supply Commission, and in spite of the rise in cost of production the price of electricity has decreased, and today is much lower than we could generate it in 1921. Since then the demand has developed by leaps and bounds so that during the year 1950, *i.e.*, last year, the consumption of Stellenbosch was 12,300,000 units. Thus in 29 years the sale of electricity has increased almost a hundredfold. This is out of proportion to the increase of the population which since 1921 I estimate, cannot have more than trebled itself. The important part that electricity plays in modern life is borne out by the fact as far as Stellenbosch is concerned in particular, that the University has established a special faculty at which electrical engineers are being trained in a five-years course. The education is based on a thorough scientific learning and facilities are available for the practical instruction of what is expected from a thoroughly competent electrical engineer. The University has provided laboratories and workshops and has a large and highly competent staff of professors, lecturers and mechanics, and up to the end of 1950, 158 students have obtained the B.Sc. degree in engineering.

Now Mr. President, Ladies and Gentlemen: In conclusion I wish you every success in your deliberations and I am looking forward to a pleasant hour with you after your work has been completed here. I sincerely hope that you will enjoy your visit to Stellenbosch and that this will not be the last occasion when my council and I will have the pleasure of entertaining you as a sign of appreciation and gratitude for all that you are doing for the various towns, industry and the country as a whole.

Ladies and Gentlemen: I declare this Conference open. I also wish to announce that the ladies will be entertained by a short drive in the town and of course if they wish to stay here it will be more pleasant.

PRESIDENT:

Gentlemen: Before throwing open yesterday's papers for discussion I wish to announce that your Executive Committee have made the following appointments:—

Sub-Committees

S.A. Standards Institution
J. C. Downey.
Alternate: D. J. Hugo.

S.A. Bureau of Standards
Safety Codes and other Committees
J. L. van der Walt.
Alternate: J. C. Downey.

Safety Precautions
J. C. Downey.
Alternate: J. C. Fraser.

Registration of Electrical Wiring Contractors
C. G. Downie (Convener).
D. A. Bradley and A. Foden.

Coal Supplies
D. A. Bradley (Convener).
C. G. Downie, J. C. Fraser and D. J. Hugo.

Import Control
J. C. Fraser, D. J. Hugo, J. C. Downey.
Alternates: C. G. Downie, C .Kinsman, J. L. van der Walt.

It was agreed that members of the Import Control Committee be authorised to deal with the question of copper if there was any need for it.

Representatives

World Power Conference Local Committee
J. C. Fraser.

Electrical Wiremen's Registration Board
J. C. Fraser.

C.I.G.R.E.
J. C. Fraser.
Alternate: A. Foden.

Safety Precautions Committee to deal with the Promulgation of the Wiring Regulations

The following members were appointed: G. J. Muller; C. Kinsman; J. C. Fraser; J. C. Downey (Convener); C. G. Downie and A. R. Sibson.

We will now continue the discussion on the paper we received from Mr. Frantz yesterday morning. Are there any visitors present who would like to discuss the paper?

Mr. E. T. NORRIS, Ferranti Limited, England:

Mr. President and Gentlemen: I do thank you for this opportunity as a visitor to this country of contributing to the discussion on this excellent paper. I have read it with great interest and I am sure it will be appreciated not only here but in other countries as well.

I am not sufficiently familiar with your economic operating conditions to be able to criticise the paper in that respect, so I will just confine my remarks to one or two of the more general aspects.

The basic problem of all capitalisation is really not an engineering one or a mathematical one. It is a political—a philosophical one of equating the present with the future because the whole problem is on the one hand paying money, pound notes, for the article now, and on the other hand getting a return for that money over the next twenty years. That of course is essentially difficult because nobody knows what is going to happen in the next twenty years. The best we can do is to make a guess and as things are in these times, and have been in the last twenty years, it is pretty safe to say, I think, that it is going to be a very wild guess indeed. The position is camouflaged to some extent by the orthodox practice of assuming that everything is going to stay exactly as it is now, that the cost of coal and the rates of interest, the load facors and the diversity factors, and all the other matters involved in this problem, are going to be exactly as they are now. I think the one thing you can say is: things are not going to be exactly as they are now. So one has to make this—I would hardly like to call it an estimate—very wild guess of what is going to happen in the future, because in this problem it is just as important that the boiler or the transformer or whatever it is, is operating as economically fifteen years hence as it is now. It is all part of this twenty or twenty-five years' estimate of the cost of the article over that period. Thus conclusions and figures such as are given in the table in the paper should be regarded, I think, as a very wild guess. That is not any criticism of the author or of the paper. It is just something we have to put up with. Fortunately the sort of mathematically optimum conditions that have been shown in the paper as examples are not very critical. Invariably one finds one can go a long way on either side of those optimum conditions without making much difference. Now when you go one side of that optimum condition you are buying a cheaper article. When you go the other side you are buying a dearer article. The efficiencies correspond to make the total cost equal, but when you don't really know what you are doing, when you realise that you are working on a wild guess anyway, and the position is not critical, it seems a logical thing to go on the side of the cheaper article because the price of the article is what you have got to pay now. You have to put pound notes down for that now and there is no doubt about that, whereas there is some doubt about the future costs, and so I think in this matter one should not only make the best guess one can of the future, but having made that guess, and realising that the optimum value is not at all critical, one should then go some considerable distance away from the optimum in the direction of buying something more cheap. A possible suggestion is to capitalise at half what you think is the normal rate which will bring you a little to that side. That is a development of Mr. Fraser's suggestion of ignoring differences of less than two per cent. The important part of capitalisation, as far as buying things is concerned, is that when you have made up your mind what you are going to do you should stick to it. You should really tell the maker of the boiler or the pump or the transformer or whatever it is, how you are going to capitalise, so that the maker can offer you the most economical proposition on that basis, and then you should stick to it.

On page twelve the author suggests that transformers, have reached a sort of limit

of development and that nothing more can be expected of them in the way of improvements. Well, I am quite sure that is not true. For one example the development of cold rolled iron within the next five or ten years will make a very marked difference to the cost or the performance of transformers and is incidentally providing right now a very critical proof of the attitude of users and purchasers to this question of capitalisation. Cold rolled iron at present is not as yet industrially and commercially available on any scale except in the United States. With cold rolled iron you can produce a transformer having say two-thirds the normal iron loss, which is a very big improvement. From all the orthodox capitalisation principles one would say well that is very fine; that is what we or you as purchasers or users have been wanting all along, a higher efficiency transformer. But it was found in the United States and Canada, and I quite expect it will be the same elsewhere, that when it comes to the point the purchaser does not want that at all, and the manufacturers instead of producing a transformer with much higher efficiency, have had to utilise this cold rolled iron to produce a transformer of the same efficiency but cheaper in price. Now any of the orthodox methods of capitalisation like the one shown in the paper, for example, would show that that is economically quite wrong, but in practice that is what happens, and emphasises the arguments I have just given that users should consider this problem of capitalisation not as a mathematical one using present worths of so much money in so many years' time, but more as a philosophical or a political one using their judgment and sagacity and what amounts to a guess as to what is going to happen in the next twenty years. Having done that they should stick to it.

Lastly I would like to make a comment or two on various references in the paper to voltage regulation.

The first is that the author states, on page 10, I think, that more often than not the limit of the rating of cables is thermal. That is not, I think, the general position throughout the world.

Ideally the most economic supply involves a size of cable or line and a substation density giving a voltage drop corrected by automatic voltage regulators, which cost comparatively little, so that the full thermal rating can be realised. In practice this ideal is affected by provision for load growth, etc., and the use of automatic regulators is frequently a temporary one catered for by a floating stock of one or two standard sizes. And lastly on page 12 I think, of the paper the author gives an illustration of the cost of voltage regulators. He says that a regulator which ten years ago cost £260 now costs £2,500. Well, I would like to ask the author about that because I do not think it is typical. The general price levels of machinery in England in general is 2½ to 3 times the pre-war value. Now, voltage regulators are still in the process of development and assuming there had been no increase in material and labour at all, then voltage regulators would be considerably cheaper now than they were in 1939, and so, even allowing for the normal increases, one would expect the cost to be somewhat below the normal rise of machinery in general instead of nearly ten times.

I again thank, you Mr. President, for this opportunity of contributing to the discussion and of listening to the other contributors. It has been a pleasure and an education to me to hear the different views that have been expressed and I thank you for it.

PRESIDENT:

Thank you, Mr. Norris.

Mr. C. LOMBARD, Bloemfontein:

Mr. President and Gentlemen: Allow me to add my quota of praise to Mr. Frantz for his paper which I read with great interest. The author in his paper mentions the use of wood poles instead of steel poles and the use of concrete poles has also been mentioned. I would suggest that the use of aluminium conductors instead of copper conductors also merits serious consideration. In many cases the adoption of aluminium conductors would result in considerable saving in capital costs. What is more, the country as a whole would derive a certain amount of benefit therefrom as copper, which would otherwise have been used, would be made available for export and would fetch a higher price on the world market than the aluminium equivalent which would have to be imported, so that the exchange of aluminium for copper would result in a net gain in foreign currency.

PRESIDENT:

Thank you, Mr. Lombard.

Mr. C. R. HALLÉ, Pietermaritzburg:

Mr. President, Gentlemen: This is a very useful paper, and I think we all would wish to thank Mr. Frantz for it. There are just one or two points I have been thinking about. The wooden pole has been mentioned and backed up. I think most of us are very pleased to hear that, but Mr. Frantz did not mention the painting of the steel pole. Now the saving on not having to paint the wooden poles is a big economical factor, and in our great city of Pietermaritzburg we have taken advantage of that, and the gang of pole painters, who have not so much work to do now because all our extensions are on wood, are now grouped with the street-line painters, doing all the stop streets and parking lines and so forth, and in their spare time they paint bus shelters. The wooden pole also is a great blessing because it does not become alive, and stray dogs who mistakenly have taken them for trees don't complicate matters of insurance.

Mr. Lombard mentioned aluminium conductors, for low tension I presume he was meaning. We are trying that. We have just ordered another 25 tons. Whether we will get it or not I don't know, but the clumsy fittings we have seen—well it looks as if there is going to be quite a bit of trouble in changing over to the aluminium conductor and I would like to know something of the economic value of that.

The other point mentioned is simple tariffs. I really do think that not enough stress can be placed on this. In Maritzburg in the old days, as in most cities, we had quite complicated tariffs. One had various tariffs for window lighting with time switches and for power and water heating and so forth, all on little separate tariffs which meant that very often one consumer had four or five meters. Well, we simplified the whole thing, cut down the number of tariffs, slightly complicating the existing tariffs by introducing three stages, that is, from the 6d. per unit for the first four units per room, then 1d. and then ½d. and we thus came to the possibility of putting in one meter for a consumer; if he had boreholes and pumps, incubators—even one dear lady had a pottery kiln—we found that by adjusting these things on paper we got down to the one meter per consumer and we recovered a thousand meters. Now a thousand meters at today's price, there are no longer the old 19s. 6d. meter, was a big economic saving. Also as you see from this Meter Testing Code we can save a considerable amount of money in the future in the cost of testing meters. The paper work in the City Treasurer's office in the meter accounts section and meter reading and everything has been greatly simplified by throwing out all these little frills of tariffs. The time switches we just handed back to the shops at £1 each. And they have now the uncomfortable job of getting the darned things to work. They are particularly interested, of course, in their operation only from half past six to half past ten, and it is their funeral if the lights go on longer. They don't ring us up to come and fix them. So I think if the smaller centres, who are thinking of changing their tariffs, would follow the line of the simple tariff they will not lose.

Finally, there is one item which has not been mentioned by Mr. Frantz in economy and that is the outdoor substation. Of course we all know that the old pole transformer is a blessing to us in the rural lines, and I think with wooden poles, vertical construction and pole transformers we will be just about cut down to the limit of economy.

In suburban work, where we used to put those hideous little chambers which are very hard to expand,—today we put in a 100 kVA outdoor transformer and before you know where you are a block of flats or something has gone up and we need 200 or even 400 kVA. Building costs are more expensive, and we are putting down a little concrete mat, with outdoor isolator units and a L.T. pillar box fenced in. There is your substation. You can easily get the land, you can double and treble the size of the thing easily, but of course some of the outdoor switchgear is somewhat expensive, and I would just like to know from Mr. Frantz what his general impression is of the economics of the outdoor substation and the possibility of more use of aluminium conductors for low tension distribution.

PRESIDENT:

Thank you, Mr. Hallé.

If there are no further contributions, I am going to ask Mr. Frantz to reply to some of the questions raised and I will remind you gentlemen that you will still have an opportunity of submitting comments in writing to the Secretary for inclusion in the proceedings. Would you care to reply to some of the discussions, Mr. Frantz? There is no need for you to do so now unless you wish to.

Mr. C. L. DE BEER, Cooper & de Beer Pty.) Ltd., Johannesburg:

(Communicated.)

Mr. Frantz has, in his paper, analysed in some detail the economics of power supply in the aspects directly affecting Supply Undertakings and, in view of the response accorded, I make no excuse for extending the paper's scope to cover what may be termed the moral field.

The cost of power to the consumer is not merely the payment made to the Supply Undertaking, but includes all charges involved in the conversion of that power to a useable form. It follows that insofar as a Supply Authority controls the supply of power by regulation or other means, it is responsible for any additional costs incurred by the consumer.

Among the objects of any rule or regulation is the protection of life and/or property and those responsible for the drafting of such regulations have therefore the very difficult task of equating the economic costs and the risk to life and property. This is no mean responsibility but one in which the economic aspect is too often overlooked.

In his paper, Mr. Frantz gives us methods by which the best economic choice is made and I give below certain fundamental facts which will, I trust, assist in the selection of economically sound regulations during the drafting period.

(a) A regulation should specify the desired object and not the method by which the object is to be achieved.

(b) No regulation or group of regulations should be so rigid as to prevent the trial of new ideas.

(c) No regulation should set out to achieve an object which in practice cannot be achieved.

(d) No set of regulations is complete without provision being made for easy modification, from time to time, of individual regulations.

To amplify the foregoing, I propose to use as an example the first edition of the I.E.E. Wiring Regulations, fully appreciating that these regulations were the first of so comprehensive a nature compiled by a local authority.

(a) Regulation 203-1 specifies a sequence of equipment for normal L.T. supplies. Among the objects of this regulation are to provide :-

(i) Sealed protection of an installation.

(ii) Means of isolating a consumer, for example, in the case of non-payment of charges.

(iii) Taken in conjunction with para. 203-4, means of disconnecting an entire installation at a known point.

With the introduction of the miniature circuit-breaker, these objects can be provided with a different sequence of equipment, but such alternative arrangement is prohibited by this regulation which is therefore economically unsound.

(b) Regulations 104-06 and 104-07 are sound insofar as regulation 104-07 specifies types of approved insulation, while regulation 104-06 specifies the procedure to be adopted for the introduction of alternative forms of insulation, so making the necessary provision for new developments.

(c) An excellent example of this type of regulation is 211-01, which specifies that every portable domestic electric appliance shall be fed from a socket outlet fixed in an adjacent readily accessible position. This regulation cannot be enforced in practice and is therefore unsound.

(d) In the introduction to the Wiring Regulations, the I.E.E. call for suggestions for their modification and moreover retain the right to so

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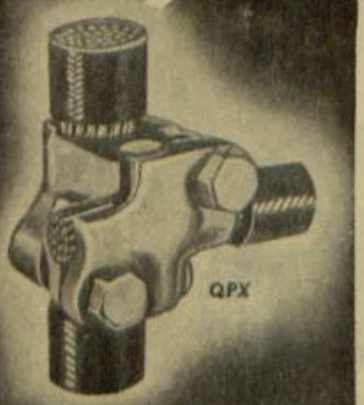

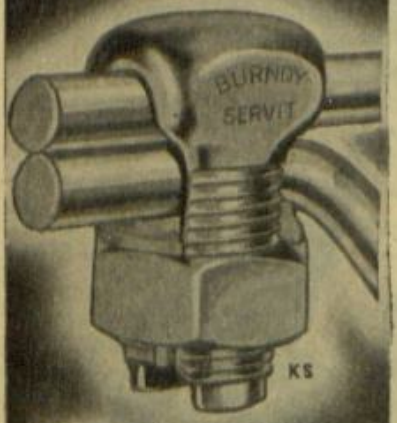

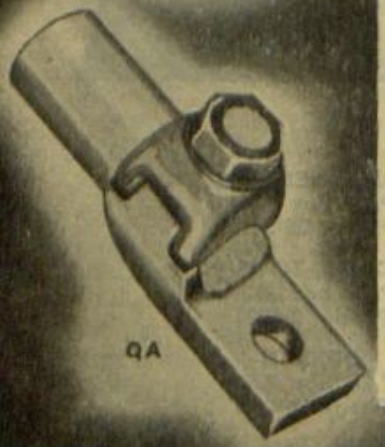

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modify them from time to time.
It is hoped that not only this procedure be adopted in the preparation of all regulations, but also that the legal procedure be made as simple as possible.

Messrs. Norris and Clinton have already drawn attention to the characteristic of economic laws that there are always so may variables that the best decision is invariably the intelligent guess. This section is no exception, but I trust that the foregoing will assist those responsible for drafting regulations.

Mr. J. S. CLINTON, Johannesburg:

Mr. President, Gentlemen: I have been asked by the President to thank Mr. Frantz for his excellent paper. Before I do so I should like to remark that I notice that the President has left behind his expensive system of relays and protection which he uses to close debates at will. Now I suppose he realises we are in the area of the Commission where you get a simple time graded system with a few seconds delay and we are allowed free speech.

As you know, gentlemen, we have listened over the years to a number of very excellent papers from members of the staff of the Cape Town Undertaking and this I think is also one which will rank high and be left in the libraries of engineers throughout the country. As I go round the country I notice from time to time papers that our old friend, Mr. Swingler, gave during his term of office as City Electrical Engineer are amongst the treasured possessions of many of the engineers and I think are still regarded as text books. This paper, I think, is something which will also fall in that category and it does more. I think it is a tribute to the younger generation who are about to take over the running of this organisation and I feel it has a big future if it is in such capable hands.

Mr. Frantz has of course given you another tool of your trade—I don't want to enter into a discussion, the paper has been closed—I merely want to warn you that it is a tool of the trade. It may be a finishing tool, but you still have to be an engineer to use it. That note of warning has been sounded by a number of previous speakers who have contributed to the discussion and made very excellent contributions and I would suggest to the younger generation when you use it, don't forget that you must use the economics and know the subject well before you apply it to engineering. It does not relieve you of the responsibility of being an engineer and you will have to apply your experience throughout in using that very excellent tool. Don't do so merely to escape the responsibility of taking decisions and don't use the economics to make your case. You still have to make your own decisions and those decisions are serious ones. Mr. Norris pointed out that the future is very dark and that money means very little. I think Mr. Sibson put it very well at a previous Convention when he said a penny today has such a different value that it should have a different name and we are very apt today to regard £1 as still £1, even though we know it buys very little and, when you are using that tool, I would just like you to remember that twenty years hence its purchasing power will be to a totally different value. Many such contributions were made throughout the discussions and when you study that paper I would suggest that you read up the contributions once again in the Association's Proceedings, so that you bear in mind those made by some of the senior members of the Association.

Mr. President, I feel that Mr. Frantz has done an excellent service to this Organisation and I hope that he will feel the tributes paid by the members will repay him for the immense amount of hard work he has done on your behalf.

Mr. A. C. T. FRANTZ, Cape Town:

(Communicated.)

In reply to Mr. Kinsman and Mr. van der Walt on the question of loss of revenue due to low volts, I would say that in Cape Town we have records, taken to demonstrate to consumers who complain of excessive consumption what percentage of their consumption is accounted for by the water heater, range, etc., from which it is possible to obtain an average for the proportion of units used for water heating, cooking, lighting and other purposes. For

instance, water heaters account for fifty per cent of the consumption of the average domestic consumer. On the basis of these figures, it was found that most of the additional units which would be sold to domestic consumers if the voltage were correct would be for lighting, the peak coming on as it does in Cape Town just after dark. Water heating might account for a little extra also. Cooking appliances were left out of the calculation because even if the volts were low it was assumed that the food would have to be cooked in any case. Radiators and other appliances would also consume a little more, but the majority of the additional consumption would be for lighting. This additional consumption would, at the tariff rate applicable, result in the additional revenue of £1,500 quoted in the paper.

With regard to Mr. Sibson's remarks on the economics of banking boilers, this particular subject was not referred to in the paper as the solution of the problem is somewhat involved. The matter is dealt with fully in the very interesting paper by P. G. Kaufmann in the December, 1942, issue of the Proceedings of the Institution of Mechanical Engineers.

Mr. van der Walt has drawn attention to an apparent contradiction in the second and third paragraphs of Section 3.2.1 of the paper. In the second paragraph appears the statement "the lower the annual cost of the losses, the smaller will be the most economic size (of cable)", whereas in the third paragraph it is stated that "an increase in the cost of the losses will also be permissible and hence a decrease in the most economic section of cable".

While at first sight these two statements appear contradictory, further consideration of them in relation to the context of the paragraphs shows that this is not so. In the second paragraph the cost of copper has been assumed constant and it follows directly from Kelvin's Law that the lower the cost of the losses (either because the tariff rate at which the cost of the losses is assessed is lower or the losses are themselves lower because of reduced load factor) the smaller must be the annual capital charges and therefore most economical cross section of cable.

In the third paragraph the cost of copper has been assumed to vary, while the cost of the losses is assessed at a fixed tariff rate. The increased cost of copper would result in higher capital charges, so that by virtue of Kelvin's Law, higher losses are also allowable and hence a reduction in the cross section of cable.

Mr. Burton has mentioned the effect of short loan periods on costs and has drawn attention to the difficulty he has experienced in obtaining authority to increase the loan periods. No such difficulty seems to exist in Cape Town, when the loans raised for extensions to the distribution system (including the building of substations) have a life ranging from 20 to 25 years, the last one raised in 1946 having an even longer life of 30 years.

I agree with Mr. Mitchell, of Salisbury, that if full use is not immediately made of an asset, the Sinking Fund method of providing for loan redemption places a heavier burden on the undertaking than might be desirable. A method of delayed redemption would in that case be preferable—this however is a question of finance and would not affect the economics of the case. With regard to Mr. Mitchell's remarks on the curves shown in Fig. 4, it must be admitted that they may not be truly representative; they have been drawn for purposes of illustrating the method only and for that reason have been drawn with more deliberate changes of slope than might be the case in practice. The curves used in any practical problem should, of course, be actual test results and, as mentioned at the end of paragraph 3.1.2, the accuracy of any system of load division is entirely dependent on the accuracy with which such curves can be determined and to what extent they can be relied upon to represent actual conditions.

Mr. Mitchell's remarks regarding concrete pole costs are interesting. In Cape Town, the last tender for spun concrete poles was turned down because the price, for no apparent reason, had been increased from £7 17s. 4d. to £11 12s. 6d.

PRESIDENT:

I judge by the applause the very true appreciation placed on the author's presenting such an excellent paper before us.

Before proceeding with discussion on Mr. Smith's paper, I wish to mention that in my report on the Safety Precautions Committee yesterday, I said that your Executive would consider the question of promulgation. Your Executive this morning considered this question and have appointed a sub-committee consisting of Mr. Sibson, Mr. Muller, Mr. Kinsman, Mr. C. G. Downie and myself (as convener) for advising and assisting you in the promulgation of the Standard Regulations, *i.e.*, the new edition now coming forward. I have been reminded by Mr. van der Walt that in his report on the Bureau of Standards he made no mention of the Approvals Committee. I hardly think it was necessary because you have already received reports of the recommendations by the Aprovals Committee. in the bulletins which are sent to you from time to time.

Item 9 of the Agenda, "Papers for next Convention". Members who are prepared to give papers are requested to submit their names to the Secretary, together with the proposed subject within the next three months.

The Secretary has just mentioned that there is a list of suggested subjects which he will include in the next bulletin. That will give you an opportunity to study the list and assist you in selecting your subjects.

In regard to Item 12 of the Agenda, gentlemen, a sub-committee has been appointed to investigate the expenses of the Executive Council members when attending executive meetings. This sub-committee will report to your Executive Committee when they meet in mid-year and then probably something more concrete will be placed before you.

As we still have some time on our hands, I will place the paper of Mr. Smith, Boksburg, on Meter Testing before you for discussion.

Mr. J. L. VAN DER WALT, Krugersdorp:

Mr. President, Gentlemen: I have the following few comments and criticisms on Mr. Smith's paper. The first one is on page 4. While it may be found possible to merely wash out the dial trains with benzine and get away with it in fairly new meters, it will be found that benzine on evaporation leaves a white film on all parts and I consider it necessary to remove this film by brushing. In other words, all dial trains should be dismantled. After all, we are anxious to give as good an accuracy as possible for as long a time as possible. I cannot agree that train bearings should receive no oil. It may not appear to be necessary on new dials when all pivots are bright, but after five or six years in service these pivots become dull and friction ensues. A good clock oil will stay on the working parts for long periods with no gumming.

In our undertaking we have not tried the vaseline idea for removing particles in the magnet gap. The suggestion seems a little bit sticky. We recommend the feathers of a backyard fowl or guinea fowl, both types being preferably dead before their feathers are removed. The flicking action of a feather will remove any foreign matter from a magnet. I am aware that many manufacturers pack the top of a meter spindle with vaseline; vaseline is sticky and we need reduced friction, that is the main idea. We recommend clock oil. One well-known manufacturer has gone so far in his efforts to abolish friction as to introduce a jewel for a top bearing.

The last sentence on page 4 is a very interesting one. I am of opinion that to repair meters, clean them and repair them, as mentioned by the author, 20 to 24 meters a day is rather pushing the job and I certainly would not like to undertake a job like that continuously of doing 20 to 24 meters a day. I think that needs consideration and meter testing is a work that should not be rushed or pushed. If a little more time is taken, the meter is received on the test bench ready for test with as little trouble as possible.

Page 5. The author mentions there the winding of coils. He says coils can be easily rewound by the larger undertakings. I do not agree that it can be done very easily. Coil winding equipment is expensive and the replacing of coils today, buying them in units, is fairly cheap, so I do not see the benefit of doing the coil winding in the test laboratory. I have my doubts whether it will be a paying proposition. Besides, some electro-magnetic

assemblies are in one part, pressure and current coils being complete with a loop of laminations. To punch and drill out rivets, unthread the laminations, rethread even with spare coils on hand, is also uneconomical considering the time taken to do the work and the cheapness of ready-made coils bought from the manufacturers.

The above remarks explode the third paragraph: Twelve meters a day with a major overhaul involved with each is, to my mind, too optimistic to be possible. I think the Meter Code originally suggested 16 meters a day could be done. The Meter Test Code has made it compulsory to test on ·5 power factor lagging, but even though it were not so, surely if it is necessary to test a meter at all, it is necessary to make sure no one is the loser. Most dwellings have refrigerators and some fluorescent lighting, therefore the power factor comes in. It is remarkable the number of meters one finds which cannot be put into service because they fail to come anywhere near the limit of accuracy on the power factor test. I am not referring to the meters of ancient vintage.

Page 6. The schematic diagram shows two points which call for comment. It would appear possible to apply heavy currents through the fine resistance and thereby burn it out unless the change over link is interlocked so that it is not possible. It is suggested that the fine resistance be across the coarse resistance and I think there will be less likelihood of the burning out of the finer resistance.

From the arrangement it is clear that the power factor will be less than unity. If a three-phase supply and a slip ring motor is available, some help can be obtained by supplying the stator from the mains and supplying the meter pressure circuit from the slip rings. I don't propose to go into the obvious details, all soluble of phase rotation, magnitude, volts and pressure coils.

On page 7 I have a few comments. Before the introduction of the Meter Test Code, setting out the methods of testing polyphase meters, the testing of polyphase meters as single-phase meters was never successful due to interaction between elements. A previous speaker has mentioned that point. Less trouble is experienced if pressure coils are fed from the respective phase voltages and corresponding currents applied as each element is tested.

On page 8 my remarks about slip ring motors would apply again in this figure. I assume that the watt meter is incorporated as a guide to load conditions and that no stop-watch tests are to be carried out, otherwise the variable C.-T. would have to be class A.L.

On page 10 I again refer to the fact that I am of the opinion that class A.L. current transformers are necessary.

Page 15. Testing on three loads as ·5 power factor seems to be expensive and a great time consumer. If a meter is correct at full load ·5 power factor and found to be outside the limits on other loads, there is nothing which can be done about it. It is not a recurring condition.

Page 16. Before I go on to that, Mr. President, some speakers mentioned the staff difficulties and the use of women. We realise that there will be staff difficulties, *i.e.*, trained staff to do meter testing. Is the lack of interest in the trade as meter mechanician not due to the fact that there has been no test code or no compulsory meter testing? Will that not be rectified once the youngsters see there is a future for them in meter testing? It will take a number of years, but I am sure the matter will correct itself.

I was rather surprised to see that the general trend of opinion is in the opposite direction than originally intended I think, and that was to use women on the cleaning and repair side of meters, assembling, dismantling and the qualified staff on the testing. In this Convention it appears that there is a reversal of that idea and that the women are to be used for testing and the trained meter staff for cleaning, repairing and reassembling the meters.

Mr. President, I think the author should be congratulated on delivering this paper, especially at this Convention where the Meter Test Code was so fully discussed. It has given all engineers an idea of the procedure and methods to be applied in testing meters and I am very glad to see that there is a trend to an interest in this science of meter testing which our country is still lacking today.

PRESIDENT:

Thank you, Mr. van der Walt.

Mr. H. M. S. MULLER, Kakamas:

Mr. President: I spoke yesterday, but there is just one question: supposing the small municipalities wish to undertake the testing of their own meters, then you come up against this: what guarantee has the consumer of the test that has been made? That is why I thought that in time of years the system that could be advocated would be a standard testing, at some standard bureau. Then there is yet another question that arises among our Inspectors of Factories at present and that is in regard to the earthing of meters. Most meters nowadays are fitted with their earthing terminals. In my experience I have found that your meter invariably is a very successful lightning arrestor in that respect, so much so that you cannot use the earth terminal. You can have very good lightning protection in your transformer stations, but when you get a direct strike on the line, you can get a dozen or more meters injured due to earthing. Other methods are adopted, such as bakelite cases. That is, of course, a very fine thing, but one would like to know the relative merits, by experience of engineers, of the insulated case and metal case, because my experience has been, I must frankly confess, that I am afraid to earth meters. On the other hand again, the incidence of accident due to metal cases, I think, must be a very, very small percentage. Your meter is generally put in a place of safety and I wonder if our Inspectors of Factories can name any instance worthy of note where that has been a source of danger, because the earthing of a meter definitely is detrimental to the meter itself as far as we are concerned.

PRESIDENT:

Thank you, Mr. Muller.

Mr. F. STEVENS, Ladysmith:

Mr. President: Contributors to the discussion on this paper do not appear to realise that a number of small undertakings do not pay any attention to their metering because of lack of facilities or the engineer being the only capable man on the undertaking and that he hasn't the time. Very many small undertakings are placed that way. The engineers would like to pay attention to their metering, but are prevented from doing so. I was at one time in charge of a small undertaking, so can sympathise with them. The paper Mr. Smith has read to us may give them ideas for setting up simple test bechnes which they had not realised would meet their requirements; if it does, I feel it will have served a useful purpose.

I agree with Mr. Mitchell that a meter should be as accurate in a small undertaking as in a big one, but that is just not possible in the small undertaking where there are not the means. The engineer is the cook and bottle-washer and I have heard it said everything but the town's midwife.

I feel personally that this paper is going to serve a useful purpose.

PRESIDENT:

Thank you, Mr. Stevens.

Mr. F. H. TYLER (Visitor, Johannesburg):

Mr. President, Gentlemen: I appreciate very much the opportunity of saying just a few words in connection with some of the subjects that have been discussed. There are two items, which really have very close association, which have been before the meeting—Mr. Smith's extremely interesting and very valuable paper, and the discussion on the Meter Testing Code. To a very large extent these are inter-related.

The first point on which I have a little information is the question of the use of girls in the calibration and testing of meters and I would like to bring to notice a point that has not previously been stated and that is that meters are largely manufactured and assembled and tested by girls in the factories when they are originally made.

Some years ago I was privileged to be in one of the large indicating instrument factories and, in this case, not only were girls used very largely for the assembling and testing of indicating instruments, but there are many operations that are carried out by girls that cannot be carried out by men. Such operations include, for instance, the grinding and sharpening of pivots. These are actually turned in the

lathe, although their dimensions are extremely small and for that class of work people with a high degree of finger dexterity are absolutely essential. They distinguish in the factories between finger dexterity and tweezer dexterity.

During the war, girls were very largely used in certain phases of electrical and mechanical engineering, particularly at the Heights, where I had a certain amount of contact with them; and a great deal of routine work was undertaken by these girls, who did not seem to tire at the job to anything like the same extent that men did. It was interesting to note also that they were particularly satisfactory when working on night shift, with one important proviso, and that is that they had to be well fed during the night.

Another point of interest that has come to light is the age-old discussion between bakelite and metal cased meters. The only real argument I have heard put forward in favour of the metal case is the fact that if it is dropped it does not usually break. Well, the feeling I have there is that if the meter has been dropped between the time that it is taken out of the meter testing room and installed in the consumer's premises, it is better that the case should break; because the probability is it will be badly inaccurate in any case and it is far better that your mechanician should be forced to reveal the fact that the meter has been damaged.

Under the question of approved types of meters, a little difficulty seems to exist. No approved list has yet, as far as I know, been issued by the Bureau of Standards and, if such a list cannot be made available at the present time, I would suggest that it would be a good idea to issue some kind of brief specification indicating the points that an engineer must look for in meters at the present time, to avoid having to take them out of service at a later date, when the Code is finally promulgated. For instance, BSS 37 of 1937 does not permit the use of cyclometer dials. Now there are quite a lot of meters with cyclometer dials installed and more of them are, I think, being put into service at the present time. The present Meter Testing Code does not, I think, prohibit their use, but if it is going to fall into line with BSS 37/1937, it is possible that the meters with cyclometer dials being put into service might prove an expensive undertaking in the near future. I think the point should be clarified so that undertakings know precisely where they are in selecting their types of meters today; and some indication of characteristics to be looked for, even if a complete approved list is not available, would be very useful.

One other little point; and that is, that it has been suggested that there will be an authorised member of the staff on the staff of undertakings who will be empowered to affix a seal indicating that the meter is approved and ready to go into service. I think that that gentleman is sometimes going to find himself in difficulties. It seems to me that, if he is not the engineer, there may be occasions when, by virtue of his connection and his authority derived from the Bureau, he may sometimes have to condemn meters as being unfit to go into service that have been bought by his senior officer quite recently; and I think his position might sometimes be just a little bit difficult. I think that point will have to be borne in mind when it is finally decided.

PRESIDENT:

Thank you, Mr. Tyler.

Mr. J. T. WILLIAMS, S.A. Bureau of Standards:

Mr. President and Gentlemen: I should like just to reply to the query raised by Mr. Tyler in regard to the list of approved types of meters. The position at present is this: a list of approved meters was drawn up and was considered by the drafting committee who drew up the Code. The list was based on practice in Britain, but it was found that there are considerable difficulties, chiefly due to the fact that in this country there are large numbers of meters of continental make in use. The chief difficulty, of course, is with the cyclometer dial. The committee decided then that they would not publish a list of meters, not for the present, at any rate, and I think the idea was that the two-year period of grace mentioned in the Code was to be used to gain experience of various types of meters in order to be able to say which meters should be discontinued

and which not. It would be very difficult to simply place a wholesale ban on a particular type of meter without having some foundation for it. It would put some of the smaller undertakings in an extremely difficult position. I know of undertakings that have no other type of meter. So that is the position at present that every meter is on the approved list. I understand that there is a possibility of the committee being re-constituted and then in that case they will give consideration to this question. In the meantime, if any of you have any comments to make or any suggestions, the Bureau would be very glad to have them.

PRESIDENT:

Thank you, Mr. Williams.

Mr. J. E. MITCHELL, Salisbury:

Mr. President: There is only one little point. Mr. Muller appeared to ask for some information in regard to bakelite covers on meters. What I can tell him is this: that we have been using in Salisbury bakelite covers now for some considerable number of years and we have not as yet had one bakelite covered and backed meter damaged by lightning, whereas we have had anything up to 100, including three-phase, meters damaged by lightning annually when they have had metal covers.

Mr. J. C. FRASER, Johannesburg:

Mr. President and Gentlemen: I would also like to add my quota of thanks to Mr. Smith for his very interesting and valuable paper and I know that it is a paper which will be read very extensively and used as a reference work long after this Convention is over. It was on that knowledge, gentlemen, that I took the trouble to get a few notes from my meter engineer, who is well known to Mr. Smith. Mr. Smith, by the way, worked in our meter department for a period of over two years and I know the interest that Mr. Smith has always had in meter work. These few notes may be of value to the valuable contributions which have already been given on Mr. Smith's paper.

The author is to be congratulated on preparing a paper which will serve to stimulate interest in meter work in this country and at the same time provide a good deal of much needed information.

Dealing first with the repair aspect, the Johannesburg Electricity Department finds that the burnishing of pivots and re-winding of potential coils is not economical as compared with replacement of these parts. The figure of 20 to 24 minor overhauls per day is considered reasonable, but 12 to 14 major overhauls seems to be rather high and from our experience a more reasonable figure would be 7 or 8. Is there justification for checking the bottom bearings of all new meters? It would be interesting to know what proportion of these bearings have been found to be defective.

With regard to the meter testing equipment recommended in the paper, I cannot agree with the statement that equipment which will ensure accuracy only within *wider* limits is justified in the case of small undertakings as, generally speaking, the smaller the undertaking the higher is the price per unit. The test board shown in Figs. 3 and 4 appears rather too simple even for the smallest undertaking. Its principal weakness lies in the use of one ordinary 25 amp watt-hour meter as a sub-standard. No rotary sub-standard should be used on less than 1/4 load, yet it is apparently intended to use this 25 amp meter as a sub-standard on 0·5 amp for testing 10 amp meters on 1/20 load.

Another point worth mentioning is that one single range ammeter is quite inadequate to cover the range of loads necessary.

In connection with the test board shown in Fig. 5, the arrangement for changing over to 0·5 lagging power factor, referred to in the text, is not shown in the diagram. The current transformer in this board would, of course, have to be of high precision type. In both this board and the three-phase board of Figs. 6, 7 and 8, it would be an advantage to place the rotary sub-standards in the secondary circuits of the current transformers as this would save current range changing on these instruments and would enable single-range 5 amp sub-standards to be used. On both these boards fine as well as coarse variac controls would be an advantage for watt-meter work.

Concerning the A.C. meter testing section of the paper, the formula to be used for rotary sub-standard work should be :-

$$\% \text{ error} = \frac{\text{Revs. sub-std. should do (if meter O.K.)} - \text{Actual revs. of sub-std.}}{\text{Actual revs. of sub-std.}} \times 100$$

Corrections for rotary sub-standard error are more likely to be required than for wattmeter error.

Warming up meters for only 30 minutes has been found to be ample and can be conveniently done while the meters are on starting load.

Tests on 1/10 and 1/4 loads at unity P.F. and on 1/4 and 1/2 loads at 0·5 lagging P.F. have been found unnecessary, but a test on twice full load for 10 amp and 25 amp long range meters is considered essential.

We have found that it is advisable to test all three-phase meters on a three-phase supply as recommended in the Meter Code. The test results given in the paper for one meter and one set of current transformers are not sufficiently representative of three-phase meters and current transformers in general. As regards current transformers, their errors should be taken into account even if they are class B.M.

In connection with the testing of three-phase meters, it should not be forgotten that the power factor on the elements of a three-phase *three*-wire meter is different from the three-phase load power factor. This alters test conditions as compared with those applicable to a three-phase *four*-wire meter.

It is not necessary to test each element separately at light load as all friction compensators, being potential-coil operated, are always in action in service.

It has been found advantageaus to do a zero power factor test on the individual elements before the balance tests.

PRESIDENT:

Thank you, Mr. Fraser. Are there any more contributions, gentlemen? I will then ask Mr. Smith to reply if he wishes to do so now.

Mr. E. L. SMITH, Boksburg:

Mr. President, Gentlemen: I do not wish to reply to the various points at this stage, but there are one or two comments I would like to make. In the first place, I wish to thank all those who have given constructive criticism and contribution towards this paper, which will be of help to any small undertakings.

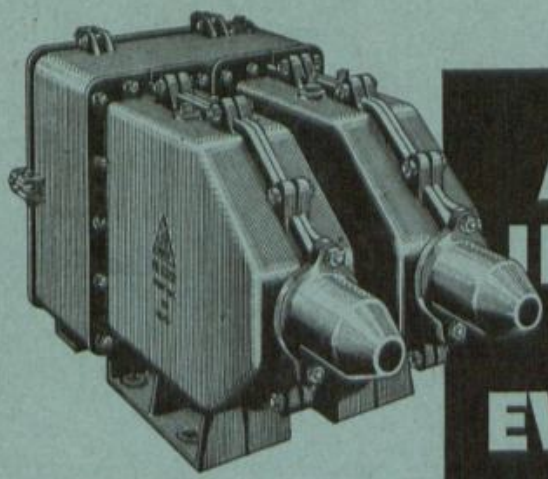
Unfortunately, some of the speakers have missed the point altogether. The idea of the paper was to help the small undertakings and the criticism has come from the point of view of the Class A Station. To suggest that a small undertaking, which might struggle along to get enough money to buy a rotating standard, should also include a microscope or a telescope or a horoscope in their set-up is altogether out of the question. I would like you to bear that point in mind when you start speaking and speak on behalf of the smaller stations and not on behalf of the Class A Stations. We are not discussing them and if you want a paper on Class A Stations I can give you one.

Another point, Mr. Chairman, is this: That some speakers have apparently not read through the paper. For instance, my third paragraph of the introduction reads as under:-

> "The intention of the paper is to be of some assistance to small undertakings who may be able to set up meter repair and testing in a simple way at a low cost and, at the same time, satisfy the provisions of the proposed Meter Testing Code."

The Meter Testing Code lays down certain provisions and nowhere in the paper is it suggested that we go outside the provisions of the Meter Testing Code.

When I spoke of wider accuracy later on, it was in reference to a meter test board, not in connection with the meter accuracy. Small undertakings cannot install Class A Station test boards, but they can install simple boards of a wider accuracy, not having the accuracy and the characteristics of an A Station board. Another point, Mr. Chairman, is that if our friend from Salisbury happens to get a pound of butter stamped plus or minus 2½ per cent, he will be surprised and we,



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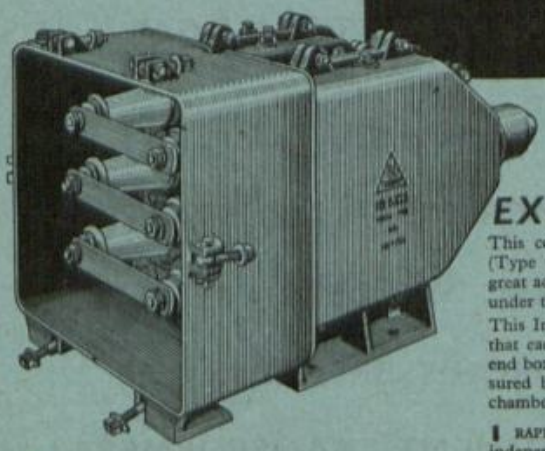

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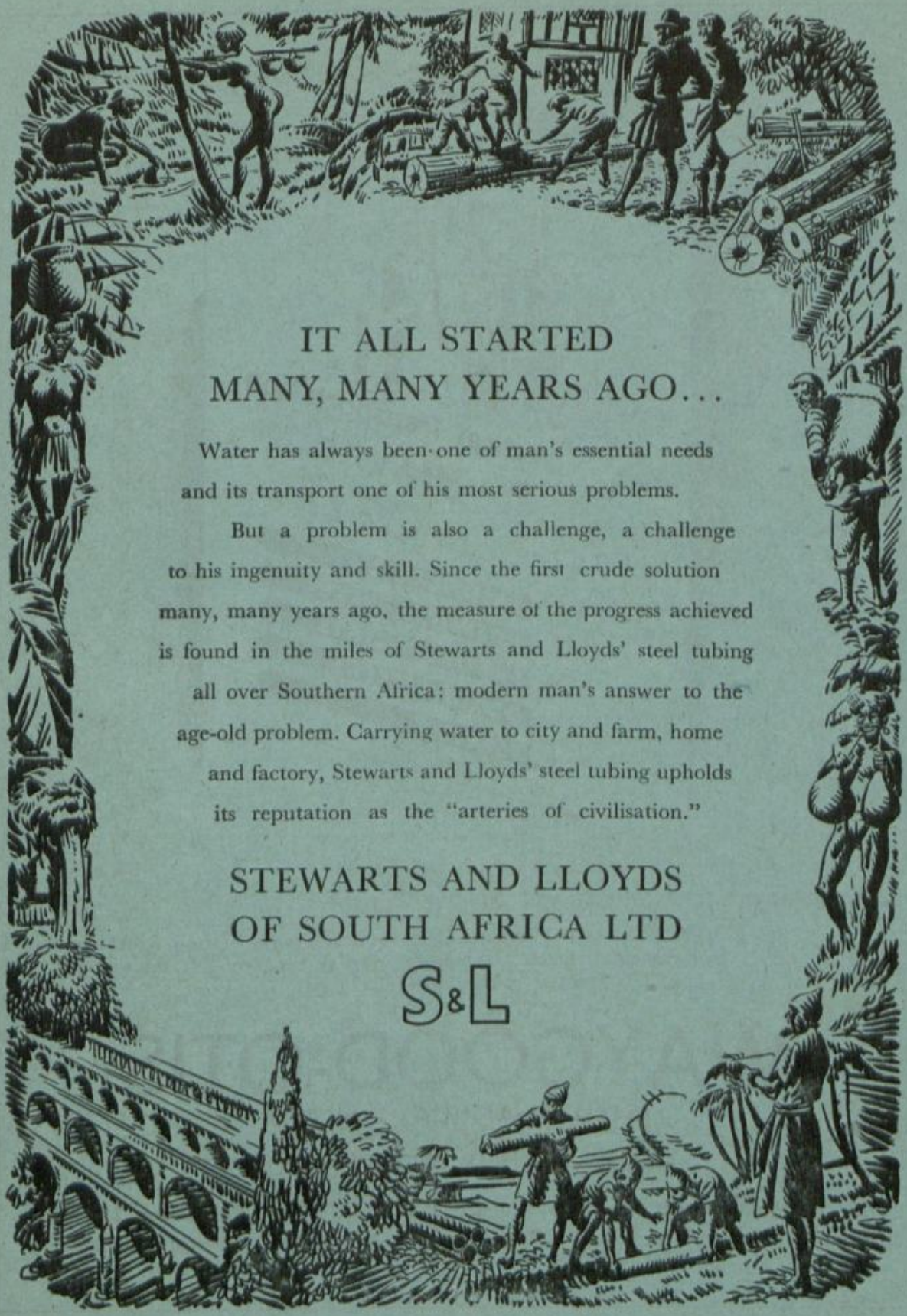

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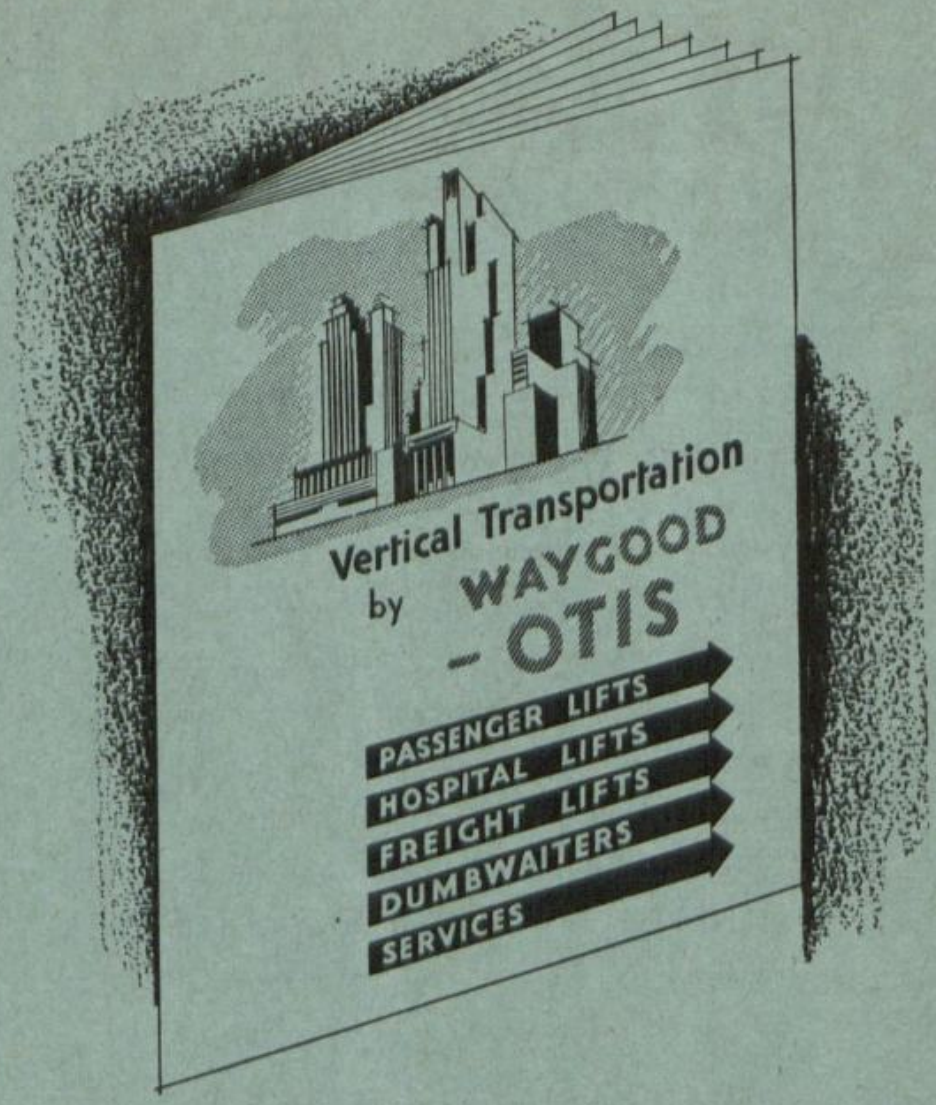

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as engineers, will also be surprised to see the Bureau stamp on a meter guaranteed 100 per cent on all loads; so, Mr. Chairman, I think that that remark was irrelevant and was no contribution to the paper at all. I hope, Mr. Chairman, that my remarks will be taken in the same spirit that I received the criticism.

Another point, Mr. Chairman, is this: In Class A Stations perfect conditions are set up. You have a beautiful load curve, a beautiful form factor and you have steady voltage, but when that meter was tested did it have conditions under which it will work? It may be put into a circuit which has a very bad wave distortion, a very big variation of voltage and so on. Are we sure, when an A Class Station is testing a meter, that that meter is accurate in situ? You can't guarantee that and I think there is a lot to be said for the American system of testing meters and that is going round with the instruments, the rotating standards, in a van and testing the meters on site. That is by far the best of the methods.

Insofar as small stations are concerned, Mr. Chairman, I think that if you give me a commercial meter of 10 and 25 amp properly calibrated, I can fairly guarantee to test meters that will compare favourably with any A Class Station, given the time to do it. Thank you, Mr. Chairman.

PRESIDENT:

Thank you, Mr. Smith.

Mr. W. M. ANDREW, King William's Town:

Mr. President, Gentlemen: After hearing Mr. Smith's spirited reply to the discussion, it feels, to me, like an anti-climax to propose a vote of thanks for his efforts and his paper. However, his brief and challenging reply has, I think, put the paper in its proper perspective and emphasised the object of the paper. He, I am sure, can fell satisfied by the reception he has received and by the contributions which have been made to his paper that he has done something for this Association and its proceedings which is constructive.

We heard, at the beginning of the Convention, our President say in his address that some decision was better than none at all and Mr. Smith's paper is timeous in that, taken with the new Meter Testing Code, the engineers who are trying to get some form of meter testing done on their undertakings will have a lead to enable them to start even in a small way to test meters. This will give them the satisfaction of at least making that start which always leads to bigger and better equipment, bringing with it a rich experience and a better and more economic knowledge of what equipment is best suited for their undertakings.

Mr. President and gentlemen, it gives me great pleasure to thank Mr. Smith on your behalf for his very good paper, which I know we have all benefited from and enjoyed very, very much inded.

PRESIDENT:

Gentlemen, I would like to remind you that if you have any further contributions to the paper you may submit them to the Secretary, who will arrange for them to appear in the Proceedings.

The time is half past twelve and I will now declare this session of the Convention at Stellenbosch closed and we will adjourn for lunch.

FRIDAY, 11th MAY, 1951.

Conference resumed at 9.30 a.m.

PRESIDENT:

Gentlemen, we will proceed with Item 8 of the Agenda and I will call on Mr. Hallé to furnish you with particulars.

RIGHT OF SUPPLY—ELECTRICITY SUPPLY COMMISSION

Mr. C. R. HALLE (Pietermaritzburg):

Mr. President and Gentlemen: We held a special Executive meeting on this subject. We collected all the information that was available and we find that the machinery set up under the Act has not been given a proper chance to function. As you know, the Electricity Control Board has the power of dealing with these matters. Now by all rules of the game, you must let the umpire make a decision before you start surging on to the field, so to speak, and it would be entirely wrong for this Convention to express its view or thrash the matter out in public before it really

can be stated that there is a dispute. It appears that the Springs Municipality has certain views, the Commission has certain views and the correct procedure is for these to be placed before the Control Board and the whole matter thrashed out there and a decision made. If the parties don't think the decision is correct, they could bring it to this Convention of Municipal Undertakings, who would then express their view. But we do strongly feel this is not a matter for us to discuss today and that the Springs Municipality should put it to the Control Board, which they have now agreed to do. Therefore the Executive urge that you allow us to withdraw this matter from the Agenda of the open Convention.

PRESIDENT:

Is it agreed, gentlemen?

Agreed unanimously.

APPOINTMENT OF AUDITORS

PRESIDENT:

I will now call on Councillor Fox to deal with the subject of appointment of Auditors.

Councillor F. T. FOX, East London:

Mr. President: I have great pleasure in moving the appointment of Messrs. Savory & Company, our existing auditors.

PRESIDENT:

Do you agree to that, gentlemen?

Agreed unanimously.

AMENDMENTS TO RULES AND CONSTITUTION

PRESIDENT:

Item, No. 11. Gentlemen, there is one small item to be attended to and I will ask the Secretary to furnish you with the particulars.

SECRETARY:

Mr. President, Gentlemen: As you know we changed the end of our financial year from the end of August to the end of February and, to put the matter in order, it is necessary to amend Rule 6 of the Constitution, which reads: "Contributions shall become due and payable annually on the 1st day of September which shall constitute the new financial year of the Association." All that is necessary now is to substitute the 1st day of March for the 1st day of September.

PRESIDENT:

Will somebody move that, gentlemen?

Mr. A. R. SIBSON, Bulawayo:

I will move that, Mr. President.

Mr. C. LOMBAARD, Bloemfontein:

I second.

PRESIDENT:

Is that agreed, gentlemen? Thank you. **Agreed** unanimously.

GENERAL

PRESIDENT:

We are now on the item General, Item No. 13. Matters of interest may now be brought forward for discussion.

Mr. F. STEVENS, Ladysmith:

Mr. Chairman: I would be interested to know the views of those present as to the desirability of municipalities having legislation enabling them to disconnect consumers with electrical appliances which cause radio interference. In the July bulletin issued by the Secretary, an opinion is expressed by Mr. Eastman with which I am in entire agreement. It is to the effect that it would be unwise for any legislation to be forced on municipalities giving them powers to disconnect consumers of electricity who possess appliances that interfere with radio reception. If this is done, Local Authorities will have to incur expenses in obtaining interferference locating equipment and sustain a loss in maintaining an inspector to carry out the investigation, all to the advantage of the broadcasting companies. There is little chance of the revenue from the sale of current used on radio sets bringing in sufficient to cover the costs.

My department has, as it happens, acquired a portable receiving set with a frame aerial which can be operated either from a battery or the mains to enable us, when we have time, to locate some of the sources of interference and tell whether it emanates from a consumer's premises or our own mains. Where called for, we

write to the offending parties a polite letter appealing to them to carry out any suggestions we may make and, at the same time, sending a copy of the letters to nearby consumers who have complained. To my mind, it is for the broadcasting companies to do anything more than this.

I am of the opinion that for those towns where there is no transmitting station nearby, little can be done to eliminate interference as reception is too weak. An investigation carried out by the S.A.B.C. at Ladysmith revealed that the interference in our town, which we thought to be very bad, was nothing like as serious as in other places. What is wanted is greater signal strength to enable listeners to reduce the volume on their sets and thereby eliminate some of the extraneous noises.

PRESIDENT:

Thank you, Mr. Stevens.

Mr. C. R. SPREIGHTON, Standerton:

Mr. President: The last speaker has brought forward a topic which I think is going to have a lot to do in the future with electrical engineers. In the town I represent, Standerton, we have already been approached about similar conditions. People who make their living by selling radio sets complain that they cannot sell a set because as soon as they demonstrate it, all that they get is the next door garage's charging set working, or something to that effect. I do not know that Standerton is too far from the Reef; the signal level is pretty high, yet the D.B. level of the interference is far above it. We actually asked the S.A.B.C. for their assistance in overcoming one or two bad cases and I will say they gave us every assistance. There is a new Act now which has been brought into force by the P.M.G. which, I believe, is covering that angle, but I think that there should be some means whereby the municipal authorities can do something. It is getting now to the stage where something has to be done. My own Council, before giving permission to instal any neon signs or signs of that description, insist that suppressors be fitted and I think that is helping a long way. There are a lot of these signs put up which cause interference. A lot of them are put up in a very good way, well installed, but they are not maintained and if they lack maintenance that is when a lot of the trouble arises. Tracking them down can be very costly. It is not every municipality that can afford to have a small portable set and it is not every municipality that has the staff who can intelligently use such an instrument and it is very difficult to find the offenders at times; but there again I think that if anybody is in trouble the S.A.B.C. will come to their help immediately.

PRESIDENT:

Thank you, Mr. Spreighton. Gentlemen, I want to be quite clear on this point: we do not intend to close the proceedings now. I know there are some of you who have points, particularly some of the smaller areas with whom we, the Executive, are not in such close contact. The smaller towns have their problems and now is the opportunity to come forward and bring your points to this Convention. I see we have present with us Capt. Joseph White. I understand he can give us some first-hand information about the committees that are being formed in connection with this very knotty problem, the suppression of interference. Perhaps Capt. White would care to come up here and give us some indication of what is happening.

Capt. J. WHITE, Johannesburg:

Mr. President, Gentlemen: In connection with the thorny problem of radio interference, I think most of you know there is a Bill, a new Radio Bill, before Parliament now. Under the regulations of that Bill, which have not yet been drafted, this question of radio interference looms very largely. I believe that the P.M.G. has convened a very large committee of all interested parties. I do not know whether this Association is represented, but that committee will deal with the drafting and promulgation of those regulations. The next step after that is to bring in the Bureau of Standards. As a result of the regulations, the Bureau of Standards will draw up specifications for the prevention of radio interference on all the various types of apparatus that cause that trouble, so that, although certain of your members get worried about this at the moment, I would merely ask them to exercise a little

patience. I think the matter will be dealt with in an official and in a legal way and in such a way that it does not put too big a load on the municipal engineer. In other words, there will be compulsory standards that will have to be lived up to and the maintenance of those standards will not fall on the poor municipal engineer but on the Bureau of Standards. I think that that really brings you up to date on this subject.

PRESIDENT:

Thank you, Capt. White. Gentlemen, in connection with what Capt. White has said about representation by your Association, I happen to be the unfortunate individual who is your representative on that Committee.

I wish to announce that the official photograph taken at the Green Point track on Tuesday is now available to be seen in the refreshment hall. Orders are being taken from those who would like a copy and it is desirable to have all names registered within the photograph. Please, gentlemen, during the tea interval will you make that a point, as a special request, to attend to this matter?

We are now under the item "General", gentlemen. Are there any further discussions on radio interference?

I will call on Mr. Smit, Inspector of Factories, to say a few words to you.

Mr. R. N. F. SMIT, Chief Inspector of Factories—Pretoria:

Mr. President, Gentlemen: First of all I want to repair an omission of mine on the first day of the Convention. I omitted to thank Mr. Fraser for his very concise and comprehensive report on the work of the Wiremen's Registration Board during the year 1950. As you know, Mr. Fraser is a very active member on the Board and we are deeply indebted to him for what he has done in connection with the work.

Secondly, we have had several enquiries during this Convention as to the determination of areas under the Wiremen's Registration Bill. The method of going about it is: Write to the Secretary, Wiremen's Registration Board, Private Bag 117, Pretoria. Put your case to them and it will be dealt with as soon as possible.

Finally, I want to thank you, Mr. President, and your Association for giving me the opportunity of attending this Convention, which I found most interesting and entertaining. Thank you very much indeed.

PRESIDENT:

Thank you, Mr. Smit.

Mr. A. R. SIBSON, Bulawayo:

Mr. President: I have a matter which I think is of interest to members. It concerns the new methods of building procedure which have been adopted in recent years by our architects. As you know, building costs have gone up and all parties concerned with the provision of housing are being urged to cut costs to the absolute minimum. Now, the architects have been fulfilling their duty in this respect by reducing progressively the size of the kitchens until they have invented what is known as a kitchenette and I rather think there is something even smaller than that in the offing. These very tiny kitchens have rendered it very difficult indeed for electrical engineers to enforce the regulations that used to be regarded as necessary for the safety of personnel working in them. As you know, the old wiring regulations provided that no plug point should be nearer than six feet from a water tap. The new draft regulations contain the same provision with the proviso also that it is possible in certain circumstances for special approval to be given for this six foot distance to be reduced and, in particular, reference is made to hairdressing saloons. Now, Mr. President, many of us have been faced with very strong requests from architects, builders and other persons concerned with housing to throw overboard the old regulations that we have enforced for so long in this regard and it is becoming increasingly difficult to resist the pressure. It has been alleged that we are holding up progress by maintaining our rigid requirements in regard to the distance between plug points and water taps; that we are causing the cost of living to remain at a high level and preventing other parties from playing their part in reducing it.

Now, it is a very knotty problem, Mr. President, but it is one which each one of us probably is being asked to solve at

the present time. The question really is more of a philosophical one, I suppose, than an engineering one and it really boils down to the proposition: should all possible measures be taken to protect human life; should the whole community have imposed upon it regulations which may be irksome and cause an increase in the cost of living for the sake of the few, possibly irresponsible people, who might fall into danger through carelessness from which we must ensure that they are protected. That is, as I say, Mr. President, a philosophical question, one that it is very difficult for us to answer, but I do suggest, as an ordinary man who happens to be an engineer, that we have possibly been inclined to be a little too rigid in our considerations of these safety precautions and that we have got to mix common sense with safety and ensure that whatever we do does not make life impossible for our consumers. It seems to me that we have reached a stage in this particular qustion of the design of kitchens where we must relax our old ideas and be prepared to march with the times and permit very much closer proximity of plug points: permit such things as the American kitchen, where you have a stove, a water sink, a refrigerator and many other electrical devices all combined into one neat chromium-plated piece of equipment which fails to comply with many of our regulations. I have been approached in no uncertain manner by the architects of Bulawayo to relax and I have only succeeded in putting them off by saying that it was my intention to consult my colleagues in the Union before considering the matter. That, Mr. President, I am now doing and it would, therefore, be of very great assistance to me and possibly to some others to have the views of those engineers who have had this problem placed before them and find out what steps they are taking to meet these demands.

PRESIDENT:

Thank you, Mr. Sibson.

Mr. C. FLETTERMAN, Electric Engineer, Ladybrand:

Mr. President, Gentlemen: I fully agree with the previous speaker, though I find that the appliance is more of a point of danger to the housewife than the outlet in the wall. Because, if outlets are at a certain distance and the housewife has a cord which is too long, she might still use the kitchen sink or a portion of the sink to get her ironing going. Standing next to the water tap, she still places the iron there at the same time. I find in small municipalities that the iron itself is more dangerous than the most dangerous outlet, because nowadays everybody sells electric appliances and they conveniently cut off the earthing terminal, as few houses have three-pin plugs and the earthing prong might not be earthed in old installations. If anything happens, the iron, etc., become alive. Of course things like these are very difficult, but would it not be possible that responsible people make sure by some means or other that irons, kettles, toasters and so on are earthed instead of conveniently having the earth taken off. Then, I think, that with the relaxation of this outlet and earthed irons, kettles, etc., will be very much safer.

PRESIDENT:

Thank you, Mr. Fletterman.

Mr. J. E. MITCHELL, Salisbury:

Mr. President: We in Salisbury have been faced with this difficulty of the small kitchenette, especially in these small bachelor flats, and we have been asked to approve of the combined kitchen unit comprising the stove, sink and the frige. We have actually relaxed in this instance possibly because flats are being built by the municipality, but we do feel that we have safeguarded the public who are going to live in these flats by adopting certain methods. The original regulations we had in Salisbury allowed this type of unit, providing it had an earth leakage relay, but we are not very satisfied about these relays because it is very difficult in these days, with the use of asbestos piping for water supplies, to get a decent earth, although in a large block of flats with a sub-station in possibly the basement or ground floor you can get an earth. What we have done to overcome this difficulty is that we have insisted that every piece of metal, that is, stove, stove plates, the sink, the taps—and when I say taps I mean the taps, because we find there is

quite an insulation in some of the points between the taps and the pipes themselves due to the packing that the plumbers put in—red lead and twine—and that gets over the difficulty because there are then no two pieces of metal in that kitchen which can ever get a difference of potential. If your earth is bad, you might get voltage on it, but you get no difference of the potential in the kitchen on any metal portion and therefore you do get a reasonable factor of safety. The only thing that becomes a difficulty then is in regard to the iron, because that is usually the only piece of apparatus which is sort of floating in the kitchen and what we have done there is we have asked them to use the kind of iron which is used in the Native quarters in Salisbury and that is the type where you actually have a place where the iron pushes in and the actual contacts which are made to heat the iron are right underneath the hole. If you push the iron in it makes contact and the iron heats up. You take it out and iron and, eventually, the iron gets cold; you push it in again until it heats up. It is exactly the same as the old iron the housewife used where she switches on and switches off. That, Mr. President, is how we have endeavoured to get over this difficulty.

PRESIDENT:

Thank you, Mr. Mitchell.

Mr. J. L. VAN DER WALT, Krugersdorp:

Mr. President, Gentlemen: In reply to our colleague from Ladybrand, he mentioned the regulations applying to appliances. I would refer members to my report on the activities of the Bureau of Standards. The Bureau of Standards has drawn up safety specifications for most household appliances. The intention is to recommend to the Minister of Economic Affairs to get these promulgated and, after promulgation, any such appliance not complying with the safety specification will not be permitted to be sold and in these safety specifications—they must not be mixed up with the quality specifications—care will be taken of the matter of earthing as mentioned by our colleague.

In connection with Mr. Mitchell's remarks about earth leakage relays, I am of opinion that this leakage relay, especially on the Reef where we have severe lightning storms, is a false sense of security because these earth leakage relays are very susceptible to lightning and offer no protection at all.

PRESIDENT:

Thank you, Mr. van der Walt.

Mr. C. R. HALLE, Pietermaritzburg:

Mr. President: I think we ought to keep this six foot regulation in regulations and that we engineers have got to try and work to it. The next problem we are going to get is from the person who is going to insist on a plug in the bathroom for his electric razor. Now, as progress goes on, I really can see the most peculiar things happening. Perhaps some kind person will complicate matters by inventing an electric tooth brush. Now, if the bathroom tap becomes a source of nuisance to us, we must try and get a plastic tap or plastic-covered tap. You know this mania for earthing produces quite a number of dangers. One of my enthusiastic inspectors came to me and said there was a barber's chair with exposed metal—should he earth it? Well, I thought of the poor barber, who, of course, would be using his electric clippers and, as it was a wooden floor, I thought it would perhaps be a kinder thing if the barber's chair was not earthed. I really do think we have got to be prepared to modify all our rules in the light of progress, but I feel that the primary safeguard of trying to keep the plug six feet away must stand. I got mixed up years ago in the Road Safety Association. which, of course, means propaganda and so on, the road being nearly as dangerous as the electrical kitchen; and I feel that we will just have to apply propaganda in the home more if we find that by relaxing regulations we are increasing the dangers but I am certain we can't get any rigid decision here that is going to make life absolutely safe.

PRESIDENT:

Thank you, Mr. Hallé. Gentlemen, we will now adjourn for tea.

Conference resumed.

PRESIDENT:

Gentlemen, we will now continue our discussions. We are ready to continue under "General".

Mr. F. STEVENS, Ladysmith:

Mr. President: We have heard a lot this morning and at other Conventions about safety precautions and wiring regulations. When one travels about one sees a lot of wiring work being carried out which does not comply with any regulations, yet it is known that those installations come under the jurisdiction of some local authority.

I heard of an instance the other day of where an electric water heater had been installed with one wire connection only, that is, no return wire. I was assured that it had been inspected and tested.

Now, Mr. President, I feel that there ought to be an appeal made to all concerned to see that the fundamental safety requirements are met on installations under their control. It seems ridiculous for us to come here and split hairs over regulations if occurrences such as the one I have just mentioned are allowed to take place. Whether there should be six feet clearances in the kitchen or not is of little importance compared with the dangerous practice of permitting a water pipe to be used as a return conductor.

Thank you, Mr. President.

PRESIDENT:

Thank you, Mr. Stevens.

Mr. A. R. SIBSON, Bulawayo:

Mr. President, Gentlemen: I want to thank those speakers who have attempted to throw a little light on the problem I raised earlier this morning. We have not solved it, of course, because it is not one of those problems which are susceptible to easy solution. It had been suggested by somebody that the answer to the whole problem of kitchens was the use of the three-pin plug. Well, this in my view is not the solution of the problem at all. I understand that in one of the largest towns in Southern Africa the only two fatalities that have been known to have been caused by electrical appliances took place because of the use of three-pin plugs which were actually introduced with the idea of ensuring safety. It is quite obvious, gentlemen, how this can happen. Provided the three wires of the flex are properly connected, there can be no doubt that the three-pin plug does provide a very large measure of security, but the proviso is a very important one, since very often the repair of flexes, when they have got a little worn, is in the hands of our duskier brethren who preside over affairs in the kitchen and who are inclined to be extremely curious in matters electrical, but somewhat lacking in colour sense when examining the colours of the cores in the cables. At any rate, they may connect the apparatus in such a way that the external metal is actually connected to the phase and the earth wire is connected to one of the ends of the element. Under those circumstances, of course, you have the most marvellous lethal weapon one could imagine. Also in the event of a fault on one piece of apparatus in an installation where the earthing is faulty, not only that apparatus but every other part of the installation which is bonded to the same earth system is equally alive. So that the use of three-pin plugs is not an answer to the problem unless you can ensure that the apparatus is invariably worked on by somebody who is competent and capable of distinguishing the colours of wires and who knows what the implication of those colours is. There is therefore no answer, Mr. President, to this problem except possibly the most expensive one of ensuring that no electricity is ever used inside the house unless the voltage is 25 volts or less. The cost of such a proposition is enormous and it seems to me to be unwarranted.

During the early history of the development of the electricity supply industry, we were faced with the competition of such people as gas companies, who invariably pointed to the mysteries of electricity as a very real and vital danger to the public. It was their best piece of propaganda and since we were trying to sell our product to a largely unwilling public, we had to fight any such propaganda methods and attempt to ensure that they were wrongly founded. We therefore adopted the policy of framing regulations that made it quite impossible, or as near impossible as we could think, for any accident ever to take place. Had electricity been as old as gas, we would by now have accepted the hazards associated with its use, which I think are no greater than those applicable to the gas industry and certainly no greater hazard

any civilised man has to face if he has to get to his office in the morning. If, as I say, electricity was an older art than it is we would have forgotten all those things by now and our people would be being electrocuted instead of gassed, or cut to pieces by trucks on the road. It is a fairly easy death, I suggest, Mr. President. I don't think it is as painful as some of the deaths one can visualise. But to be serious, there is a limit which we should impose upon ourselves in regard to the degree of expense which we are prepared to bear to approach the impossible ideal of ensuring that no single member of the community can under any circumstances suffer damage and I therefore suggest that the time has come for us to relax somewhat and adopt other methods of encouraging safety in the home. Those other methods should be the greatest possible propaganda and publicity, instructing people who use electrical apparatus of its risks and how they could be avoided.

We have been rather loth to do this in the past because we did not want to draw attention to the fact that there were any risks at all. We did not want our particular product to be associated with danger. We were so sensitive about the thing and about the propaganda that had been used against us that we were anxious on all occasions to keep quiet and never let it be known that there was any danger attached to the use of electricity. If I may reiterate, Mr. President, our policy now might be that instead of attempting to make rigid regulations to ensure that absolute safety is assured for all, including the congenital idiot, we should take the most active steps to propagandise the dangers that are inherent in the use of electricity and to ensure that all those people who use it are acquainted with those dangers and take reasonable precautions to safeguard themselves from them.

PRESIDENT:

Thank you, Mr. Sibson.

Mr. C. LOMBARD, Bloemfontein:

Mr. President, Gentlemen: Quite a few of us here, I am sure, would be interested to know whether the Department of Labour has given any consideration to the possible revision of some of the requirements of the Factories Act concerning the construction of overhead lines to bring them more into line with the new Code of Practice for Overhead Lines.

PRESIDENT:

Thank you, Mr. Lombard. I would like to bring one matter forward, if I may, which has been discussed by the Reef Electrical Engineers, which I had hoped that the members present would have raised themselves: it is the question of multiple earthing of an underground system. Perhaps the members who are here now would like to bring the matter forward and express their views.

Would you care to speak on the matter, Mr. Barton?

Mr. R. W. BARTON, Welkom:

Mr. President and Gentlemen: The question of multiple earthing arose at Welkom through a neutral connection breaking in a sub-station and causing damage to domestic equipment. We had approximately 15 refrigerators and wireless sets burnt out and the question then arose as to whether it might not be a good idea to earth each consumer's neutral and then, in the event of any neutral break, there would be no possibility of excess voltage being applied to domestic appliances. This has already been introduced at Welkom, which is one of the reasons why I did not bring the matter up at this Convention. I originally brought it up at one of the Reef meetings and requested members to contribute to the discussion as I wanted to know whether they had experienced any disadvantages when using such an arrangement. I had introduced it before on an overhead line system for lighting protection, with very good results, but in the case of an entirely underground system I wondered whether there were any disadvantages. The only one that was mentioned (by Mr. Kane, of Johannesburg) was the question of an earthing system becoming alive and there is that possibility, of course, but in my opinion these earth voltages would probably not amount to much. I have undertaken to carry out some tests in this connection, but so far I have not had the time. If there is any member present who has had experience of multiple neutral earthing and knows of any dis-

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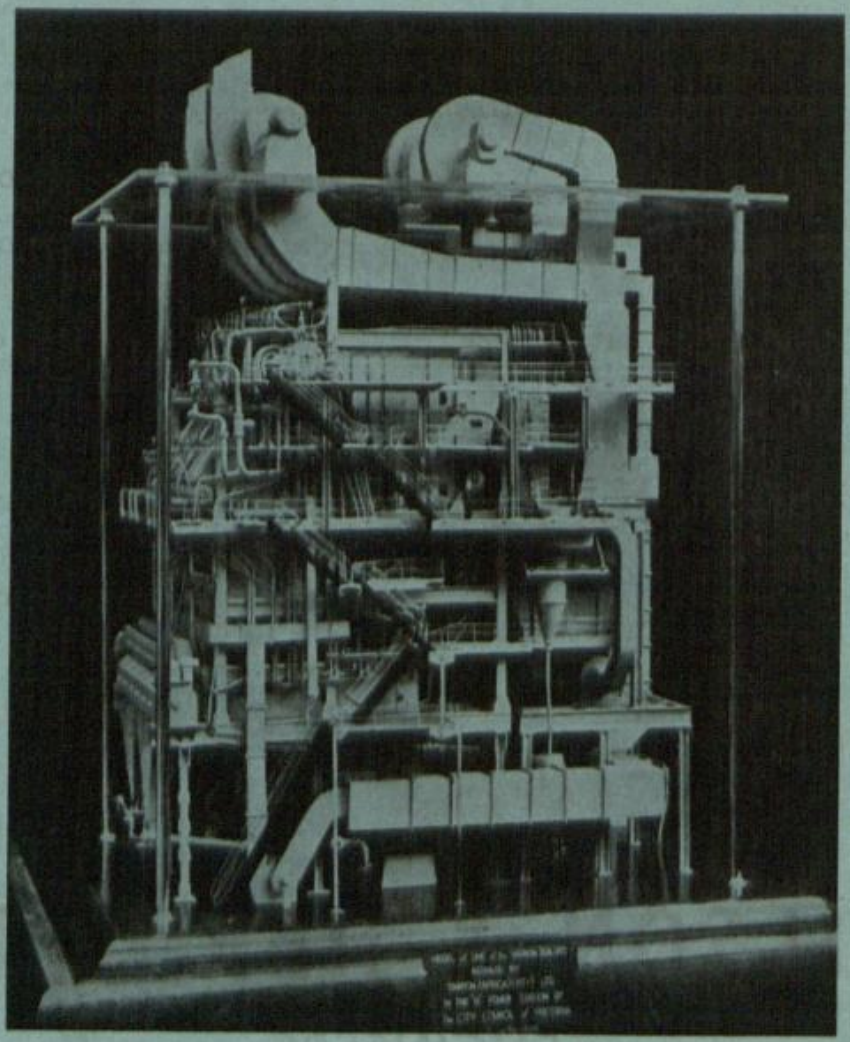

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advantages other than the one mentioned, I think most of us would be interested to know.

PRESIDENT:

Thank you, Mr. Barton.

Mr. R. N. F. SMIT, Chief Inspector of Factories:

Mr. President: In connection with Mr. Lombard's question, every case in connection with overhead lines which is submitted to our Department is very carefully gone into and each one is dealt with on its merits. I can say no more.

PRESIDENT:

Thank you, Mr. Smit.

Mr. F. P. W. HALL, Somerset West:

Mr. President, Gentlemen: Regarding the earthing of the neutral, I had a most unusual case recently. The supply to a butcher shop had the neutral link earthed in the butcher's shop and men working in that area disconnected the live wires in that street but the neutral was left through; then I got complaints that people were getting shocks all over the butcher shop. Everything had become alive. There was obviously a feed back, giving a shock of about 50 volts. It is possible it was due to the street neutral being, I think, a No. 10 gauge wire, which is ridiculously small. This is one example where you can have, not dangerous, but possibly unpleasant conditions. I definitely recommend that the neutral should be earthed to each separate pole according to the Electricity Regulations which, I understand, call for each metal pole to be earthed. The easiest way, I think I have seen it in Johannesburg, is using cast-iron so-called "insulators" for earthing neutrals. Another possible way would be to use a copper sleeve bolted to the pole to carry the neutral. In one case where the neutral was solidly bonded to a pole top, I remember noticing that an appreciable current was flowing between the neutral and the top of the pole judging by the flash when connecting up. This shows you can have very large circulating earth currents between different parts of a town when you are working with very large amperages.

PRESIDENT:

Thank you, Mr. Hall.

Mr. F. STEVENS, LADYSMITH:

Mr. President: Multiple earthing of the neutral has been practised in Ladysmith for over ten years, but we are most particular to see that when we do multiple earth the neutral that it is solidly earthed both ends. By this I mean that there is an earth within one ohm both ends. If we are not satisfied with the earthing, we do not hesitate to run an insulated neutral. I do not think there is anything further to add.

PRESIDENT:

Thank you, Mr. Stevens.

Mr. D. A. BRADLEY, Port Elizabeth:

Mr. President, Gentlemen: There is one matter which has been of concern to Port Elizabeth recently. We had a fatality through an unearthed roof becoming "alive". I referred the matter to the Inspectorate of Machinery and as yet have had no definition of what they acclaim to be done, but, of course, there is a Government regulation which states that all metal roofs shall be earthed. The matter was discussed at a conference that I called of electrical contractors in Port Elizabeth and their point of view was that the owners or tenants of the property were not prepared to pay the costs for the necessary "earthing" of roofs. They did not see any reason for it because they had not had any fatality; they had had no trouble and why should they go to any expense in that connection! The matter is very serious in that the law says we shall have the roofs "earthed". The older properties which constitute the great majority of the properties in any city today have no "earthing" on their metallic roofs and the matter I think may be ventilated here as to whether the law should be enforced and compulsion brought about to give effect to that law or whether it should be done as and when the owner is prepared to pay for it to be done. To cite an incident: one of the contractors about to install an electric stove—a new installation entirely—told the owner that he had been advised by me to have the roof "earthing" effected. The owner refused. A second

contractor was brought on the job, who did not mention roof "earthing" and, consequently, quoted a lower price; he got the job and the job was put in. When my Inspector went along and questioned the owner about the "earthing", he was told: "We don't do anything that is not required; we are not paying money today for work that is not necessary". So there is the position where one contractor may get the work at lower cost and the man who is trying to do the job in accordance with the regulations is turned down because of the higher cost. I wonder whether any members here have had any trouble about roof "earthing" in their particular Undertaking.

PRESIDENT:

Thank you, Mr. Bradley.

Mr. F. STEVENS, Ladysmith:

Mr. Chairman: Speaking to the point Mr. Bradley has raised, that is, the question of "earthing" of roofs. During the last two or three years we have run with our overhead connections to houses earth wires connected to the multiple earthed mains neutral. That is to say, we run a phase wire and neutral, both of which are insulated, and in addition a third wire as an earth wire, which is connected to the roof and the installation. I do this as I am of the opinion that if we wait for all consumers to provide means for earthing their roofs, it will be years before they are all done.

Where there is an insulated mains neutral which I spoke of, earlier, we have, in addition, a separate mains earth wire, from which we connect the third wire to the roof and parts of an installation that have to be earthed.

Thank you.

PRESIDENT:

Thank you, Mr. Stevens.

Mr. R. N. F. SMIT, Chief Inspector of Factories:

Mr. President and Gentlemen: I would like to read Regulation 76 (2): "A supplier shall satisfy himself that all metal roofs of buildings in which electricity is used are adequately earthed before supplying current." So far as I can see, the supplier has the matter entirely in his own hands. He must disconnect. I think that is the answer.

PRESIDENT:

Thank you, Mr. Smit.

Mr. D. A. BRADLEY, Port Elizabeth:

Mr. President, Gentlemen: The point at issue is that it is not the new installations only that are to be "earthed", it is the existing or older ones that have probably been in use for thirty odd years. To have a visit made to each installation and prove the effectiveness of the "earthing" is a tall order and I don't know whether there are enough Inspectors on the staff to do that. It is a point as to whether we should enforce a given time limit when these measures have to be certified, in some way or other, that "earthing" connections have been attached to all metal roofs. That is the point. All the overhead services always have been necessarily and properly "earthed" by the Council when installed, but it is the older premises we are concerned with in safety precautions. Where the fatality occurred the supply was from an underground service and it is presumed that someone who just didn't care had taken a flex connection from the kitchen. through the window, and tied it up to the guttering for the supply to an outside light. That was the cause of the down-pipe becoming "alive" and through that, of course, the roof. The fatality occurred actually by the lady going to hang clothes on the clothes line. So the point is whether a stated period should be made to have the "earthing" regulation effective on all existing houses which may include installations of thirty odd years of age. If I take it that Mr. Smit's determination this morning is to be brought about, then quite a lot of Port Elizabeth residents will have no lights next week and I shall be a very popular fellow. I will be able to build up a coal supply; it is quite a good, if ironical, suggestion. Sir, I owe a debt to the Inspector of Machinery for some lead in this contentious matter.

PRESIDENT:

Thank you, Mr. Bradley

Mr. H. A. EASTMAN, Cape Town:

Mr. President: I wonder whether it is realised, judging by the discussion we had this morning, that the "earthing" of a roof, a galvanized iron roof, for example, is in itself introducing a source of danger which would not exist if the roof were not "earthed". When the regulation in its present form was under consideration, together with all the other regulations which are now printed for our instruction, guidance and use, our Association was given a draft copy for the purpose of commenting on them. One of the comments made in connection with this matter was that it was completely out of the power of the Municipalities to ensure that corrugated iron roofs were properly "earthed" and representations were made that the "earthing" of the roof was introducing a source of danger that did not otherwise exist. It was suggested that the proposal to "earth" the roofs emanated not so much from the standpoint of supply of electricity but from that of the supply of electricity from the clouds, such as lightning or static charges. That the Supply Authorities should have the responsibility for ensuring that the roof was properly "earthed" we said was wrong and could not be enforced in practice.

PRESIDENT:

Thank you, Mr. Eastman.

Mr. W. G. THACKWRAY, Kokstad:

Mr. President: I think it is the generally accepted procedure to expect the wiring contractors to do the work of "earthing" roofs.

I would like to know whether any of the engineers permit other contractors—building contractors or plumbers—to execute this work.

We recently had an incident where the electrical contractor came along very concernedly wanting to know what the procedure was. The plumber, working for a firm in a neighbouring town, said the electrician was taking their work.

Building contractors usually undertake the work of installing lightning conductors and it is possible that some may try to encroach on the recognised work of electrical contractors. If so, this could lead to some confusion when the time came for inspection and test.

PRESIDENT:

Thank you, Mr. Thackwray.

Mr. W. T. ATTERIDGE, Somerset East:

Mr. President: In connection with the disconnection of consumers who break the bye-laws, I would like to state that in our town we have a number of old houses, about 25 per cent, and if I had to enforce the regulations very strictly I think I would not get enough money in to pay for the power station. I can only state that I am all in favour of the regulations being enforced and I would try to do my best to get them enforced, but we cannot take a high hand and go round and disconnect everybody. It can't be done. I have had an incident where I went into a house to inspect the wiring and found that it was not according to the regulations. I asked the occupant would he fix it up please. He said: "Well, this was passed by an engineer, passed by an inspector a number of years ago, say ten years ago, and I don't see what is wrong with it now". Well, as far as I was concerned it was wrong. Then he said: "If you maintain that it is wrong, why does the Municipality not re-wire the house itself?" That is the kind of question we get and I think we should treat this matter with discretion, but should eventually make everybody comply with the regulations. To get that cooperation, I usually discuss with the man the possibility of the house burning down or his daughter getting killed by an electric shock, which eventually gets him interested and results in the job being done. I think we could as an Association carry out a little propaganda on these lines. Another matter we come across in small towns (I would just like to raise the matter) is the question of the small lighting plants that are installed on farms. They are 220 volts, and usually are not installed safely. It is not my job, but I think I have to advise the people accordingly.

PRESIDENT:

Thank you, Mr. Atteridge.

Gentlemen, I have been asked to announce to you that there is a demonstration in the offices of the E.S.C. on the

7th floor, Grand Parade Centre, of an alarm system which Mr. Dennis, the Assistant to the E.S.C. Distribution Engineer, has devised to indicate at a distant point any trouble or fault that may occur in a sub-station. Mr. Dennis will be very pleased to demonstrate this system to anyone who might be interested.

CONCLUSION

Mr. E. VIVIAN PERROW, Johannesburg:

Mr. President, Gentlemen: First of all, I should like to thank you and your Executive for the very kind invitation extended to me as Chairman of the Safety Precautions Committee to be with you at this Convention. It has been a most interesting week and, I am sure we are all agreed, a particularly successful one.

I have also been asked by the President and Council of the South African Institute of Electrical Engineers to extend their felicitations and best wishes for the continued success of your Association. Our President, Mr. Lineker, was unable to accept your invitation and I have been requested to represent him and the Institute at this Convention.

Finally, I should like to congratulate you, Mr. Downey, on your election to the presidential chair of this Association, having known you for a long time as a hard worker, particularly in committee work. I trust that you, as President, and your Association will have a very successful year.

PRESIDENT:

Thank you, Mr. Perrow.

Mr. J. C. FRASER, Johannesburg:

Mr. President and Gentlemen: On behalf of the Institute of Certificated Engineers, I have to convey the President's and the Executive's good wishes to you, Sir. Mr. Campbell Pitt, the President, was very sorry he could not be present himself and he asked me if I would convey his good wishes to you and he wishes you a successful year of office.

PRESIDENT:

Thank you, Mr. Fraser.

Mr. W. H. MILTON, Electricity Supply Commission (Johannesburg):

Mr. President and Gentlemen: I have been asked by the Chairman of the Electricity Supply Commission, Johannesburg, and the Joint General Managers, Messrs. J. S. Trelease and G. R. D. Harding, to convey to you their good wishes for the continued successful operation of the Association and to wish you a very successful year of office. Unfortunately, neither of these two gentlemen was able to make the trip down here due to the amount of work we have in hand now.

Mr. Jagger has also asked me to convey to you the same message of good will. He was unfortunately unable to be present this morning because he is not feeling too well and Mr. Damant also has had to leave in view of an urgent appointment which he had made for 12.30 and which he had to keep. Thank you very much.

PRESIDENT:

Thank you, Mr. Milton.

Mr. J. M. MAGOWAN, Electricity Supply Commission, Southern Rhodesia.

Mr. President and Gentlemen: On behalf of the Chairman and Commissioners of the Electricity Supply Commission of Southern Rhodesia, I thank you, Mr. President, and your Association for the kind invitation to send a representative to this Convention. I have thoroughly enjoyed my stay in Cape Town both from the point of view of attending the meetings and the occasions we had to meet thereafter.

Whether one is an Engineer engaged in Municipal Service or associated with some other form of Power Supply Authority, the problems are all very much the same. Conventions of this nature do give us the opportunity of getting together and discussing these problems both in conference and outside. I was particularly interested in the reports of the sub-committees dealing with Wiring Regulations and also the South African Bureau of Standards. My Commission is at the the moment, in conjunction with certain Municipalities, modifying their Wiring Regulations or, more correctly, drawing up new Regulations and we are finding that the assistance

given by an Association such as yours is extremely helpful. I am very pleased to know that the venue of the next Convention is Southern Rhodesia and I look forward to seeing all of you there. Thank you.

PRESIDENT:

Thank you, Mr. Magowan.

Dames en Here: Voordat ek die Burgemeester van Springs vra om 'n paar woorde te sê, wil ek u een en almal baie hartlik bedank vir julle saamwerking en ondersteuning waarsonder ek sekerlik nie my moeilike taak sou kon verrig het nie. Baie dankie.

Ladies and Gentlemen: Before asking the Mayor of Springs to speak I wish to thank you one and all for your co-operation and support which has lightened my task considerably.

Councillor R. H. TAINTON, His Worship the Mayor of Springs:

Mr. President, Ladies and Gentlemen: On behalf of the Council, delegates and guests, I wish to pay tribute to our hosts and the officials who made this such a pleasant Conference. Sir, I heartily congratulate you on your election to this high office. You have always proved to be a glutton for work and your energy, ability and doggedness are particuarly welcome at this time when this Convention of Municipal Undertakings has important issues to face. With the confidence we have in you and your Association, I am sure the controversial issues will be met with determination and resolution. It must be appreciated that the Undertakings your members control and guide are of permanent and paramount importance. To a young country such as this, the striving to gain a recognised foothold in the industrial world as professional and unbiassed men, your impartial viewpoint will go a long way to combat the undemocratic, warped material which is a breeding ground for monopolies and many worse things that we catch glimpses of in our time. We welcome the liaison between the many Government Departments and I think this would be more closely knitted if the powers that be would take an Association of this description into their confidence as to their intentions. I think that is very important. My town is greatly honoured in our Electrical Engineer being elected President and I thank your colleagues for this honour.

To the Mayor and citizens of Cape Town we are most grateful for their generosity and hospitality, for their indefatigable efforts to satisfy our pleasures and comforts; for the delightful way they have treated the delegates and the ladies who have accompanied us; for the opportunity of admiring the serenity and the maturity of this beautiful mother city and the vitality which is so evident in industry and commerce.

I also wish to thank Stellenbosch and Paarl for the hospitality of yesterday. It is one of the memories we will carry away with us and always remember. In our short sojourn here, I am sure the delegates and visitors will agree, we are greatly impressed by the skill and the speed of the motor traffic and the wonderful dash and agility of the pedestrians. This, I am sure you will agree with me was a direct contrast to a certain building we visited in this city where we watched the detached indolence of its members.

To the Engineers and their staffs and local officials we are most grateful for their organisation and care, particularly in the attention to our ladies, who have asked me to convey their thanks for this wonderful visit.

I must say we appreciate the presence of our ladies. They added charm to this Convention and a safety code of conduct.

To this city and the many parts we have visited, we thank you for everything. To you, Mr. President, and your Association, we say we have enjoyed the Convention and wish you and your Executive a most successful year.

I formally move a hearty vote of thanks to our hosts for the hospitality and the great work they have done to make this Convention such a great success.

Councillor C. M. NEWMAN, Bulawayo:

Mr. President: I would like to second the resolution of thanks that His Worship the Mayor of Springs has just put before you. I associate myself, particularly as a pedes-

trian, with many of his remarks. I am also very grateful that I have been able on this occasion to speak for the rest of the Rhodesians here from Northern and Southern Rhodesia, who have come a very long way to attend this Convention, for the hospitality, the happy hospitality, the generous hospitality, which the Mayor and all these ladies and gentlemen have given us. Yesterday, when we experienced the hospitality also of Paarl and Stellenbosch, was a happy day and a useful one, making a break in the sterner subjects that were being discussed.

Next year you are coming to Bulawayo and I hope there will be a very large contingent of people from Cape Town, so that by deeds, rather than words, we can reciprocate the hospitality we have received. I have much pleasure in seconding the resolution of His Worship the Mayor of Springs.

Mr. C. G. DOWNIE, Cape Town:

Ladies and Gentlemen: The Electricity Department of this city thought fit to make a momento to honour the occasion of Mr. J. C. Downey's visit to this city and for so ably conducting himself as President of this Convention. He has come here with a big reputation as a Chairman of the Rand Electricity Undertakings and when we wondered what we should present to him as a momento for his visit to this city, we had one of these things, a gavel, suitably inscribed and, on behalf of the Electricity Department, Mr. Downey, I have very great pleasure in presenting this gavel to you.

Mr. E. R. J. SMITH, Secretary, S.A. Cable Makers' Association:

(Communicated.)

Mr. President: As circumstances prevent my being present at your final session this morning, will you please, in your capacity as President, accept and convey to your members my most sincere thanks for once again having given me the opportunity of attending your Convention on behalf of the South African Cable Makers' Association.

As in past years, I personally have derived great pleasure from my visit to your Convention and have found my relationships with your members stimulating and exhilarating.

On behalf of the South African Cable Makers' Association, I assure you that both the Association and its members are at all times anxious to be of assistance to the Electricity Supply Undertakings and if I can be of service to your members I trust they will not hesitate to get in touch with me.

Mr. A. C. TILLEY, Chloride Electric Storage Co. (S.A.) Pty.) Ltd.:

Mr. President: On behalf of the delegates of the engineering firms present at this Convention, I wish to convey to you, to members of the Association and to the City Council of Cape Town our sincere thanks for the hospitality extended to us and also the most interesting discussions which took place.

PRESIDENT:

Mr. Downie, Ladies and Gentlemen: This is indeed a very pleasant surprise and I am deeply grateful. Apparently the reputation of Reef Electrical Engineers cannot be a good one as, by the very nature of this momento, you will notice that this mallet head is even larger than the one we have used for the Convention, which shows that apparently a great force is required to keep the Reef Engineers in order.

I wish to thank you, Mr. Downie, for this very fine gift and can assure you that it will always be treasured as a reminder of you and the happy Convention held here. I thank you most heartily.

It is now my duty to declare this Twenty-fifth Convention held in Cape Town closed.

Thank you, ladies and gentlemen.

SOCIAL FUNCTIONS

The social functions arranged for delegates and their wives were many and varied and the perfect sunny autumn weather which prevailed throughout the Convention Week contributed in no small measure to their success.

After a full day's work at Sea Point on Tuesday, the 8th May, delegates were taken to the City Hall, where they were

entertained by His Worship the Mayor, Councillor C. O. Booth, J.P., at a civic cocktail party. This proved to be a most enjoyable function and gave delegates the opportunity of meeting and becoming acquainted with others attending the Convention as well as interested friends connected with Electricity Supply matters in Cape Town. In all some 400 persons were present on this occasion. The Grand Hall was very effectively illuminated and a dance band in attendance provided the necessary accompaniment for the more energetic members of the gathering who desired to dance.

On Wednesday morning about thirty of the lady visitors attended the weekly cookery demonstration at Electricity House. Mrs. Williams, the Chief Demonstrator on the staff of the Cape Town Electricity Department, gave the visitors some very useful tips on cake baking and all present were unanimous in their decisions that it was a morning well spent. During the afternoon of that day a party of forty-six ladies and ten delegates enjoyed a bus trip round Chapman's Peak. The breeze off the sea was inclined to be chilly, which made the tea served at the Muizenberg Pavilion doubly welcome. In the evening delegates and their wives joined a cinema party at the Odeon Theatre.

An early start was made on Thursday, when the Convention adjourned to the country as guests of the Stellenbosch Municipality. The thirty-mile run to Stellenbosch through the Cape countryside, was a very pleasant one and the party arrived at the Town Hall in time for morning tea at 10.15. After being welcomed by the Deputy Mayor, Councillor G. P. Blake, the Convention resumed and the ladies were taken on a sightseeing trip round Stellenbosch, visiting the Jonkers Hoek Fish Hatcheries and other places of historical interest. On their return a most enjoyable luncheon was served in the beautiful Town Hall.

The whole party left Stellenbosch at 2.30 p.m. and journeyed to Fransch Hoek to visit the Huguenot Memorial. From here the route lay along the fertile Fransch Hoek Valley to Paarl, where the Mayor of that town, Councillor J. F. Knott-Craig, entertained delegates to tea at the Central Hotel. Delegates were loath to leave such pleasant country surroundings, but eventually the party got under way again and returned to Sea Point after a day that was thoroughly enjoyed by all.

On the Friday morning, forty ladies journeyed by bus to the National Botanical Gardens at Kirstenbosch, where morning tea was served in most pleasant surroundings. Unfortunately, owing to lack of time it was not possible to see anything of the Gardens, but these will remain a treat in store for the ladies on the next occasion that the Convention meets in Cape Town.

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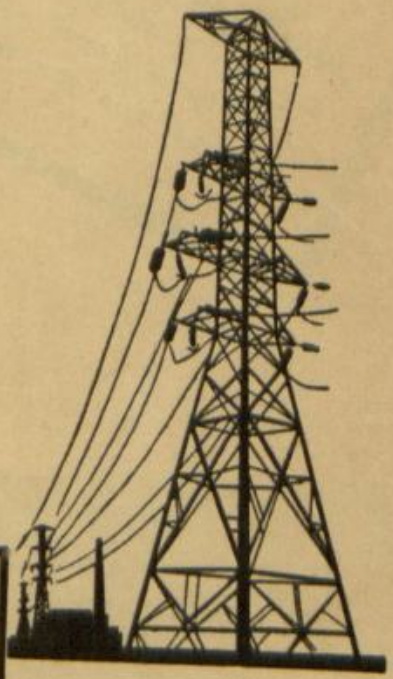

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