PROCEEDINGS of the 33rd CONVENTION

OF THE

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA

(FOUNDED 1915)

HELD AT

JOHANNESBURG

12th to 15th MAY, 1959

VERRIGTINGS van die 33ste KONVENSIE

VAN DIE

VERENIGING VAN MUNISIPALE ELEKTRISITEITS-ONDERNEMINGS VAN SUIDELIKE AFRIKA

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JOHANNESBURG

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PRICE 20s. PRYS

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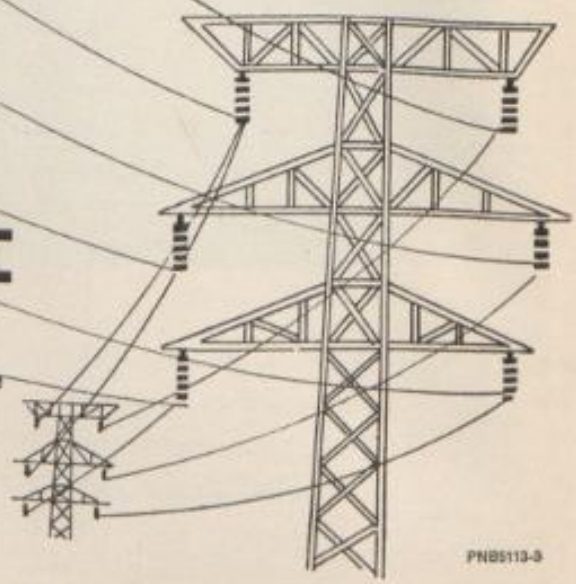

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Worcester, C.P., Municipality, P.O. Box 37.

ENGINEER MEMBERS/INGENIEUR-LEDE

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Aalbers, G., Municipal Electrical Engineer, P.O. Box 12, Wellington, C.P.
Adams, C. H., Municipal Electrical Engineer, P.O. Box 19, Somerset West, C.P.

Beard, G. R., City Electrical Engineer, P.O. Box 176, Grahamstown, C.P.
Barnard, F. J. W., Town Electrical Engineer, P.O. Box 113, Potchefstroom, Tvl.
Barratt, V. E. O., Municipal Electrical Engineer, P.O. Box 113, Queenstown, C.P.
Barton, R. W., Electrical Engineer, P.O. Box 708, Welkom, O.F.S.
Beesley, W., Town Electrical Engineer, P.O. Box 29, Livingstone, N.R.
Benson, T., Town Electrical Engineer, P.O. Box 35, Matatiele, E.G.
Booysen, L., Town and Electrical Engineer, P.O. Box 155, Vrede, O.F.S.
Brown, D. D., Municipal Electrical Engineer, P.O. Box 217, Roodepoort, Tvl.
Brown, D.C., Town Electrical Engineer, P.O. Box 21, Odendaalsrus, O.F.S.
Bellingan, G. F., Town Electrical Engineer, P.O. Box 59, Windhoek, S.W.A.
Botes, P. J. Assistant Electrical Engineer, P.O. Box 217, Roodepoort, Tvl.

Clarke, M. P. P., Municipal Electrical Engineer, P.O. Box 21, Somerset East, C.P.
Cherry, J. R., Municipal Electrical Engineer, P. O. Box 139, Randfontein, Tvl.
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Cowley, B. W., Municipal Electrical Engineer, P.O. Box 33, Barberton, Tvl.
Craig, J. S., Borough Electrical Engineer, P.O. Box 21, Newcastle, Natal.

Dunstan, R. S., Deputy City Electrical Engineer, P.O. Box 369, Port Elizabeth, C.P.
Dawson, J. D., Municipal Electrical Engineer, P.O. Box 45, Uitenhage.
De Villiers, E. E., Municipal Electrical Engineer, P.O. Box 3., Witbank, Tvl.
De Villiers, S. de V., Municipal Electrical Engineer, P.O. Box 52, Robertson, C.P.
De Wet, D. P., Municipal Electrical Engineer, P.O. Box 15, Willowmore, C.P.
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, H. C., Assistant Electrical Engineer, P.O. Box 94, Krugersdorp, Tvl.
Dreijer, D. V. S., Town Electrical Engineer, Tarkastad, C.P.
Dreyer, H. C., Town Electrical Engineer, P.O. Box 19, George, C.P.
Durr, H. R., Electrical Engineer, Peri-Urban Areas Health Board, P.O. Box 1341, Prtoria, Tvl.

Erikson, J. G. F., Borough Electrical Engineer, P.O. Box 15, Estcourt, Natal.

Fisher, K. M., Municipal Electrical Engineer, P.O. Box 551, Bethlehem, O.F.S.
Futcher, L., Municipal Electrical Engineer, P.O. Box 13, Kempton Park, Tvl.
Fohren, H., Borough Electrical Engineer, P.O. Box 37, Eshowe, Zululand.

Gericke, J. M., Municipal Electrical Engineer, P.O. Box 99, Klerksdorp.
Giles, P. A., City Electrical Engineer, P. O. Box 529, East London, C.P.
Grandin, P. C., Municipal Electrical Engineer, P.O. Box 114, Gatooma, S.R.

Hadfield, A. W. K., Town and Electrical Engineer, P.O. Box 278, Gwelo, S.R.
Hafele, C. F., Deputy City Electrical Engineer, P.O. Box 288, Bloemfontein, O.F.S.
Haig-Smith, D., Municipal Electrical Engineer, P.O. Box 55, Middelburg, C.P.
Halliday, K. W. J., Municipal Electrical Engineer, P.O. Box 5, Port Shepstone, Natal.
Harvey, A. O., Town Electrical Engineer, Warmbaths, Tvl.
Hattingh, J. D., Municipal Electrical Engineer, P.O. Box 8, Rouxville, O.F.S.
Hatwich, A. H. J., Town and Electrical Engineer, P.O. Box 13, Dewetsdorp, O.F.S.
Heunis, G. B., Town and Electrical Engineer, P.O. Box 66, Standerton, Tvl.
Hobbs, I. L., Town Electrical Engineer, P.O. Box 156, Virginia, O.F.S.
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.

Jones, G. E. H., Municipal Electrical Engineer, P.O. Box 42, Mafeking, Bechuanaland.
Joubert, J., Town Electrical Engineer, P.O. Box 48, Ermelo, Tvl.

Kane, R. W., General Manager, Electricity Department, P.O. Box 699, Johannesburg.
Kirberger, M. N., Town Engineer, P.O. Box 3, Bethal, Tvl.
Kruger, M. J. C., Municipal Electrical Engineer, P.O. Box 13, Port Alfred, C.P.

Lategan, J. F., Town Electrical Engineer, P.O. Box 17, Stellenbosch, C.P.
Lees, D., Town Electrical Engineer, P.O. Box 45, Benoni, Tvl.
Leishman, R., Deputy General Manager, Electricity Department, P.O. Box 699, Johannesburg.
Lewis, L., Town Electrical Engineer, P.O. Box 25 Mossel Bay, C.P.
Lombard, C., City Electrical Engineer, P.O. Box 145, Germiston, Tvl.
Lotter, G. A., Town Electrical Engineer, P.O. Box 96, Louis Trichardt, Tvl.
Lynch, E. C., Assistant City Electrical Engineer, P.O. Box 73, Salisbury, S.R.

McIntyre, H. A., Asst. Town Elec. Eng., P.O Box 35, Vereeniging.
Macques, J. A., Municipal Electrical Engineer, P.O. Box 42, De Aar, C P.
Martinson, W. A., Municipal Electrical Engineer, P.O. Box 45, Nelspruit, Tvl.
Mathews, J. A., City Electrical Engineer, P.O. Box 194, Kimberley, C.P.
Meintjies, P. A., Municipal Electrical Engineer, P.O. Box 16, Rustenburg, Tvl.
McGibbon, J., Municipal Electrical Engineer, P.O. Box 197, N'Dola, N.R.
Mitchell, J. E., City Electrical Engineer, P.O. Box 73, Salisbury, 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.
McNeil, J. L., Borough Electrical Engineer, P.O. Box 72, Stanger, Natal.
Millen, T. J., Town and Elecrical Engineer, P.O. Box 24, Tzaneen, Tvl.

Naisby, R. N., Assistant Town Electrical Engineer, P.O. Box 708, Welkom, O.F.S.
Nobbs, D. M., City Electrical Engineer, P.O. Box 369, Port Elizabeth.
Odendaal, M. W., Town Electrical Engineer, P.O. Box 4, Alberton, Tvl.

Paull, R. A., Municipal Electrical Engineer, P.O. Box 57, Umtata, Tembuland.
Potgieter, N. A., Municipal Electrical Engineer, P.O. Box 106, Brits, Tvl.
Pretorius, D. R., Town Electrical Engineer, P.O. Box 39, Parys, O.F.S.

Rautenbach, G. F., Electrical Engineer, P.O. Box 13, Burgersdorp.
Redman, R. H., Deputy City Electrical Engineer, P.O. Box 1803, Bulawayo.
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Rush, W., Borough Electrical Engineer, P.O. Box 57, Vryheid, Natal.

Sibson, A. R., City Electrical Engineer, P.O. Box 1803, Bulawayo, S.R.
Simpson, A. C., Municipal Electrical Engineer, P.O. Box 5010, Walmer, C.P.
Simpson, R. M. O., City Electrical Engineer, P.O. Box 147, Durban, Natal.
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.
Stevens, F., Borough Electrical Engineer, P.O. Box 29, Ladysmith, Natal.
Schaftenaar, G. A. H., Town Electrical Engineer, P.O. Box 71, Graaff-Reinet, C.P.
Sulter, F. J., Assistant Electrical Engineer, P.O. Box 145, Germiston, 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.

Turner, H. T., Town and Electrical Engineer, P.O. Box 121, Umtali, S.R.
Turnbull, A. F., Town and Electrical Engineer, P.O. Box 33, Vereeniging, Tvl.

Van der Merwe, F. J., Municipal Electrical Engineer, P.O. Box 20, Stilfontein, Tvl.
Van Heerden, B. G., Mun. Elec. Eng., P.O. Box 201, Heidelberg, Tvl.
Van Heerden, W. J. B., Elect. Eng., Orkney Health Committee, P.O. Box 34, Orkney, Tvl.
Van Meerdervoort, J. K. L., Pompe, Town Electrical Engineer, P.O. Box 43, Harrismith, O.F.S
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.
Verschoor, D. R., Town and Electrical Engineer, P.O. Box 36, Fort Beaufort, C.P.
Vorster, P. J., Deputy Town and Electrical Engineer, P.O. Box 15, Brakpan, Tvl.
Von Ahlfton, J. K., Town Electrical Engineer, P.O Box 60, Sasolburg, Tvl.

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.
Williams, A. H., Assistant Electrical Engineer, P. O. Box 45, Springs, Tvl.
Waddy, J. C., City Electrical Engineer, P.O. Box 399, Pietermaritzburg, Natal.
Ward, H. V., Borough Engineer, P.O. Box 71, Greytown, Natal.

Yodaiken, J., Municipal Electrical Engineer, P.O. Box 115, Que Que, S.R.

Ziervogel, E. W. Municipal Electrical Engineer, P.O. Box 23, Nigel, Tvl.

ASSOCIATE MEMBERS/VERBONDE LEDE:

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Attridge, W. H., P.O. Box 463, Tsumeb, S.W. Africa.

Burton, C. R., 54, Memorial Road, Kimberley, C.P.
Bailey, R. V. , P.O. Box 197, Ndola, N.R.

Campbell, A. R., P.O. Box 584, Johannesburg.
Clinton, J. S., P.O. Box 4648, Johannesburg.
Conradie, D. J. R., P.O. Box 1009, Bloemfontein, O.F.S.
Cowen, A. B., Southern Rhodesia Electricity Supply Commission Corporation, P.O. Box 377, Salisbury, S.R.

Dalton, G. A., 111, Eckstein Street, East, Observatory Extension, Johannesburg, Tvl.
Dawson, C., Electricity Supply Commission, P.O. Box 2408, Durban.
De Wit, T., P.O. Box 44, Brits, Tvl.

Gripper, H. Jasper, c/o. 54, Southwood Lane, Highgate Village, London, N 6, England.
Gyles, J. H., "Bodriggy", Moyeni Road, Gilletts, Natal.

Heasman, G. G., P.O. Box 77, Fort Victoria, S.R.

Lutsch, W. J. F. S., c/o. Faculty of Engineering, University of Stellenbosch, C.P.

Marchand, B., P.O. Box 223, Witbank, Tvl.
Mercier, G., c/o., P.O. Box 176, Mazabuka, N.R.
Mole, E. W., P.O. Box 106, Saxonwold, Johannesburg.
Muller, H. M. S., P.O. Box 112, Upington, C.P.

Nicholas, I. J., P.O. Box 185, Dordrecht.

Petersen, G. R., Federal Power Board, P.O. Box 630, Salisbury.
Phillips, J. W., P.O. Box 1731, Bulawayo, S.R.

Rothman, J. L., P.O. Box 606, Kimberley.

Simpson, H. G., Engineering Department, Searles, Ltd., Great Brak River, C.P.

Theron, G. C., P.O. Box 1, Vanderbijl Park, Tvl.
Tubb, B. H. J., P.O. Box 1699, Salisbury, S.R.

Wright, G. R. E., P.O. Box 465, Benoni, Tvl.
Williams, J. T., P.O. Box 1617, Pretoria, Tvl.
Wylie, R. J. S., c/o. E.S.C., Rand Undertaking, P.O. Box 103, Germiston, Tvl.

Zeederberg, T. D. ,39, Penzance Street, New Redruth, Alberton.

ASSOCIATES/GEASSOSIEERDES :

Bester, J. H., Town Electrician, P.O. Box 15, Ventersdorp, Tvl.

Carpenter, B. F., Town Electrical Engineer, P.O. Box 14, Middelburg, Tvl.

Jordaan, J. H., Municipal Electrical Engineer, P.O. Box 35, Vryburg, C.P.

Lochner, J. van S., Town Electrical Engineer, P.O. Box 64, Ladybrand, O.F.S.

McNamara, A. B., Electrical Engineer, P.O. Box 21, Komgha.

Psotta, K. U., Town Electrical Engineer, P.O. Box 17, Upington, C.P.

Ross, M. J., Town Electrical Engineer, P.O. Box 13, Brandfort, O.F.S.

Schoombee, G. T. van W., Town Electrical Engineer, P.O. Box 61, Lydenburg, Tvl.

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Jones, G. E. H.

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Sims, C. N.
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DELEGATES/AFGEVAARDIGDES:

GOVERNMENT DEPARTMENTS AND PUBLIC UTILITY UNDERTAKINGS
GOEWERMENTDEPARTEMENTE EN PUBLIEKE UTILITEITSONDERNEMINGS

Arthur, H. R., Department of Posts and Telegraphs.
Bell, T. S., Federal Ministry of Power.
Carr, W. J. P., Non-European Affairs Department.
Cowen, A. B. Electricity Supply Commission, Southern Rhodesia.
de Haas, J. J., Public Works Department, Pretoria.
du Toit, C. W. H., S.A. Bureau of Standards.
Dalton, E., South West African Administration (Inspector of Factories, Engineering).
de Villiers, I. Electricity Supply Commission.
Fenwick, W., Electricity Supply Commission (Rand Undertaking).
Gouws, R. B. J., Transvaal Provincial Administration.
Heckroodt, H., Native Resettlement Board.
Harding, G. R., Electricity Supply Commission.
Jackson, A., Cape Provincial Administration.
King, W. L., South African Railways.
Lineker, A. W., Rand Water Board.
Middlecote, A. A., S.A. Bureau of Standards.
Malan, G. J., Department of Labour (Chief Inspector of Factories (Engineering).
Molyneux, G. C., Rhodesia Railways.
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Smuts, M., Department of Bantu Administration of the Union Government.

OTHER REPRESENTATIVES/ANDER VERTEENWOORDIGERS:

Adams, A. J., Associated Scientific and Technical Societies of South Africa.
Black, J. A., Steel and Engineering Industries, Federation of S.A.
Bobek, K. H., Public Works Department, Swaziland (Electrical Branch).
Campbell Pitt, L. T., Institute of Mechanical Engineers.
Craib, S., S.A. Institution of Mechanical Engineers.
Cotton, F. A., S.A. Institution of Certificated Engineers.
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Lategan, Dr. P. N., Transvaal Coal Owners Association.
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Baxter, J. D. C., Northern Cape Regional Electrification Board.
Cormack, Prof. W., University of the Witwatersrand.
Gorshel, A., Deputy Mayor.
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Holmes, Dr. I. Q., City Treasurer, Johannesburg Municipality.
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Horsley, W. D., C. A. Parsons & Co. (Pty.) Ltd.
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Marais, D. J., Johannesburg City Council.
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Henley-Simplex Africa (Pty.) Ltd.	R. A. Dines, J. A. Morrison, R. W. Lord.
Heinemann Electric S.A. Ltd.	G. A. Dalton.
Hopkinsons S.A. (Pty.) Ltd.	E. C. Enfield, G. Richardson, W. G. van Aswegan, G. Chambers.
James Howden & Co. (Pty.) Ltd.	E. P. Rodger, H. K. Roseveare.
Hubert Davies & Co. Ltd.	W. N. Powell, F. O. Iles.
International Combustion Africa Ltd.	Q. R. Nothard, G. R. C. Usher.
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Johnson & Phillips (S.A.) (Pty.) Ltd.	H. L. Dawe, D. S. Shorten, E. W. Dixon.
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George Kent (S.A.) (Pty.) Ltd.	G. H. Toop.
G. H. Langler & Co. Ltd.	G. H. Boyle, K. T. Gilson.
Lusaka Electricity Supply Corp. Ltd.	W. P. Ford.
Mitchell Engineering (Pty.) Ltd.	L. O. Benckendorff, A. B. Bullock, W. Henery, R. O. Kode.
G. H. Marais	G. H. Marais.
Harold Marthinusen & Co. (Pty.) Ltd.	G. Roeske.
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Metropolitan Vickers (S.A.) (Pty.) Ltd.	S. McCracken, J. Monks, C. G. Watkins-Ball.
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Pretoria Metal Industries (Pty.) Ltd.	O. H. Hodgkin.
Reunert & Lenz, Ltd.	I. A. Mondal, J. H. Todd, I. N. A. Rav.
A. Revrolle & Co., Ltd.	M. L. Breaden, W. W. Martin, A. S. Bridger.
Rice & Diethelm, Ltd.	T. F. Suttie, I. Birtles.
Samuel Osborn (S.A.) Ltd.	H. Snow, R. E. Harden.
Scottish Cables (S.A.) Ltd.	D. G. Sutherland, A. C. Grant, R. C. Snow.
Shell Co. of S.A. Ltd.	G. Phillips, I. H. G. Nicholson.
Siemens Edison Swan (Pty.) Ltd.	R. C. Hamilton, A. W. R. Woods.
Stamcor (Pty.) Ltd.	J. M. Taylor, A. E. Lee.
Standard Telephones & Cables, Ltd.	R. Oxley.
Stewarts & Lloyds of S.A. Ltd.	T. A. Robinson, W. H. Harvey.

S. A. General Electric Co. Ltd.	R. Valkenburg, G. H. Acker.
Superconcrete Pipes S.A. Ltd.	P. H. Levick, A. R. Nel.
S. A. Philips (Pty.) Ltd.	Dr. J. C. R. Heydenrych, D. L. Bezuidenhout, D. W. Young.
Switchcraft (Pty.) Ltd.	C. Manoim, G. Ludewig, T. K. Lavery, G. J. Bailey.
Union Steel Corporation S.A. Ltd.	T. N. D. Griffin, J. T. Oosthuizen, N. G. Beveridge.
M. Wegener & Co. (Pty.) Ltd.	M. Wegener.
Wilson & Herd (Pty.) Ltd.	W. M. Herd, H. N. Hancox, R. G. Edwards.
Wright Anderson (S.A.) Limited	E. Reg. Tickton, A. F. Butters, K. Yuill.
Yarrow Africa (Pty.) Ltd.	H. D. T. Harris.

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Adams, Mrs. K.
Allen, Miss O.
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Archer, Mrs. R. R.
Arthur, Mrs. H. R.
Aspinall, Mrs. H. T.
Axe, Mrs. L. G.

Barnard, Mrs. W.
Ballendon, Mrs. L. B.
Barnett, Mrs. H. J. A.
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Wegener, Mrs. M.
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Woods, Mrs. A. W. R.
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NOTICE OF 33rd ANNUAL CONVENTION

Notice is hereby given that the 33rd Annual Convention of the Association will be held at the Cranbrooke Hotel, 58, Leyds Street, Johannesburg, from the 12th to the 15th May, 1959, both days inclusive.

All Convention meetings will be held on the 2nd Floor, Cranbrooke Hotel, with the exception of Thursday, 14th May, 1959, when the venue will be the Ground Floor Hall, West Wing, Cranbrooke Hotel.

Executive Council meetings will be held on Monday, 11th May in the Committee Room, City Hall, and thereafter in the First Private Room, Ground Floor, Cranbrooke Hotel.

DAVIDSON & EWING (PTY.) LTD.
per: R. G. EWING,
Secretaries.

KENNISGEWING VAN DIE 33ste JAARLIKSE KONVENSIE

Hiermee word kennis gegee dat die 33ste Jaarlikse Konvensie van die Vereniging van 12 tot en met 15 Mei 1959 in die Hotel Cranbrooke, Leyds-Straat 58, Johannesburg, gehou sal word.

Alle Konvensie vergaderings sal gehou word op die 2de verdieping van die Hotel, met uitsondering van Donderdag, 14 Mei, wanneer die vergaderplek bepaal is vir die grondverdieping in die Saal van die Westelike Vleuel.

Vergaderings van die Uitvoerende Raad sal Maandag, 11 Mei in die Komiteekamer van die Stadhuis gehou word en daarna in die Eerste Komiteekamer, Grondverdieping, Hotel Cranbrooke.

DAVIDSON & EWING (EDMS.) BPK.,
per: R. G. EWING,
Sekretarisse.

AGENDA and PROGRAMME

MONDAY, 11th MAY, 1959.

9.30 a.m.— 4.30 p.m.—Meeting of Executive Council — Committee Room City Hall.

5.30 p.m.— 7.30 p.m.—Civic Welcome and Cocktail Party at City Hall.

TUESDAY, 12th MAY, 1959.

8.45 a.m.—Registration and Issue of Badges.

9.30 a.m.—Welcome by His Worship the Mayor of Johannesburg. Official Opening of the Convention by Mr. R. Gettliffe, President of the South African Institute of Electrical Engineers.
Election of President.
Venue of next Convention.
Election of Vice-President.

10.30 a.m.—Refreshment Interval.

11.00 a.m.—Apologies and Greetings.

11.15 a.m.—Presentations (Past President's and Hon. Members' Medals and Certificates).

11.30 a.m.—Election of Executive Council.

11.45 a.m.—Presidential Address.

12.45 p.m.—Luncheon Adjournment.

AGENDA en PROGRAM

MAANDAG, 11 MEI, 1959.

9.30 vm.—4.30 nm.—Vergadering van Uitvoerende Raad—Komiteekamer, Stadhuis.

5.30 nm.— 7.30nm.—Burgerlike onthaal en Skemerpartytjie in Stadsaal.

DINSDAG, 12 MEI, 1959.

8.45 vm.—Registrasie en Uitreiking van Kentekens.

9.30 vm.—Verwelkoming deur Sy Ed. die Burgemeester van Johannesburg.
Amptelike opening van die Konvensie deur Mnr. R. Getliffe, President van die Suid-Afrikaanse Instituut van Elektrotegniese Ingenieurs.
Benoeming van President.
Vergaderplek van volgende Konvensie.
Benoeming van Vise-President.

10.30 vm.—Pouse—Verversings.

11.00 vm.—Verskonings en Goeie Wense.

11.15 vm.—Toekenning van Erepenning en Sertifikate aan Oud-President en Erelede.

11.30 vm.—Benoeming van Uitvoerende Raad.

11.45 vm.—Presidentsrede.

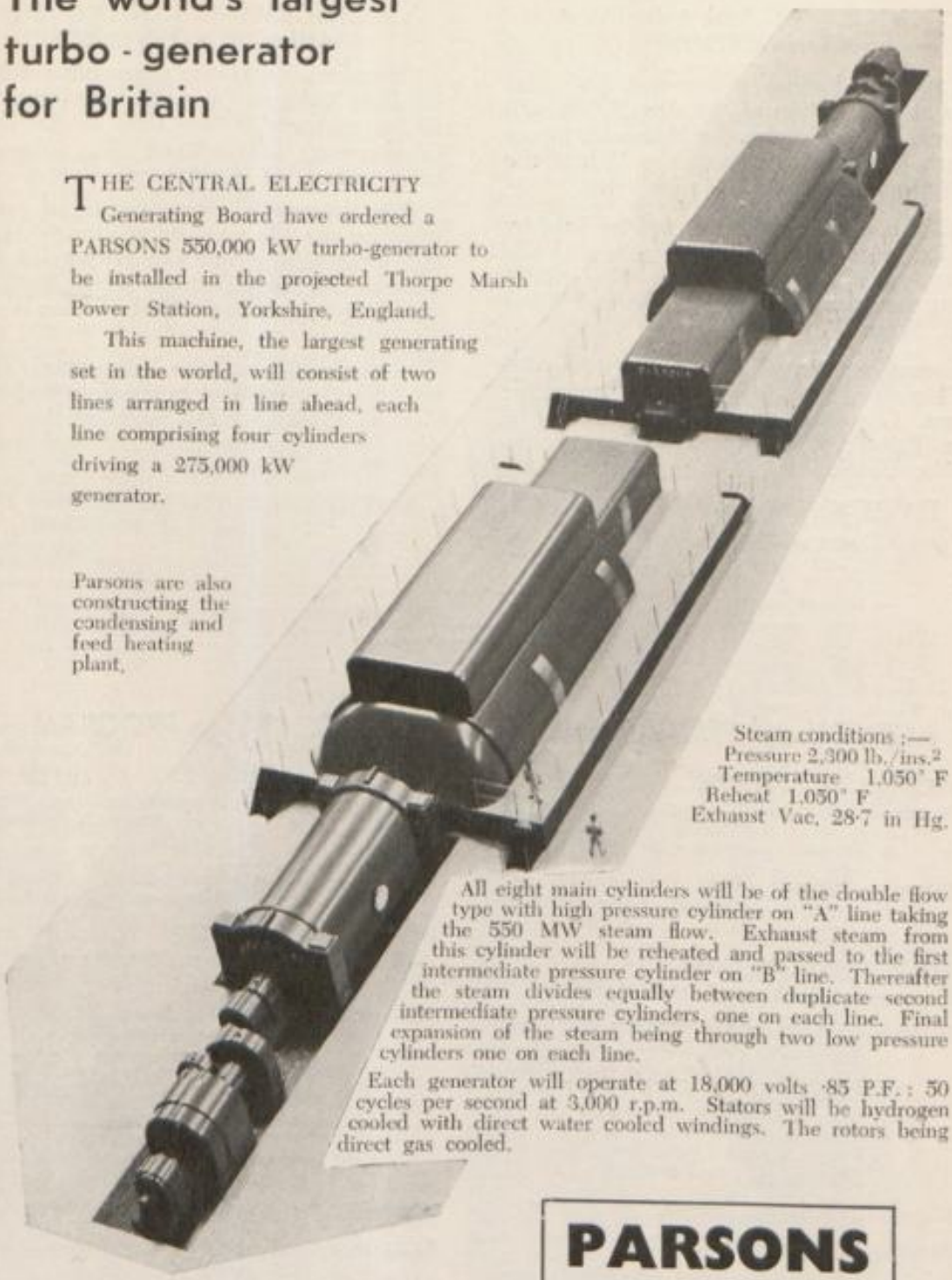
12.45 nm.—Middagete.

The world's largest turbo-generator for Britain

THE CENTRAL ELECTRICITY Generating Board have ordered a PARSONS 550,000 kW turbo-generator to be installed in the projected Thorpe Marsh Power Station, Yorkshire, England.

This machine, the largest generating set in the world, will consist of two lines arranged in line ahead, each line comprising four cylinders driving a 275,000 kW generator.

Parsons are also constructing the condensing and feed heating plant.



Steam conditions :—
Pressure 2,300 lb./ins.²
Temperature 1,050° F
Reheat 1,050° F
Exhaust Vac. 28·7 in Hg.

All eight main cylinders will be of the double flow type with high pressure cylinder on "A" line taking the 550 MW steam flow. Exhaust steam from this cylinder will be reheated and passed to the first intermediate pressure cylinder on "B" line. Thereafter the steam divides equally between duplicate second intermediate pressure cylinders, one on each line. Final expansion of the steam being through two low pressure cylinders one on each line.

Each generator will operate at 18,000 volts ·85 P.F.: 50 cycles per second at 3,000 r.p.m. Stators will be hydrogen cooled with direct water cooled windings. The rotors being direct gas cooled.

PARSONS

C. A. PARSONS & CO. (S.A.) (PTY.) LTD., P.O. BOX 3425
642 — 648 MARITIME HOUSE, LOVEDAY STREET, JOHANNESBURG.

2.30 p.m.—Paper: "Nuclear Power" by A. E. Powell.

3.30 p.m.—Refreshment Interval.

4.00 p.m.—Discussion on Paper.

5.00 p.m.—Adjournment.

8.00 p.m.—Theatre Party, Reps Theatre, Stiemens Street, Braamfontein.

WEDNESDAY, 13th MAY, 1959.

8.30 a.m.—Meeting of Executive Council. Communications from Council.

9.30 a.m.—Convention Resumes.
Annual Report of Secretaries.
Appointment of Auditors.
Reports of Sub-Committees and Representatives and discussion thereon.

10.30 a.m.—Refreshment Interval.

11.00 a.m.—Paper: "The Supply of Electricity to Native Townships" by G. Masson.

12.00 noon—Luncheon Adjournment.

1.30 p.m.—Visits to Factories. Transport will depart from Cranbrooke Hotel.

8.15 p.m.—Members' Forum.

10.00 p.m.—Refreshments.

THURSDAY, 14th MAY, 1959.

8.30 a.m.—Meeting of Executive Council.

9.30 a.m.—Convention resumes.
Communications from Council.
Discussion on Papers.

10.30 a.m.—Refreshment Interval.

11.00 a.m.—Paper: "The Development of a Method of Reticulation for the Johannesburg Township of Montgomery Park" by W. Barnard, B. Sc. (Eng), A.M.I.E.E., A.M. (S.A.) I.E.E., and discussion on Papers.

12.30 p.m.—Luncheon Adjournment.

2.30 p.m.—Reports of Sub-Committees and Representatives and discussion thereon. Discussion on Papers. Continuation of Members' Forum, (if time permits).

4.30 p.m.—Adjournment.

8.30 p.m.—Convention Ball at Cranbrooke Hotel.

FRIDAY, 15th MAY, 1959.

9.30 a.m.—Convention resumes.
Communications from Council.
General.

10.30 a.m.—Refreshment Interval.

11.00 a.m.—Closing Session.

12.00 noon—Meeting of Executive Council.

2.30 nm.—Referaat: „Kernkrag" deur A. E. Powell.

3.30 nm.—Pouse—Verversings.

4.00 nm.—Bespreking van Referaat van Mnr. Powell.

5.00 nm.—Verdaging.

8.00 nm.—Teatergeselskap, Reps Teater, Stiemens-straat, Braamfontein.

WOENSDAG, 13 MEI, 1959.

8.30 vm.—Vergadering van Uitvoerende Raad. Aankondigings van Uitvoerende Raad.

9.30 vm.—Hervatting van Konvensie.
Jaarverslag van Sekretarisse.
Benoeming van Ouditeure.
Verslae van Onderkomitees en Verteenwoordigers en oorweging daarvan.

10.30 vm.—Pouse—Verversings.

11.00 vm.—Referaat: „Die Voorsiening van Elektrisiteit aan Naturelledorpsgebiede" deur G. Masson.

12.00 nm.—Middagete.

1.30 nm.—Besoeke aan Fabrieke. Vervoer sal vertrek vanaf Hotel Cranbrooke.

8.15 nm.—Ledeforum.

10.00 nm.—Verversings.

DONDERDAG, 14 MEI, 1959.

8.30 vm.—Vergadering van Uitvoerende Raad.

9.30 vm.—Hervatting van Konvensie.
Aankondigings van Uitvoerende Raad.

10.30 vm.—Pouse—Verversings.
Bespreking van Referate.

11.00 vm.—Referaat—„Die Ontwikkeling van 'n Metode van Benetting vir die Johannesburgse Voorstad Montgomery-Park" deur W. Barnard, B.Sc. (Eng.), A.M. I.E.E., A. M. (S.A.) I.E.E., en bespreking van Referate.

12.30 nm.—Middagete.

2.30 nm.—Verslae van Onderkomitees en Verteenwoordigers en oorweging daarvan. Bespreking van Referate. Hervatting van Ledeforum, (as daar tyd beskikbaar is).

4.30 nm.—Verdaging.

8.30 nm.—Konvensie-Dansparty by Hotel Cranbrooke.

VRYDAG, 15 MEI, 1959.

9.30 vm.—Hervatting van Konvensie.
Aankondigings van Uitvoerende Raad.
Algemeen.

10.30 vm.—Pouse—Verversings.

11.00 vm.—Afsluiting.

12.00 nm.—Vergadering van Uitvoerende Raad.

LADIES' PROGRAMME

MONDAY, 11th MAY, 1959.

5.30 p.m.— 7.30 p.m.—Civic Welcome and Cocktail Party at City Hall.

TUESDAY, 12th MAY, 1959.

8.45 a.m.—Assemble for Registration, Issue of Badges and Official Opening of Convention.

10.30 a.m.—Refreshments.

11.00 a.m.—Apologies and Greetings.

11.15 a.m.—Presentation of Past President's and Hon. Members' Medals and Certificates.

11.45 a.m.—Presidential Address.

Afternoon :—Visit to Diamond Cutting Works or "Free."

8.00 p.m.—Theatre Party, Reps Theatre, Stiemens Street, Braamfontein.

WEDNESDAY, 13th MAY, 1959.

Morning :—Visit to Diamond Cutting Works, Rand Refinery, or "Free."

1.45 p.m.—Visit to Factories.

8.15 p.m.—Members' Forum.

THURSDAY, 14th MAY, 1959.

9.30 a.m.—Tour of Suburbs and Tea with the Mayoress at Zoo Lake.

Afternoon :—Free.

8.30 p.m.—Convention Ball.

FRIDAY, 15th MAY, 1959.

10.30 a.m.—Assemble for refreshments and closing session of Convention.

PROGRAM VIR DAMES

MAANDAG, 11 MEI, 1959.

5.30 nm.— 7.30 nm.—Burgerlike Onthaal en Skemerpartytjie in Stadsaal.

DINSDAG, 12 MEI, 1959.

8.45 vm.—Vergader vir Registrasie, uitreiking van Kentekens, en Amptelike Opening van Konvensie.

9.30 vm.—Amptelike Opening van Konvensie.

10.30 vm.—Pouse—Verversings.

11.00 vm.—Verskonings en Goeie Wense.

11.15 vm.—Toekenning van Erepennings en Sertifikate aan Oud-President en Erelede.

11.45 vm.—Presidentsrede.

Namiddag :—Besoek aan Diamantslypery of eie keuse.

8.00 nm.—Teatergesel skap, Reps Teater, Stiemens-straat, Braamfontein.

WOENSDAG, 13 MEI, 1959.

Oggend :—Besoek aan Diamantslypery, Die Randse Raffinadery of eie keuse.

1.45 nm.—Besoek aan Fabrieke.

8.15 nm.—Ledeforum.

DONDERDAG, 14 MEI, 1959.

9.30 vm.—Besoek aan Voorstede en Versversings by Dieretuinmeer in geselskap van Burgemeestersvrou.

Namiddag :—Vry.

8.30 nm.—Konvensie-Dansparty.

VRYDAG, 15 MEI, 1959.

10.30 vm.—Vergader vir Verversings en Afsluiting van Konvensie.

The Thirty-Third Convention of the Association was opened in the Cranbrooke Hotel, Leyds Street, Johannesburg, by R. Gettliffe, President, South African Institute of Electrical Engineers at 9.30 a.m. on Tuesday, 12th May, 1959.

Attendance at the Convention was as follows:—80 Councils represented by 54 Councillors and 80 Engineers and Associates; 4 Honorary Members (not representing Councils or Affiliates); 10 Associate Members; 32 representatives of Government Departments, Public Utilities and other organisations; 135 representatives of 73 Affiliates; 28 Visitors; 223 Ladies; 4 A.M.E.U. Officials;—a total of 570 persons.

FIRST DAY

THE PRESIDENT (Mr. C. G. Downie, Cape Town): Ladies and Gentlemen. After having shaken you all by the hand at that very enjoyable cocktail party in the Johannesburg City Hall last night, alongside Johannesburg's charming Acting Mayoress and Mayor, it is my very pleasant duty this morning to greet you to this the Thirty-Third Annual Convention of the Association of Municipal Electricity Undertakings. You are to be officially welcomed to this Convention, ladies and gentlemen, by the Acting Mayor, Councillor Gorshel, and I have very great pleasure in now calling upon him to perform that ceremony.

COUNCILLOR A. GORSHEL, His Worship the Acting Mayor of Johannesburg: Meneer die President, Meneer die Voorsitter Utiliteits Komitee van die Stadsraad Johannesburg, Dames en Here.

As Waarnemende Burgemeester van Johannesburg, dit is vir my 'n groot genoeë om u vir die Drie-en-Dertigste jaar Konvensie van Vereeniging van die Munisipale Elektrisiteitsondernemings van Suid Afrika in ons Stad te verwelkom.

Hierdie Konferensie is seersekerlik een van die belangrikste wat in ons land plaasvind. Want dit sal voorkom dat oor die honderd plaaslike bestuurders van die Unie en buite ons grense verteenwoordig is. Hulle het honderde miljoene ponde belê in hulle ondernemings wat on ontbeerlike lig en krag aan hulle gemeenskappe verskaf en hulle het duisende geskoolde werkers in diens. U doen enige stad of dorp eer aan deur die Konferensie daar te hou en ek bedank u namens die Stadsraad en die Stad Johannesburg vir hierdie eer.

Mr. President, Mr. Chairman of the Utilities Committee of the City of Johannesburg, Councillor Ross Spencer, Ladies and Gentlemen.

It gives me great pleasure as Acting Mayor of Johannesburg to welcome you to our City for the Thirty-third Annual Convention of the Association of Municipal Electricity Undertakings of South Africa.

This Conference is surely one of this country's most important, representing as it does the forum for over 100 local authorities in the Union, and beyond its borders, who

have hundreds of millions of pounds invested in their Undertakings, which provide indispensable light and power to their communities, and which employ many thousands of skilled personnel.

It is therefore an honour for any city or town to be chosen as a venue for your conference, and I thank you on behalf of the City Council and the City of Johannesburg, for that honour.

I don't propose, Mr. President, ladies and gentlemen, to give your Association your own history, but there are a few points which I think bear some reference in regard to this particular Convention today.

As you know, the Association was formed in 1915 and the first meeting was held under the Chairmanship of Dr. Dobson, who was then the General Manager of the Johannesburg Electricity Department; and so from its very inception, your Assoc'ation, Mr. President, and gentlemen, has had a very strong connection with Johannesburg.

This in fact is the Sixth Convention to be held in our City, and I am also very glad that we have the pleasant and unique experience of having both Mr. Rodwell and Mr. Fraser, who have both served as Presidents of your Association, and in the lesser capacity of General Manager of the Electricity Department, of the City Council of Johannesburg and we are very glad indeed to see them both here, as hale and hearty as ever. In fact, amongst the 460 handshakes that I was happy to give and receive last night, I think Mr. Fraser's was the one that knocked me back the most.

Judging by your programme, you will have very interesting discussions during your week of Conference session in Johannesburg. I am interested to see that you are going to discuss Nuclear Power, which, to some laymen like myself, has always been a sort of a bugbear in relation to the further development of what we believe is the conventional method of power generation.

But, Mr. Kane, our General Manager, does not seem to be worried about the threat of nuclear power, or even about the portable power equipment that I referred to yesterday — although he was heard to say that he was prepared to sell Kelvin B to me for twenty million pounds. We have not made the deal yet!

I am also very interested in your novel reticulation scheme, (that is, the little that I understand of it), and certainly all of us in Johannesburg are more than interested in the description of the electrical work being done in the Native Townships, which we hope in this city will grow apace, until we have solved one of our major problems, through the terrific amount of work that has been done, and will be done in the next 10 years by our own Electricity Department.

This Association is unique in that it consists mainly of Municipal Electricity Undertakings, and therefore it is able to provide a happy combination of councillors engineers who, as a rule, know much more about their jobs than the councillors who are supposed to tell them what to do, and since this has a basic membership of 112 local authorities, it is undoubtedly a national and very important Association. I am sure that all of you, as delegates to this Convention, (and you, particularly, Mr. President), are gratified to know that 83 of those local authorities are here today which I believe is a record attendance. I think an important conference like yours deserves such a record attendance.

There are too, five additional members who were considered by your Executive yesterday. Now, the total number of the delegates and their ladies, I am told, is approximately 560. They come from as far afield as Ndola, Cape Town, and Windhoek.

At the rate at which your Association has grown during the past 33 years, I don't think that a venue like the Cranbrooke Hotel is going to be adequate for future conferences when you bring them to Johannesburg, and that, perhaps, gives us in Johannesburg, some incentive to go ahead with our new civic centre, so that we can make quite sure that when you come to us again, we will have adequate accommodation for a conference as important and large as yours is.

That may only involve the spending of six million pounds incidentally, but I say again, as a layman that, having regard to the amount spent on power stations, the six

million pounds is not really going to worry us in Johannesburg!

In any case, I sincerely hope, on behalf of the City Council of Johannesburg that since you celebrated your 21st Anniversary as an Association by meeting here during the Empire Exhibition, you will be able to celebrate your 50th Anniversary by meeting in Johannesburg at our new Civic Centre. I hope all of you will be with us — and that I will be able to greet you again on that occasion.

We know that the ladies have not come here in order to discuss technical matters which the delegates are interested in, and I am therefore very glad that we have been able, as a City Council, to provide some little entertainment for you — and particularly for the ladies. For example, as you know, we have a theatre party at the Reps. tonight. I am sorry the theatre is not as big as it might be; it has certain limitation of capacity, but I hope as many of you as possible will be able to attend this theatre, although we cannot indulge in the new pastime which I believe takes place in telephone booths, of trying to squeeze as many people in as possible, and form a record that way! We will also, all of us, look forward to the Ball which you are giving on Thursday night, and I am sure that my wife as Acting Mayoress, will be delighted to meet the ladies in the course of their tour of Johannesburg, that is at the Zoo Kiosk during this week.

I am well aware of the fact that you have a very long agenda including some very important items from the point of view of Chiefs of Electricity Undertakings, and Electrical Engineers, and so I am not going to detain you very long, but I would like to say that one of the things that strikes me as a layman, is the appearance of a power station.

On my visits to, say, Orlando, I have often wondered how they manage to keep these enormous places where so much activity supposedly goes on, as clean, as ship-shape, as they are, and I have even told my wife, that if a house could be kept as tidy as some of the power stations that we have in Johannesburg, no husband would have any cause for complaint about the condition of his home. I think it is partly, if not largely due to the fact that engineers are men with tidy minds. They are men who believe in organisation from the beginning of any undertaking or project — men who devote themselves in a rather remarkable way to the fulfilment of their ideal, which is to provide a very important, and indispensable service to the community, in the most efficient, and may I say, in the most unobtrusive way. One has to pay for that of course — that is assumed. For example, we have got so close to this situation in Johannesburg where if Mr. Kane were to say that he required a transformer sub-station at the corner of Eloff and Pritchard Streets, we would have to consider that very seriously. Fortunately he moved a little to the East and we now have a new transformer substation at the corner of Kerk and Von Wielligh Streets, which in Johannesburg is pretty central. I think it shows the co-operative attitude which the local authority here, including the public, has taken up towards our Electricity Undertaking. This is borne out by the experience of Councillors and delegates of other towns and cities throughout the Union and the Central African Federation. That attitude, I believe, springs from the knowledge that we must have the light and the power which our Electricity Undertakings provide, and that the people who are in charge know well what they are doing. They are highly skilled and specialists in their subject which entitles them to give the local authority advice which that local authority should, under all normal circumstances, be happy to follow.

It is in that spirit, Mr. President, ladies and gentlemen, that I have come here on behalf of the City Council, to say once again, thank you for bringing your conference here. We hope that your deliberations will prove fruitful, and that when all of you return to your homes (those of you who don't live in Johannesburg and I speak particularly of the ladies visiting us), all of you will take back some pleasant recollections of your all too brief stay in our city — and may I say that we look forward to seeing you all again soon.

Thank you Mr. President, ladies and gentlemen.

THE PRESIDENT. Thank you very much Mr. Acting Mayor. I know what a

hectic day you had yesterday on becoming the Acting Mayor, upon the departure of the Mayor overseas. I appreciate, very much indeed that you have been able to come along to welcome us, and I must say that a lot of us now know, after having seen your picture in the Rand Daily Mail this morning how you managed to start your day so fit and fresh.

Mr. Acting Mayor, Councillor Ross-Spencer, Ladies and Gentlement, as most of you know, this year marks the 50th Anniversary of the founding of the S.A. Institute of Electrical Engineers, of which many of us are members. The Institute this year celebrates its Golden Jubilee, and because of our connection with the Institute, as Municipal Engineers, the President of the Institute, Mr. R. Gettliffe, has been invited to officially open our convention for us this year.

I have great pleasure in now introducing Mr. Gettliffe to you and asking him to perform the opening ceremony.

Mr. R. GETTLIFFE. Mr. President, Mr. Acting Mayor, Ladies and Gentlemen: I believe this to be the first occasion that the President of the South African Institute of Electrical Engineers has been asked to open your Convention.

Undoubtedly, the reason which guided your Executive Council to extend the invitation to me was not my prowess as a speaker but because this year the South African Institute of Electrical Engineers is celebrating its Golden Jubilee.

The Council of the Institute was most appreciative of the cordial sentiments which prompted your invitation and I personally feel greatly honoured that I should be the means of showing the strong bonds of friendship which exists between our two organisations.

From time to time the Institute has busied itself in developments which have been of great value to you in your everyday work.

As long ago as 1931/1933, the Lightning Investigation Committee was set up. The results of its researches and findings have been invaluable in making available to electrical engineers a clear picture of how lightning works and how best to counter its effects.

The Overhead Lines Code of Practice was another major achievement which demanded a big sacrifice in time and labour from the Committee Members concerned.

More recently, in the interests of safety, the Institute and the Prevention of Accidents Committee of the Transvaal and Orange Free State Chamber of Mines have been busy with a Code of Practice on "Earth Leakage Protection on Mines for Alternating Current Circuits up to 660 Volts" and a Code of Practice for Mine Substations.

Both of these codes have considerable technical merit and it is interesting to note that when an accident is reported, the recommendations of the codes have usually been ignored.

This year, the Inistitute has taken over full business control of the work of the Safety Precautions Committee in connection with the "Standard Regulations for the Wiring of Premises." Let me add, however, that we look forward to the continued co-operation and help of those other Associations who have always shown so much interest and enthusiasm for this all important work since its inception. It is hoped that in future it will be possible to keep abreast of developments and to revise the Wiring Regulations as and when necessary. It is unfortunate in the interests of standardisation and safety that the Wiring Regulations are not applied automatically to the country as a whole.

Standardisation in some matters is absolutely essential for safety.

I was recently distressed to learn of a fatal accident to a coal cutter operator in a colliery which was brought about by the red conductor of a trailing cable being used as the earth continuity conductor. This practice had been standard on the colliery in question over many years and it was only after an electrician had used the green core for the earth continuity core when repairing damaged trailing cable that the fatal accident occurred. Needless to say, earth leakage protection had not been installed. The colliery has now switched over to the Commonwealth standard of using the green core for the earth continuity conductor.

As all of you are concerned with this problem in connection with flexible cords on domestic appliances, I would refer you to a most important report just issued by

the International Commission on Rules for the Approval of Electrical Equipment. The report of the British Member Body regarding the Draft Resolution on Standardisation of the Identification of the Earthing Core in Flexible Cords and Cables is dated December, 1958. In that report it is recommended that the insulation of the earth continuity core should be green and it is suggested that it should be ribbed on the outside so as to assist a colour blind electrician to distinguish between the insulation of the earth core and the smooth insulation of the phase cores.

Engineers in charge of municipal undertakings finding their work demands ever greater skill in estimating very closely the load trends of municipal supplies and thought has to be given to the relative importance of continuity of supply and the elimination of radio interference and the cost of achieving this.

This forecasting of load trends may be divided into two portions:

(a) the generation and transmission side, and

(b) the distribution side.

If a new generating station has to be built, forecasting approximately five years ahead is necessary if sufficient time is to be given for the selection of a suitable site and the design, ordering, manufacture, and commissioning of the plant. It is exceedingly difficult to forecast five years ahead with any accuracy but it is just these figures and those for even further ahead that are the ones which determine major policy.

Tied up with the power forecast is naturally the association financial forecast. This is a most important part of the forecast. It enables the necessary finance to be arranged at a favourable time and also gives the engineer an opportunity of taking a long view of his revenue and tariffs, and enables adjustments to be made in good time.

A five-year forecast enables the distribution side to be planned intelligently and economically but normally a shorter time is sufficient. Even so, in some areas of a city, the changes in the use of the ground over five years can be most extraordinary as is well illustrated in Hillbrow and Braamfontein in this City.

The better the service given the more costly and therein lies a nice test of management and finance.

The increasing use of electricity in our civilisation, be it industrial, business, or domestic, is throwing an ever increasing burden on our electrical engineers. I will go so far as to say that modern civilisation, as we know it, would collapse without electricity.

It, therefore, is of major importance that the standard of all technical staff, including the artisan, should be raised steadily, so that an adequate level of safety and efficiency can be maintained.

If we expect to raise the standard of the artisan, it will of necessity take a long time for this will have to start with the apprentice.

Certain provisions are made in the Apprenticeship Act which could very well do with modification to achieve this result.

If an artisan is regarded as a skilled person —and I think that we all agree that he is— then surely he must be required to pass a qualifying trade test to become an artisan, and not rely solely on the effluxion of time.

It has recently been stressed at the Symposium on Apprentice Training of the S.A. Institution of Mechanical Engineers that the training of apprentices needs drastic overhauling.

Among many other far reaching recommendations, it is suggested that the apprentice should be able to present himself voluntarily for the trade test at the end of the penultimate year of his apprenticeship. If he passes then he becomes an artisan.

A trade test should be compulsory at the end of apprenticeship for those who have not qualified sooner. Those who cannot pass should then become improvers until they do pass their trade test at a rate of pay below that of the artisan.

In this connection, the good work done by the Department of Education Central Organisation for Trade Testing is most important. At the same time, the Technical Colleges have started the "Sandwich" Course of enhanced technical standard for those boys who have greater ability and who wish to go further in their technical studies.

I cannot resist this opportunity of doing a little propaganda work for the South

African Institute of Electrical Engineers. As part of our Golden Jubilee Celebrations, an exhibition "Electricity in the Service of Mankind" will be held at the University of the Witwatersrand in collaboration with the Departments of Electrical Engineering and Physics from the 13th to the 18th July.

We have been promised some excellent exhibits, colour transparencies, models, and technical films.

As can be judged from the theme of the exhibition, the field to be covered is enormous and, in commending the exhibition to you, I am sure that you will find much that will interest you, whether your interest lies in things scientific, the domestic field, or industrial applications.

I now have pleasure in declaring this your Thirty-third Convention open and wish you every success in your deliberations.

THE PRESIDENT: Thank you very much Mr. Gettliffe. Your opening address has been quite a unique one as far as opening addresses go in that it has touched on matters which are of considerable direct concern to Municipal Electrical Engineers.

I think the South African Institute of Electrical Engineers can count on Municipal Electrical Engineers to support the Institute's Golden Jubilee celebrations this year.

Before proceeding with the next item on the Agenda, ladies and gentlemen, I feel that I should take the opportunity now of expressing my appreciation for your having elected me your President for the past year. I can only hope that I have fulfilled my task and duties to your satisfaction.

The President's job is made all the easier by the Secretary, and I would like to take the opportunity in your presence also, of thanking Dick Ewing for having been so helpful. I can tell you that he is a very efficient and conscientious secretary.

And, of course, ladies and gentlemen, there is always the Executive. One of its functions is to keep the President out of mischief — to keep him from talking too much, and to keep him on the rails — and of course vice verse! The Executive, as you know, is comprised of several ex-Presidents of the Association who have acquired the experience and wisdom which the President can lean on to make his job easier.

Again, ladies and gentlement, I thank you for the honour which you have done me and the Mother City of Cape Town in having elected me to the Presidential Chair which I am shortly to give up to your next President.

Now I come to the most important item on the Agenda, and that is the election of your President for the ensuing year.

I call for nominations for that office.

Mr. J. L. VAN DER WALT (Krugersdorp): Mr. President, Mr. Deputy Mayor, Mr. Gettliffe, ladies and gentlemen, it is always fitting to reward a person who has served any Association unstintingly and well with the highest office, and, in our case, it is that of the Presidency. The person cannot be a difficult choice here, because he has all those requirements. What manner of man is this, you may wish to ask me? Well, he is a South African born Irishman, bred in Scotland, and rounded off again in South Africa, and with all the characteristics of those nations thrown together, I think he is tough enough and wise enough to lead this Association.

The Irish in him — well, always "agin the Government," therefore he can control your Executive. The Scottish in him — he has been on our Finance Committee for a couple of years, therefore our healthy Balance Sheet. The South African in him, his genial disposition which makes him the likeable person he is.

Meneer Kane is ongeveer 55 jaar gelede in Johannesburg gebore. Hy het sy onderwys opleiding gedeeltelik in Johannesburg en gedeeltelik in Skotland ontvang. Sy vakleerlingskap het hy in Skotland gedien, en ek dink daarvandaan sy deeglikheid in alles wat hy doen. In Augustus 1928 het hy by die Stadsraad van Johannesburg aangesluit, en sy deeglikheid en hardwerkendheid het natuurlik baie gou die oog van sy meerderes gevang en daarom vind ons dat in 1938 was hy al bevorder tot Assistent Distribusie Ingenieur (Konstruksie).

In this position as Assistant Distribution Engineer, Construction, he played a big role in developing the nucleus of this large city's expansion programme, which, today, is still continuing.

He was also in charge of the electrification of the once-famous Rand Airport, and

one of his works of art was that air clock which has been seen by thousands of important visitors when the Country's main airport was the Rand Airport. I believe he was not quite sure that this clock was going to function, so he thought it best to go on leave on the day of the official opening of the Air Port.

In July, 1941, he enlisted and served with the South African forces in the Middle East and Europe, and eventually obtained the rank of Captain. His employers and his superiors thought so highly of him that he was twice promoted whilst on Active Service — the first time as Assistant Distribution Engineer (this time Maintenance), and in 1945 he was promoted to Assistant General Manager. In October, 1954, he was appointed General Manager of the largest Municipal Electricity Undertaking in Southern Africa. He has held some of the highest offices in the engineering world in this country.

1959, President of our Association — the Association of Municipal Electricity Undertakings of Southern Africa.

Do not think that this person I am going to propose is perfect, however. No Sir, by no means. He has many shortcoming. He plays that silly little game where they hit a small white ball with a club, or a stick, or a cane, and he does it so deftly that at his club his fellow members call him "sugar cane."

I believe he also used to send his young son to bed very early at night so that father could play with the mechanical toy train. However, I think we can forgive him these few shortcomings.

In die begin het ek uitgewing dat hy hierdie hoogste posisie verdien het. Hy verteenwoordig u Vereniging op die Aanbevelingskomitee vir Nuwe Elektriese Draadwerkers, Die Suid-Afrikaanse Buro vir Standaarde. Inderek behartig hy ook ons belange op die Randse Elektrolisekomitee, Steenkooltoewysings Komitee en andere.

I do not think that this Association could wish for a better qualified President. Mr. President, Mr. Deputy Mayor, Mr. Gettliffe, ladies and gentlemen, I propose Mr. Bob Kane, the first Johannesburg-born General Manager of the Johannesburg Electricity Department, as our President for the ensuing year.

THE PRESIDENT: Thank you Mr. van der Walt. Will somebody please second the proposal.

COUNCILLOR C. J. ROSS-SPENCER (Johannesburg): I have very much pleasure in seconding the proposal of Mr. Bob Kane as President for the coming year.

As a member of the Johannesburg City Council, I feel very honoured, and I am sure the Council will feel very honoured when they hear that once again, our General Manager has been given a high honour.

The original President on the foundation of your Association in 1915 was the late Dr. J. H. Dobson, and I think it is very appropriate and a great honour to us that you have nominated Mr. Kane, a representative from Johannesburg.

I am not going to say very much about Mr. Kane because Mr. van der Walt has done his job very well, but there are just one or two little things I would like to add.

It will be interesting for you to know that Mr. Kane, has, under his charge, and he is responsible for no less than 2,600 employees. That is an enormous organisation, by South African standards, and how he manages to keep so calm — he is always the same, he is always unruffled, no matter what problems and irritations he has I don't know — and I think that is a great example, particularly to commercial executives, who seem to work themselves to death, even when they have very much smaller organisations under their control.

Finally I would like to refer again to what the Deputy Mayor said about Mr. Kane's way of being able to get what he wants. We have found in the Council that we have great difficulty in passing small items of expenditure running into, say, 10/- or a £1, or something unimportant, but when Mr. Kane comes along with a six million pound proposition, there is absolutely no debate, and in a couple of seconds it is all agreed. You will agree with me, I think, on the strength of that if nothing else, he is a most appropriate person and I have very much pleasure in seconding the proposal.

THE PRESIDENT: Any other nominations, ladies and gentlemen.

THE PRESIDENT: Mr. Acting Mayor, Mr. Councillor Ross-Spencer, Mr. Gettliffe, ladies and gentlemen: I have very great

pleasure in declaring Bob Kane, General Manager of the Johannesburg Electricity Undertaking, President for the ensuing year.

The Acting Mayor will now invest the incoming President with the Presidential Chain of Office.

Mr. R. W. KANE was invested with the Presidential Chain of office.

HIS WORSHIP THE ACTING MAYOR OF JOHANNESBURG, COUNCILLOR A. GORSHEL: I'm sorry I can't resist this. It arises out of what Mr. van der Walt said about "sugar cane." I am sure that your new president will, within the next year, prove the paradox that "Kane is able."

Mr. R. W. KANE (New President, Johannesburg): Mr. Acting Mayor, they have also forgotten "Tubal Cane."

Mr. Acting Mayor, Mr. Gettliffe, Mr. van der Walt, Councillor Ross-Spencer, all members, ladies, and last but no means least, Johannesburg City Council.

I thank you all very much indeed for honouring Johannesburg and myself today, and will thank you more fully during my address. I particularly thank Van and my Chairman. To Van I just want to say that I will elect myself honorary editor of the Proceedings, and clear up what he said this morning! And I think Councillor Ross-Spencer should ask certain members of the staff this last week how cool and calm and collected I have been!

I feel I would be lacking in my duties if I did not take this opportunity of thanking Chris Downie on your behalf for his year of office. Later on we'll give him some other substantial award, but I think it is my job now to thank him on your behalf for his year of office and for his very sincere and thorough attention to the requirements of the Association. Thank you.

My first duty, ladies and gentlemen, is to ask for nominations for the venue of the 1960 Convention.

Mr. R. M. O. SIMPSON (Durban): Mr. President, Mr. Deputy Mayor, ladies and gentlemen, unfortunately I must first apologise for the non-attendance of the Councillor from Durban, but Mr. Gild unfortunately had two rather important deputations he had to represent, and he was unable, at the last minute, to attend. So I have been asked, in connection with the venue of the next Convention to invite you to hold your Convention in Durban, in 1960.

THE PRESIDENT: The next item on the Agenda is the proposal for Vice-President. May I have proposals please?

Mr. J. C. FRASER (Johannesburg): Mr. Deputy Mayor, Mr. President, President of the S.A. Electrical Engineers, ladies and gentlemen.

Thirteen years ago, almost to the day, I had the honour and privilege at our Bloemfontein Convention to propose as Vice-President of the Association an Engineer who is loved and honoured by all our members, our esteemed friend, past president and honorary member, Clarence Kinsman, then Electrical Engineer of the City of Durban.

Today I consider it an even greater privilege to be spared and have the honour to propose an Engineer as Vice-President who, thirteen years ago, was one of Clarence Kinsmen's back-room boys, and who today is holding the important position of City Electrical Engineer Durban.

Mr. Simpson who is commonly known to some of us as Ronald, will have a difficult task to maintain the high standard which has been set by his predecessors for stageing an A.M.E.U. Convention at Durban.

Many of us here today have happy and very pleasant memories of the last Convention which was held in Durban.

In the time I have been associated with Ronald, he has shown by his interest in the Association that he has the outstanding qualities and ability for such a difficult and important task.

I have every confidence in asking this gathering to accept Ronald Simpson as Vice-President of this Association for the ensuing year.

THE PRESIDENT: Thank you, Mr. Fraser. May I have a seconder please?

COUNCILLOR A. W. LOUW (East London): Mr. President, Mr. Deputy Mayor, ladies and gentlemen: it is my great privilege as a Councillor member, who has been in the fortunate position to be able to attend a second convention as a City Councillor, where I have kept my eyes and my ears open, to have the privilege today to second the nomination as Vice-President

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for the ensuing year of Mr. Ronald Simpson of Durban.

Gentlemen, I feel that in Mr. Ronnie Simpson we will have someone of whom we can all be proud, and on whom the mantle will eventually fall one day to be the President of this Association. He is the City Electrical Engineer of a very prominent Electricity Undertaking in the Union. He also represents one of our finest, our best, and most progressive coastal towns in South Africa, and I think that Mr. Ronnie Simpson will be able to do the job with dignity; he will be able to do all the work he is required to do with courage, and I am sincere in saying that I do not think we can have a better choice today than to nominate and elect Mr. Ronnie Simpson to this elevated post, as Vice-President for the ensuing year.

I have much pleasure in seconding.

THE PRESIDENT: Thank you Councillor Louw. I will now ask Mr. Ronnie Simpson to join us up here at the main table.

Mr. R. M. O. SIMPSON (Durban): Mr. President, my Proposer and Seconder, and all members of the Convention, I am afraid I have been given a very big task to do, and all I can say is that I shall endeavour to do it to the best of my ability.

THE PRESIDENT: Thank you, Mr. Simpson.

(The PRESIDENT continued with Convention Announcements).

Ladies and gentlemen, we have about six minutes to go to the tea break. I wonder if some of the delegates would care to give greetings.

Mr. A. W. LINEKER (Rand Water Board, Johannesburg): Mr. President, on behalf of the President and Council of the Institute of Electrical Engineers, London, I offer you greetings and sincere wishes for a successful Convention.

Mr. J. C. DOWNEY (Springs): Mr. President, on behalf of the National Committee on Illumination, I wish to congratulate you on your election to the office of President of the Association of Municipal Electricity Undertakings, and wish you a very happy term of office.

THE PRESIDENT: Thank you, Mr. Downey.

Mr. W. L. KING (South African Railways): On behalf of the General Manager of the South African Railways, I bring greetings and good wishes for the success of this Convention. I also take this opportunity of congratulating you, sir, on your election to the post of President, and wishing you every success in your term of office.

Mr. J. C. FRASER (Johannesburg): Mr. President, I bring you congratulations and greetings from the Safety Precautions Committee, on whose activities I shall be reporting later on in the Convention, but while I am on my feet, Bobbie, may I deliver my personal congratulations to you for the very high office you attained today. Thank you.

Mr. I. DE VILLIERS (Escom): Mr. President, on behalf of Escom I would like to congratulate you on your apointment. We have known you for many years, we have worked together, and we are all very pleased that we will have your co-operation in the future. We would also like to wish this Convention everything of the best, and hope the rain holds off! Thank you.

THE PRESIDENT: Thank you Mr. de Villiers. Frankly, the rain sells electricity!

Mr. H. T. ASPINALL (Johannesburg): Mr. President, the Director of the Witwatersrand Technical College has asked me to convey to you his good wishes, and every success during your year of office.

THE PRESIDENT: I think it is time we went downstairs for some refreshment, and we will resume again at 11 a.m.

TEA ADJOURNMENT.

On Resuming at 11.00 *a.m.*:

(The meeting opened with a number of Convention announcements).

THE PRESIDENT: I now have a very sad duty to perform, and that is to announce the death of the following members during the past year:

Mr. E. Poole, from Durban originally. He was a foundation member, and was secretary, I think, at the second meeting of this Association, and at various times for 15 years.

Mr. Coulthard, who was a member, but was not a member at the time of his death.

Mr. J. D. Lamb, formerly Electrical Engineer at East London, and a past president in 1927/29.

Finally, I think we all know Mr. Muller, who used to be an engineer of Upington. I don't think he is here today, but his wife passed away during the year, and I think we should send him our condolences.

(The Convention stood in silence).

I am going to ask the Secretary to announce apologies and greetings.

THE SECRETARY, Mr. R. G. EWING (Johannesburg): We have a number of apologies and greetings this morning. Firstly a telegram from Mr. C. W. Everett, who wishes all the best for the Convention.

Mr. J. Yodaiken, of Que Que, who is listed as attending, was unavoidably detained, and he sends his best wishes for an informative and pleasant Convention.

The President of the Institution of Mechanical Engineers regrets his inability to attend the Convention and sends best wishes.

Mr. Dave Bradley says "Greetings and congratulations. Best wishes for happy and instructive Convention. Much regret my inability to attend."

Mr. H. V. Ward, Greytown, was unavoidably detained but trusts that the Convention wil be a great success.

Mr. J. A. Black, President of the Steel and Engineering Industries Federation of South Africa regrets his inability to attend, and members of the Executive Council.

The S.A. Institute of Electrical Engineers, Mr. C. M. Southgate, regrets his inability to attend, but also sends his best wishes for a successful Convention.

The City Librarian of Johannesburg, Mr. R. E. Kennedy, regrets his inability to attend.

Mr. W. G. Berry will be away, but conveys, to you, Mr. President, his best wishes for an enjoyable and fruitful Convention.

Mr. R. M. Stephenson, formerly of the British General Electric Co. (Pty.) Ltd. has send an apology.

Dr. D. B. Reay of Escom has sent an apology, and Dr. Reay extends his best wishes for the fullest success to you, Mr. President, on this occasion.

Mr. Brian Colquhoun, Hugh O'Donnell & Partners, Salisbury, regret their inability to attend.

The British Thomson-Houston Company of Central Africa extend their apologies; as do Falks Electrical (S.A.) (Pty.) Ltd., Metropolitan-Vickers Central Africa (Pty.) Ltd., and Mr. C. R. Deglon conveys his best wishes for a successful meeting.

Messrs. Mine-Elect (Pte.) Ltd., Salisbury, regret non-attendance on this occasion.

Apologies have come from the National Occupational Safety Association, C. A. Parsons & Co. (Rhodesia) (Pvt.) Ltd., the Provincial Administration of Natal, the Transvaal & Orange Free State Chamber of Mines, and the Provincial Administration of the Orange Free State.

Regrets have been forwarded on behalf of the Secretary of the Department of Labour for his inability to attend; apologies also from the General Manager of Transport, Johannesburg, Mr. C. E. R. Langford, Mr. A. Foden, the Municipality of Wellington, the Town Council of Nigel, the Municipality of Matatiele, — who all regret their inability to be present on this occasion.

Apologies have been received also from the following: Municipality of Mossel Bay, Mr. H. P. Alexander of Escom Natal Undertaking, Mr. H. J. Gripper, the City of Kimberley and the Municipality of Springfontein. Also from Mr. Nicholas, and Mr. Attridge, of Tshumib, South West Africa.

Thank you Mr. President.

THE PRESIDENT: Thank you, Mr. Ewing.

We have one or two awards to make today. I am referring to Honorary Members elected through the year, and I would like to ask our immediate Past President to present the awards to the three gentlemen concerned.

First of all Mr. Halle.

Mr. Halle received his award.

Before Mr. Halle sits down — there is a microphone behind him.

Mr. C. R. HALLÉ (Port Elizabeth): Mr. President, ladies and gentlemen: I thank you very much indeed for this honour. It is a very fine and unique occasion for a Transport Manager to discover he is still an honourable member of Society!

Actually, I have not been retired — I have just been re-treaded, and, as you know, you are only young twice, that is before and after 60, so I am very glad to be here to help you "raise Kane!"

Thank you very much indeed.

THE PRESIDENT: Mr. Giles, would you come up and collect Mr. Foden's award.

Mr. Giles received Mr. Foden's award.

Mr. J. C. Waddy collected Colonel C. G. Ewer's award.

Perhaps I should have told you that Mr. Hallé, a Past President, was elected Honorary Member during the year, Mr. Foden, Past President, East London, also an Honorary Member, and finally Colonel Ewer, who, at one stage, was the City Electrical Engineer of Pietermaritzburg. (I don't know if it was a city in those days), and I think the eldest surviving Past President, so we ask Mr. Giles of East London and Mr. Waddy of Pietermaritzburg to accept their badges on our behalf.

Finally, I have another duty to perform, and I know you will join with me in my pleasure in giving Chris Downie proof that he has served an apprenticeship to join the ranks of Past Presidents, and to wear one of these delightful little identification discs or reference books, or whatever they are are called, and on your behalf, congratulate him and thank him for what he has done throughout the year, and wish him many years of happiness with us.

Mr. G. C. DOWNIE (Cape Town): Mr. Kane, ladies and gentlemen, thanks very much indeed for these tokens of your appreciation of my having carried out my duties as President of your Association. Thank you very much indeed.

THE PRESIDENT: The next item is the election of the Executive Council. The staff was supposed to hand out ballot papers to those who want them, but I think they have been placed throughout the hall. I want to remind you that it is only the Engineer Member and one Councillor member of any Municipality or Supply Undertaking who can vote, in terms of the Constitution. The office bearers at the present moment are:

P. L. van der Walt, Krugersdorp.
C. G. Downie, Cape Town.
R. M. O. Simpson, Durban.
R. W. Kane, Johannesburg.

In addition the two Chairmen of the Branches, Mr. Stevens of Ladysmith, and Mr. Barrett of Queenstown, will continue as Chairmen of the Branches until the mid-year Executive. Consequently you have six vacancies on the Executive. The retiring members are:

J. E. Mitchell, Salisbury.
D. P. Hugo, Pretoria.
C. Lombard, Germiston.
J. C. Downey, Springs.
G. J. Muller, Bloemfontein.
P. A. Giles, East London.

There are six vacancies.

You will elect at least one representative from each Province.

I also suggest that you do not write every name down at this stage. Let us collect the names as they are accepted, then we will read them out and then vote. (Incidentally the Federation is a Province!)

The following members were duly nominated and seconded:

P. A. Gilles, East London.
J. C. Downey, Springs.
G. J. Muller, Bloemfontein.
D. Murray Nobbs, Port Elizabeth.
J. C. Waddy, Pietermaritzburg.
C. Lombard, Germiston.
J. E. Mitchell, Salisbury.
D. J. Hugo, Pretoria.
A. R. Sibson, Bulawayo.
A. Rossler, Cradock.

I beg your pardon, I made a mistake. Mr. Muller is automatically elected if there are no further nominations, and you have to vote for five.

Honorary Members can also vote.

I wonder if Mr. Wilson and Mr. Burger would act as scrutineers?

(This was AGREED.)

Mr. R. M. O. SIMPSON (Durban): Ladies and gentlemen, it gives me very great pleasure to call upon our President to give his Presidential Address.

PRESIDENTIAL ADDRESS

I must first express to you all my deep appreciation of the honour you have done the Johannesburg City Council and myself in electing me your President for the ensuing year. Like our retiring President in his remarks last year, I feel all the more honoured that I have been selected to occupy the same Chair as my predecessors from Johannesburg. I refer to the late Dr. Dobson, the first President of the Association, the late Bernard Sankey, and then Arthur Rodwell and J. C. Fraser, both of whom are with us here today. Arthur Rodwell held office on two occasions and consequently this is the sixth occasion upon which Johannesburg has been honoured. I knew Dr. Dobson, but not as employer, and have served under Bernard Sankey, Arthur Rodwell and J. C. Fraser. I still have a letter in my dossier from Bernard Sankey reprimanding me for certain misdeeds. All I can say about Arthur Rodwell and J. C. Fraser is that they either were very tolerant, or, perhaps I am proud of the fact that I am the first Johannesburg born President to represent Johannesburg on your Executive Council.

In deciding on a topic for the Presidential Address, I thought of many subjects. I was severely tempted to talk about Johannesburg and noted that many problems concerning municipal undertakings and their role in Southern Africa—economics, staff, development in the future, and various undertakings—had been discussed by my worthy predecessors, and finally I decided to talk to you about our Association. I got the idea from Mr. Clinton's address in Salisbury during 1945 and it is interesting to note that he mainly referred to the future of the Association, his plea being that no organisation can afford to remain static but must forever advance and change. He made certain suggestions for consideration and some of these have borne fruit.

My plea will be in a somewhat different form in so far as I hope that your Executive Council will receive advice and suggestions from members.

First of all let me deal with the history of the Association. For that I make no apology to those who know it well, but as there are many others in our ranks today who are relatively newcomers—like myself —I trust they will find it interesting. In addition, with the presence here today of our President of the Electrical Engineers, which Institute celebrates its 50th Anniversary this year, a little history will not be amiss.

The first Congress, as it was called, was held in Johannesburg during November 1915 and lasted for six days. It was then that the Association of Municipal Electrical Engineers was formed and of the 22 persons present, representing 16 towns plus a further 9 persons elected during that year, representing a further 8 towns, constituting a foundation membership of 31 natural persons (to borrow a phrase from our Constitution) and 24 towns, it is interesting to note that only one of these towns is no longer a member of the present Association, having resigned about 10 years ago. I have not been able to establish how many of the original members are hale and hearty today, but I had hoped to welcome here today our first Honorary Treasurer, then a member of the Johannesburg Electricity Department, Mr. E. T. Price, Senior. In his first statement given in 1917 he referred to the happy position of having a credit balance of over £30 which, with an income of £79 10 0 actually works out as a profit of 38·6%! However, I won't enlarge on that!

Apparently it was decided in those days to meet every two years, and, with the exception of the periods 1919 and 1920 and again in 1926 and 1927, this habit continued until 1933, thereafter the Association met yearly with the exception of the period covered by World War II.

I have been interested in the advertisements printed in the early days of the Proceedings and some of these have been reproduced and displayed in the hall today. My apologies to many of our affiliates whose activities are not reproduced and I hope I am not accused of favouritism. Included in the reproduction is a chart showing the membership from inception to the present day, including

attendances of all classes of members at Conventions. Records of attendances at the various Conventions were not completely detailed until 1955 particularly with regard to the fair sex together with what are now known as affiliates, and consequentily I feel that somewhat higher figures applied prior to that date.

Before the Association was many years old it is recorded that the following subjects were matters of discussion :—

Standardisation of Conditions of Supply, Wiring Regulations, Statistical Returns, Registration of Contractors, Registration of and examinations for Wiremen. (Johannesburg By-Laws for wiremen registration were promulgated in 1915 and these have recently been rescinded despite the Wiremen and Contractor's Act of 1939). As Engineers our status appeared to be somewhat elevated in those days, since it is recorded that in 1919, 40 gentlemen sat down to dinner!

The Presidential Address was not sacrosanct but was subject to discussion and members cheerfully took advantage of the opportunity afforded them. How lucky the President is today!

Again is it recorded that membership was open to officials of Tramway and Trackless Tram Associations. For some of us the Tramways Department was our largest consumer and shall I say the most troublesome—it is obvious for a few of us that they still maintain the troublesome aspect only!

The late Dr. Hamlin, latterly City Engineer of Johannesburg, was a foundation member of the Association representing Stellenbosch.

In 1922 it is recorded that the dissemination of information on matters of particular interest in the supply and generation of electrical energy under local conditions through the Hon. Secretary throughout the year should be introduced. It had been experienced that despite Conventions extending over a period of a week, the opportunity of the fullest discussion on many questions did not exist. Our Bulletins of today continue this practice.

Theft of material was discussed and the use of screw holders advocated for this reason. It would be interesting to know how many members still follow this practice as we do in Johannesburg for certain installations. In passing it is remarkable that we have not yet found a solution for the theft of copper conductors.

The effects of gas competition were discussed and our competitor, Mr. Curnow, of the Gas Department, whom I had hoped would be here today would be interested to read the Proceedings of 1922.

One Councillor deplored the preference for imported equipment as against that of South African manufacture but did admit to a preference for a little (?) Scotch Whiskey!

Some concern was expressed over the Electricity Act of 1922 and in retrospect I think our fears were somewhat exaggerated, although I must also admit that active objections to the results of the Act have not been lacking over recent years.

We were concerned about the advent of the metallic filament lamp when the carbon filament originally required 4 watts/candle, the then reduction to nearly ½ a watt/candle and the further possibilities of this being reduced to 1/10 watt. Lighting of course was one of our main types of consumption in those days whilst today we are perhaps more concerned about its effect on power factor and to a certain extent in capital charges. Dr. Hamlin in 1924 rather deplored the life of the new ½ watt lamp and for the benefit of our affiliates this argument on life has never been concluded!

At the same time methods of tendering were under review and no doubt some of our members will be interested in this. Labour quoted for planting of poles varied from 10/- to £3 5s. 0d., excavations for cables from £250 to £1,170 per comparable unit whilst meters varied in quotations from the makers as against that of agents, between 50 and 100 per cent. In those days we were apparently concerned about the immense variations in price and today we are suspicious if there is no variation at all! Somewhat illogically I again refer to the preference for Scotch Whiskey! And sigh a sigh of relief when I realise that this address is not open to public

discussion. May I suggest that our own preferences are rebounding on us!

However, I do want to say at this stage that although tendering abuses are apparently indicated in certain cases, shall we not rather add that the larger local authorities can look after themselves in the case of generating plant and for everyone, large or small, we get good value in our purchase. Let us compare the cost of a simple—to us—electric meter with the price of a shirt, pair of grey flannels or a suit. Latest quotations for single phase meters are standing at £3 0s. 6d.—and I will not quote the other prices, but I do sincerely think that the quality and material involved in the manufacture of meters is outstanding. A meter life is 10 years before adjustment with 20 years for replacement. Meters are used 24 hours per day and every day up to 10 years—shirts, suits and slacks have a much lower load factor. In this connection a 5 guinea pair of slacks should last nearly 65 years compared with a meter, before being overhauled, apart from being replaced. No wonder engineers are generally poorly dressed! Need I say any more?

On reflection perhaps I should say that all our development and planning is indirectly affected by our friends of the affiliate membership who, through their parent companies can exert a vast and definitely a beneficial influence in our undertakings by their continued endeavour to produce the latest and the best at reasonable cost.

For the benefit of our Councillor friends I also quote from the Proceedings of 1924 considering the question "Who are the consumers and what is the Electricity Department?" "Many persons appear to hold the view that muncipal councils are composed of members endowed by anything 'by law,' with no interest or sympathy for the individual as such and over whose actions the ratepayer has no control, often losing sight of the fact that each member is freely elected by the people from among themselves and that the prime object of electing such representatives is that the few may, in the name of the whole community, carry on such works and provide such necessities as cannot be provided by the individual himself. While individuals may be able to provide some or all of the essential services for themselves in some form, yet experience indicates that a municipal service for the whole community offers the 'greatest good for the number'.

I am interested to note that Mr. Wolley Dod of Pretoria is quoted to the effect that a later Manager in Johannesburg, namely Bernard Sankey, was really the founder of the Association, it being through his efforts, whilst still in Port Elizabeth, that the idea was expanded, since he was a member of a parent association in England.

Electrolysis concerned us in 1927 mainly because of our friends of the Tramways and, in this connection, I am delighted to record that their big brother of the railway Administration has taken over this problem, at least on the Rand, and have given the average local electricity authority a breathing spell.

We were told in 1927 that 30% of the coal mined in South Africa goes to waste and that this is the coal that the power stations should use. Many of us did in fact design and plan to use this coal but alas other economical problems have caught up on us and we now pay what I consider is far too much for our coal! With, I hope, the return to normal conditions as distinct from the post war problems of transport and banning of export, is it too much to hope that we users should be given more favourable consideration? Your Coal Allocation Committee this year reported the availability of ample supplies of coal to the Railways and other consumers and I sincerely hope that our friends of the coal mines will re-establish the export trade lost to them in recent years.

This now brings me to the subject of tariffs which, like earthing, will be with us always and these are the two hobby horses that we all like to ride. Shall I quietly sum up by saying that I was delighted to read in one of our Proceedings that the difference between lightning and lighting, is that we all pay for lighting! Entirely overlooked, is the fact that the supply authority also pays for lightning, at least in sundry repairs and replacements.

In concluding the historical aspect I would like to briefly mention that in 1926 the Rhodesias were invited to be members, and, in 1936, in Johannesburg our consti-

tution was changed to more or less that of today, and in effect it became an Association of Municipal Undertakings with our friends the Councillors taking a more active part in the deliberations—if only from a financial point of view, because I have still to meet the average Councillor who can distinguish between Kilovolt amperes (kVA), Kilowatts (kW), Megawatts (MW) and K.W.V., though it was apparent in Cape Town last year that K.W.V. was thoroughly assimilated, particularly by the fairer sex—I mean of course the perfumes produced.

Again in 1955 for the first time, our affiliates, for their sundry misdeeds of the past, appeared as members of the Association and may I once again, as other Presidents have done, welcome them to our activities.

Tomorrow we will visit the factories of some of our affiliates. I do sincerely thank those who have made these visits possible.

I have now reached the main topic of my address, namely, our Association and its activities and I will start with your Executive Council.

By circumstances appreciated by the bulk of members it seems to be inevitable that the larger towns provide representatives for your Executive Council and this, from time to time, has caused some concern. I am rather conscious of the fact that such an Executive can become somewhat autocratic even with the best of intentions and my following somewhat rambling observations have been expressly designed to encourage the receipt of the views of members.

Size of Executive Council.

The constitution has been altered over the years to provide a membership of 12 in 1937, 14 in 1949, 18 in 1950 and 20 plus in 1958. The main alterations provided increased representation by Councillors, Provincial representation and finally, the introduction of branches which today form a council of 22 individuals with automatic increases when additional branches are formed. Roughly this means that 10% of your members constitute your Council. It is perhaps too early to judge whether this is too large or not, although I tend to suspect the former, particularly in its effect on our finances.

Branches.

The constitution was altered during 1955 to make provision for regional branches. This alteration was introduced mainly because of the activities of the Rand Association of Municipal Electrical Engineers, which meets fairly regularly throughout the year and whose recorded proceedings was, and is, highly appreciated by others further afield. At that time provision was made of branches, one in Natal and another in the Cape and accordingly your Executive was increased by two additional members.

What does amaze me, however, is that Rand Association has not seen fit to take advantage of the opportunity offered. I have noted that the two relatively large undertakings represented, namely, Pretoria and Johannesburg (with all due apologies to Springs) have consistently taken care not to hold senior office in that Association, apart from secretaryship, and in fact, have welcomed and supported the election of others to the post of Chairman.

There may have been a period when all were not members of our Association of Southern Africa, but that is not entirely the case today. Approximately 31 cities or towns can be present at a meeting of the Rand Association which indicates that the Rand, as such, has grown somewhat. Personally I would be pleased to see that Association a branch of this Association and I suggest that this matter again be considered by our Rand members. I appreciate that there are a few problems, mainly of a geographical nature, but these are not insurmountable.

Election Procedure.

Regarding elections it would appear that it has always been customary to conduct the election at the Annual Convention and this, of course, means that only the members present have any real say in the election. Whilst this may be suitable and perhaps all that is neecssary, I have often wondered if we should not introduce a system whereby our absent members could at least have more say in the election. This, of course, could only be done by a postal vote which, in turn, would mean a fair amount of expense and labour in first of all seeking nominations, then the

preparation of ballot papers and finally scrutinising the votes.

At Cape Town last year 76 Engineers, 54 Councillors and 6 others were available for voting, a total of 136. The total electorate is 237 and consequently we had or could have had a 57% poll and slightly above average. On the other hand, approximately 43% of the members had no say in the election.

Considering a postal vote, one must not forget that the Councillor representatives sometimes vary from year to year, may not know the nominated persons and human nature being what it is, postal voting could also provide a very disappointing poll.

As I see it, the present system provides a reasonable poll, whilst a postal vote would enable all members to participate and bluntly, only those entitled to vote. Its disadvantages would be mainly expense and the possibility of a poor poll.

Rotation of Election.

Some years ago a suggestion was made at Convention that members of Executive should automatically retire after 3 years' service. The practical application of this was not considered or explored but the purpose of the suggestion was really to prevent any undertaking serving on the Executive continuously for a number of years and thereby enabling others to share in the Executive duties.

It was also suggested that voting should be done in groups by Provinces. Again no details were given as to whether each Province should be allotted a fixed number of seats on the basis of fees paid, units sold, membership or any other basis, or whether such procedure would appoint the single provincial representatives and thereafter the balance of representatives would be by Convention. Personally, I feel that this suggestion, apart from being somewhat cumbersome in application, would restrict somewhat the members' choice of suitable representation.

Reverting to the previous suggestion, namely, automatic retiral after a defined period of presumably continous service and particularly with a smaller executive, there may be room for thought here. For those of us who are honoured by being elected office bearers, traditionally the period is 4 years and constitutionally 3 years. I think it is for members to decide whether any advantage or improvement is possible on this suggestion or whether, in fact, the present system is satisfactory and preferable.

Attendance at Conventions.

Normally the attendance at Conventions is reasonably good and in the post war years has never dropped below 50%, the average being approximately 65%, but there are 4 members who have never attended Conventions and a further 10 where the attendance varies from one to three appearances. Taking into account the vast distances to be travelled in this sub continent, the size of some of the towns represented and quite possibly other factors of which we have no knowledge, it does seem regretful that the only contact with a few of our members is through the postal service and even our proceedings are only forwarded to them many months after the Convention. Normally non attending members receive no prior details of the papers to be presented or other aspects of the Convention programme, but this year, and possibly for the first time, it has been arranged to forward all information to all such members, together with a request that written contributions would be welcome.

It is hoped that this will at least be welcomed by our absent members and may engender a desire to be present more often. No doubt financial reasons are mainly responsible for some absences and with all diffidence, I am suggesting that perhaps your Executive could see their way clear to invite—perhaps one per year —to our Convention as guests of the Association. The idea is not entirely original but with our rather improved finances perhaps something could be done in this direction.

Duration of the Convention.

You may remember that I mentioned that the first Congress lasted 6 days—Monday to Saturday inclusive. This period has varied throughout the years, but more recently the formal business has been limited to 3½ days. Admittedly, the Executive meets for a full day prior to Convention and may also meet again after Convention, but there have been many

occasions where I have gained the impression that discussion has been stifled or limited owing to the time available. Agreed that a genuine attempt to comply with the programme times may be responsible for this and any deviation may be awkward.

However, when one considers the distances invariably travelled, the outlay, particularly of our Councils, in sending us to Conventions, the sometimes obvious lack of time in satisfactorily discussing mutual problems with each other privately and many other factors, would there be any advantage in extending the duration of the Convention for say a further day?

Training of Personnel.

Mr. Clinton mentioned in his 1945 address the possibility of our Association training or controlling the training of operating personnel. I think I am correct in saying that this problem has affected us all in varying degrees. Whilst it may not appear of immediate necessity nevertheless is it unreasonable to imagine that the time is not so far distant when the class and source of such personnel will change? Should we prepare the foundation of a scheme now and if so, in what manner?

Conclusion.

There are many other aspects of our activities, some of which will be covered by the reports of your representatives later on this week that could be mentioned here in more or less detail, and briefly I refer to the registration of wiremen and contractors, the wiring regulations, the Recommendations Committee and others. Have the members any thoughts or decided opinions on these? Often in Conventions certain aspects of our activities are commented on, or suggestions are made; quite frankly many of these are not fully considered nor is the time available. Consequently, I sense that an opportunity for consideration before reaching a decision would be appreciated.

Hence in concluding my address, I sincerely hope that members will take the time, either here or on their return to their homes, to let the Executive know what your thoughts are, any suggestions you may think requires consideration.

Thank you all for your tolerance and I hope we will get some fruitful results.

Mr. R. M. O. SIMPSON (Durban): I now call upon Mr. Clinton to propose the vote of thanks to our President for his most interesting address.

Mr. J. S. CLINTON (Johannesburg): Mr. President, Mr. Ross-Spencer, ladies and gentlemen: My name has been mentioned in the President's address for something I said 14 years ago. Just in case it was done with the intention of allowing me an opportunity to recant, may I say that I am not repentant. I still mean what I said 14 years ago, but would like to warn members that I have now been driven into the outer fringe of associates, so possibly there is a penalty for speaking one's mind.

The President, I am sure, in 14 years' time is likely to be extremely proud of what he has told you today and the deeds I am certain will follow his very interesting Address.

The aspects of the address to which I should like to refer are, first of all, its timeliness, the critical approach of the address and the courage with which Mr. Kane has dealt with the subject matter. Finally the tactful way in which he has handled a very contentious subject.

Sir, the timeliness of your address is very opportune because of the low activity in the field of public supply of electricity. As we all know, the average rate of growth throughout the country is very much lower than it has been for the last 15 years and I think it is well that we now take stock, as the President has suggested, to ascertain whether there are the means at our disposal for improving matters in regard to the supply of electricity and generally to overhaul the whole system of municipal ownership of electricity undertakings.

The President has referred to the existence of public ownership of trading undertakings. He has also indicated that the extent of policies we adopt in the administration of electricty undertakings might affect the growth of the material welfare of our country well or otherwise and I suggest that, when you go back to your homes you should take heed of what he has said and make some attempt to contribute to the welfare of this Association and to this country of ours.

As you all know, Dr. van Eck as long ago as 1936 referred the Government of

the day to the fact that public ownership throughout the Union of South Africa was absorbing roughly 50% of the total investments of the country each year.

Now, sir, that, as you will agree, is a very big proportion and of that electricity undertakings play a very big part, but unfortunately, (and it is an important aspect) only about 3% of the gross national product arises from that huge expenditure in regard to capital investment.

As you know, in public ownership, the great difficulty is to remain efficient. In Britain, some 7 years after complete nationalisation the Government set up a very important investigation committee, now known generally as the Herbert Committee, which reported on all aspects of public ownership of the means of producing electricity in Britain. I think the President is to be congratulated upon bringing to our notice that we, too, in this country, need to review that very important aspect.

I think, sir, that one of the unwritten instructions in our constitution should be in future that every seventh President be asked to review the welfare of the Association and perhaps even the existence of trading undertakings run by municipalities.

The next part of the President's address which gave me cause to think (and we all know him very well), is his flair for critically analysing problems put to him.

He is a person who does not readily accept what the public is inclined to believe is for its own good. My friends who read heavy books on philosophy tell me that one of the hardest tasks of a philosopher is to get outside current thought of his time and to review it objectively.

I think, if the philosophers were municipal engineers, they would find the task very much more difficult and the task of a chairman of an electricity committee even harder.

It is extremely difficult, sir, for all of us to get outside the ways of a municipal engineer and to analyse whether the public is, in fact, enjoying what we do for them.

When I attended a meeting at Cape Town recently, Major Berman slated our affiliates for all their wrong-doings. He was assisted very ably by a number of lieutenants and from the President's army career, he will know he had far more lieutenants than a regiment. The criticism was all one-sided and as I listened to it, I wondered what our affiliates would say at their monthly banquets, when they sit back with their long cigars, replete with large brandy glasses, about us as monopolists.

The trading undertakings of this country are monopolies and they would do well to follow the President's recommendations, viz. to examine themselves critically, as he has tried to do.

I listened to the address and I though we might do as well if we had a President, someone who acted as a magic mirror to whom we could say, "Mirror, mirror, on the wall . . . " or "Mr. President, Who is the fairest of us all?"

This large section of the economy makes it very necessary for us to have a President at this very critical time in the history of South Africa who will be reluctant to accept the ways that have become accepted practice as necessarily for the good of the country's future.

The next aspect of your address which impressed me was its display of courage. We have known for a long time that you are courageous in dealing with subjects which other and lesser men would be afraid to tackle. Possibly you have crossed the borders of Ireland and Scotland and South Africa so often, that you have learned to be courageous when you meet immigration folk and customs people. By now I suppose your courage is well-entrenched and we are glad to have you here today as our President and to know that for the next year we have somebody who is going to bring about a big change in the affairs of the Association.

Sir, courage in leaders is a rare think. Lots of people have ideas, but it takes a courageous leader to carry them through and in referring to your address I could not help remembering the past millennia of evolution, during which in the archaic oceans of the world there were courageous polyps who jumped on to dry land and led mankind to its present stage of development.

The need for courageous people and leaders is, of course, something we cannot overdo. We don't want too many Presidents who are going to criticise us and take us out of our lazy ways. We wouldn't mind

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one every seven years, sir, but I think one every two years would be rather too much.

But the courageous leaders who will attract to their cause men of like ideas will get nowhere without the tact that you, sir, have always displayed in handling matters, either in committee or in open council.

In our democracies we get nowhere merely by rebellion. Rebels can't succeed by themselves they must have friends and in the field of private enterprise I am afraid we have grown very sensitive to criticism. I would like to give you a few examples. If our friend Mr. Downey were to leave his very smart Rover at Springs and come in by train and if the train service were not up to scratch, I am sure if he were to write to the Star and complain there would be, as a footnote to his letter, in italics, a very caustic comment from our equally good friend Mr. du Plessis, proving to him how very efficient our railway system is. We have friends, Banana Boys from Natal, who might have wives who don't like our Eastern Transvaal bananas. Mr. President, I suggest you advise their wives we have a "Sunday Express"; but if they were to write to the "Sunday Express," there would not be merely a footnote, there would be a few columns from our Banana Control Board proving that our bananas are of excellent quality.

As I looked around the hall, I thought there might be an opportunity of our Reef members introducing the very vexed question of rights of supply in urban areas, but having seen our Commission friends very strategically placed around the room, I suggest there is not much chance of winning and that you stifle a discussion on that score.

But, sir, jesting apart, in our ivory tower of municipal ownership, we are inclined to forget that very important person, the customer. I think we have all of us worked in municipal undertakings and found that criticism bears rather hard on us. We feel, we are doing so much good for the town and any form of criticism, we feel, is unjustified. Our complacency and our smugness which is so apt to develop, will be shaken out of us by your address today. We shall be led once more to believe that a customer is a person to whom we must pay a great deal of attention.

Mr. President, throughout your address I think you have made a comprehensive survey and a good set of reasons have been produced for us to consider the welfare of the Association and the welfare of municipal trading undertakings.

Dames en here, onder ons vandag is daar lede van ons universiteitsdorpe. Uit hulle is ek dan ook seker ons President kan een vra om aanstaande jaar 'n professor van ekonomie saam te bring. Ek het voor my die naam van Prof. Schumann van Stellenbos, maar daar mag ook iemand anders wees gewillig om vir ons aanstaande jaar 'n rede in verband met ekonomiese sake te lewer. Dis 'n agterstallige drukkende nood. Ons hoor van atomiese kragsentrale en verspreidings netwerke, maar wat belangriker is en wat ons persoonlik raak, is finansies. Byvoorbeeld, ons behoort seker te wees dat plaaslike owerhede se bestuur en eiendomsreg van elektrisiteitsondernemings nog in die belang van Suid Afrika is.

Presoonlik wil ek ook weet watter rol profyt speel in ons kapitalisme en ook in ons plaaslike bedrywighede.

Lede, ons President het vir u ondersteuning gevra. Onthou goed.

Ladies and gentlemen, it is my very pleasant task to propose a vote of thanks to the President. I personally enjoyed his address. I am sure you all enjoyed it and I am sure it will lead to greater things in the history of this Association of ours.

I have very great pleasure in asking you to signify your approval of the vote of thanks for his entertaining and instructive address.

Mr. R. M. O. SIMPSON (Durban): Thank you very much Mr. Clinton. I now cal on Mr. Rodwell to second the vote of thanks.

Mr. A. T. RODWELL (Johannesburg): Mr. Vice-President, Mr. Ross-Spencer, ladies and gentlemen: it is my very pleasant duty to second the vote of thanks which was so ably proposed by Mr. Clinton.

The President, in his address, makes reference to a reprimand he once received from one of his former chiefs for what Mr. Kane calls "certain misdeeds." I am relieved to find that he considered his other chiefs, including myself, very tolerant. Tolerance begets tolerance, and I can only assume that his well-known broad outlook and tolerance was reciprocated.

I well remember, long ago, it was my unpleasant duty to refuse a request from him of a very honourable and generous nature. He was very hurt, and in his usual straight-forward way, he made no secret of the fact. I was not in a position to elucidate my reason for refusal, and was precluded from explaining my difficulty, but he accepted my statement that he would be satisfied with events in the near future.

He carried out his duties even more ably, and meticulously, than before. I believe he agrees that things subsequently worked together for good. These and other matters convinced me that Mr. Kane would attain eminence in his career and profession and it gave me great pleasure when he, following Mr. J. C. Fraser, was appointed General Manager and Chief Engineer of this City's Electricity Undertaking.

He has held the position as President of other scientific and technical organisations, and now he occupies the important position of President of our Association.

The President's address is not open for discussion. Among other matters, his address deals with the history of the Association, and a number of fundamental matters of great importance which have and will recur from time to time during its history.

It is often thought that these matters are not adequately dealt with, are held in abeyance, and even shelved. This is not so. Each problem has been dealt with in the particular form of its presentation, and to best suit the particular period of its presentation. There are a number of matters which cannot be dealt with and concluded immediately. They change with progress and events, and cannot be finalised.

Our Association has not remained static. You remember Mr. Clinton's quotation in 1945. He certainly didn't remain static. I remember many years ago, at one of these Conventions I went for a walk with him. I had to take at least three steps to his two, and then he took me for a rather hectic motor ride, and now I understand he has taken to the air and has his own flying service. We do hope that he will not take off into space! We need him. He has done such good work for the Association, and, of course, there are other reasons, that we would like him to remain with us.

Our Association has not remained static, but has advanced with the progress of science, technology, and sound economy, and here I make no reference whatever to — what did you call it Mr. President? A profit of £477 in our Balance Sheet. That, of course, would be quite out of place. In dealing with an Association you may not talk of profit but "excess of revenue over expenditure."

We claim that the Assocition has contributed through the work of its members in no mean measure to the development of the Electricity Undertakings represented here, and has a record of successful achievement of which we are proud.

The electrical profession requires no justification for its existence, although among the younger of the professions, it is so essential, so virile, and so necessary, it does not follow but it leads. Both the councillors and the engineers desire to serve the public. Generally city and town councillors with a public spirited desire to take their part in improving public services, and to ensure as far as possible, that efficient service is given to the ratepayers, at economic cost, are not in possession of the detailed facts, technical requirements, methods, organisation, and the period of time necessary to carry out their attempts to improve existing conditions. They are often disappointed when their efforts appear to be delayed, opposed and even nullified. This often leads to a feeling of frustration. The engineer's duty is to advise the city or town council, through appropriate committees, of the object, possibility, advisability and his opinion, of the necessity or otherwise of the suggested works. He must furnish all particulars and estimates of the requirements to bring the work to successful completion, he must bear in mind government and provincial requirements, the rapid advance in design and manufacture and the possibility of obsolescence. He reports and recommends to his committee, (which may be looked upon as his board of directors), his opinion of the best course to adopt and pursue. The recommendations prepared after much work and investigation may not be accepted to the distress and disappointment of the engineer.

The President, when concluding the historical aspect, refers to the period when the

Rhodesian Undertakings joined the Association, the active part the councillors take in deliberations, discussions, and decisions, outside bodies and provincial representation, regional branches and affiliates. Our Association was among the first in South Africa, to realise the importance and to give effect to meeting the human relations aspect of our work, and to create the essential atmosphere of co-operation and understanding of all its members. This has led to a better appreciation of each other's difficulties and problems, leading to sound conclusions. This understanding in human relationships should not, and does not prevent straight speaking in discussion, nor mar the friendly relations and respect we have for each other in our Association. It enhances our respect for our fellow members and their opinions, resulting in wise decisions to the advantage of the ratepayers and the public whom you all serve.

The attainments of the electrical profession are practical manifestations of its personnel and its progress is principally dependent on the efficiency with whom we organise and stimulate human effort. Under our President and Executive we, of the Association, in the future as in the past, will not fail to keep abreast of the needs of service and modern requirements, and will, in full measure, and in a spirit of mutual help, continue to permeate the electrical profession and industry as a vital stimulus to effort and progress. The greater the knowledge acquired by the scientist and the physicist, leading to brilliant discoveries, the more we realise that we are only on the fringe of the great tracks of knowledge and truth.

In our Association we have members who have served as engineers and are now councillor members. They, indeed, have a wide and varied experience, of the need for goodwill and tolerance, and are a great asset to our Association.

Apart from his other attributes, our President by training, experience, and nature, is ably fitted to carry out this work dealing with human relationship, in addition to the other important activities he has enumerated in his address.

The position of President carries onerous duties, which we know Mr. Kane will discharge with distinction, and will enhance the position of President.

It affords me particular pleasure to second the vote of thanks to our President, and we all wish him a successful and very happy year of office.

Mr. R. M. O. SIMPSON (Durban): Just before I vacate the Chair, will the Convention express to our President in the usual manner their appreciation for his most interesting address.

THE PRESIDENT: Thank you Mr. Simpson, and particular thanks to Mr. Clinton and Mr. Rodwell.

Mr. Clinton did refer to smugness, and the bad habits we all get into in consideration of our customers: I fully agree with him. I think from the way some of our customers treat us, we do get somewhat case-hardened, and so do members of our staff, but I have always thought, you have to listen to the other man, and see if you could possibly make a mistake yourself. You find out how often you do.

Mr. Rodwell has let one or two cats out of the bag — those unhappy interviews during the war years, when I didn't agree with his decisions, but, as he said, it turned out all for the best.

Thank you very much, particularly the two proposers, Mr. Simpson — and all of you for listening to me.

Finally I would like to announce that there has been absolutely no change whatever in the Executive. I am sorry for them, and I am very sorry for myself. I am sorry for the other two or three good people who have been unsuccessful, and I hope they will keep on trying.

I would like to welcome this very good team, I know I am going to have a tough time tomorrow morning, and I hope they will carry on as they have with other Presidents, in the good work of the Association. My congratulations.

LUNCHEON ADJOURNMENT.

On Resuming at 2.30 *p.m.*:

THE PRESIDENT welcomed Mr. A. E. Powell, from Newcastle-on-Tyne, and thanked Messrs. Merz and McLellan for releasing him to come all the way to Johannesburg in order to give his paper on "Nuclear Power."

NUCLEAR POWER

by

A. E. POWELL

Presented to the 33rd Convention of the Association of Municipal Electricity Undertakings in Southern Africa at Johannesburg, 12th May, 1959.

Summary :

The paper contains a brief survey of the preparation of uranium for use as a nuclear fuel, and discusses the differences between it and conventional fuels. A review is made of the principal characteristics of various types of reactor potentially capable of meeting the requirements for power generation in the near future, mentioning the relative advantages and disadvantages of each. The problems of integrating nuclear power stations with existing generating systems are discussed with special reference to economy, and reference is made to energy storage schemes in this connection.

URANIUM

(i) Introduction

At the present stage of the nuclear power industry, uranium is the paramount material and one for which there is no substitute. Plutonium can be used in some applications but it is made in nuclear reactors from uranium, and although thorium will eventually be used in nuclear reactors to make more uranium, that process will require uranium to start it off. Uranium is thus the vehicle on which the whole nuclear industry rides.

South Africa has extensive reserves of uranium in ores of fairly low concentration and her contribution to the nuclear power industry at this time is as an exporter of ore. In 1957 her exports were worth £50m. and last year they rose in value to £53m. This paper deals with one or two aspects of nuclear power relevant to the question of whether or not South Africa should play a greater part in this industry at the present time.

(ii) Occurrence and reserves

The two minerals uraninite and pitchblende consist chemically of uranium oxide U_3O_8 and are of primary importance to the uranium industry. Most of the world's uranium production comes from ores with an oxide content between 2 and 5 lb/ton of ore, except South Africa's contribution which originates principally in gold-bearing ores having an average oxide content of about 0.7 lb/ton. Published figures for the high concentration or workable reserves and outputs of the principal producers are as follows :

	Reserves Tons U_3O_8	Probable 1958 Tons U_3O_8 output
South Africa	370,000	6,000
Canada	370,000	15,000
USA	220,000	12,000

France, Australia, Czechoslovakia and USSR (undisclosed) also have important reserves of workable ores. China claims to be rich in reserves but so far no indication has been given of either location or size.

(iii) Extraction and purification

The ore is crushed and ground and then dissolved in chemicals of which large quantities are required as physical concentration of the ore is generally not possible. Most of the impurities are removed by filtration before the uranium is extracted as a high grade concentrate and fed to the purification factory where all but the smallest traces of impurity are removed especially elements such as boron which are particularly good neutron absorbing substances. The pure uranium ingots produced in the purification factory are melted in electric furnaces and cast under vacuum to form rods of metal which are subsequently machined and sealed in metal cans to become fuel elements. Many complex chemical processes requiring costly plant and raw materials are used throughout the various stages of extraction and purification and the final product is expensive. The market value of natural uranium is $18/lb. The raw material high grade concentrate costs $8-12/lb U_3O_8 and the purification charges account for the difference of $6-10/lb. Natural uranium fuel elements with a magnesium alloy can cost $25/lb which allows $7/lb for fabricating the fuel element and any contingencies.

(iv) Enrichment

Natural uranium consists principally of two isotopes U235 and U238 which may be described as two types of uranium whose atoms have the same chemical but different physical properties. The important isotope in the chain reaction is U235 which constitutes only 0.7 per cent of natural uranium, the rest being U238. In enriched uranium the concentration of U235 is increased above 0.7 per cent to whatever concentration is required. The enrichment process is carried out in a diffusion plant the successful application of which is made possible by the small difference between the weights of the U235 and U238 atoms. Diffusion plants are possessed by the UK, USA and USSR and France is building one.

In principle the process of separating these isotopes by diffusion is simple enough but the engineering problems of such an installation are considerable as are the power requirements. The US AEC's diffusion plants take about 65,000 million kWh per annum, one tenth the output of USA or more than four times the number of units generated by all the Escom undertakings for 1958. The cost of uranium enriched to 90 per cent U235 quoted by US AEC is $7,000/lb. The same 0.9 lb of U235 would be present in approximately 129 lb of natural uranium costing $2,322.

(v) Use of fuel

In the nuclear reactions occurring within the reactor the nuclei of the fissionable U235 atoms are split into two fission fragments to release energy which appears as heat principally in the uranium fuel. If all the atoms of U235 contained in one pound of natural uranium — approximately one ninth of an ounce U235—give up their energy in this way the heat released is equivalent to that produced by burning 10 tons of high grade coal. The isotope U238 can be converted to plutonium within the reactor and then burnt to give the same heat output per atom fissioned as U235.

Research and power reactors use various types of fuel element of which uranium metal in rod form is one. The can serves to contain the radioactive fission fragments and keep the coolant away from the uranium, so preventing any possible corrosion. The coolant which is passed through the reactor core to remove the heat released in the fuel transfers the heat to another part of the plant where it is used to produce electric power. Eventually it becomes necessary to remove the fuel elements from the core because the initial quantity of U235 has been reduced to a low level and partly replaced by the fission product 'poisons,' or possibly the mechanical strength of the can has deteriorated. The discharged fuel elements are sent for chemical processing in which the unburnt uranium and plutonium will be recovered. In the natural uranium graphite moderated reactor with a fuel burn up of 3000 MWD/tonne less than half the U235 content will have been burnt and less than 0.25 per cent of the U238 converted to plutonium when the elements are removed for processing. Chemical processing like enrichment is expensive.

(vi) Chemical processing of irradiated fuel elements

The discharged fuel elements containing the dangerous radioactive fission products are placed in a decay pond and left for a period of about three months immersed in water while the fission products become less active. After the decay period the cans are stripped from the fuel rods under water and the rods are transferred to shielded containers called coffins in which they are transported to the chemical processing factory. The problems are now to recover the uranium in a form pure enough to put it back into the reactor after the depleted U235 has been restored, to recover the plutonium and to get rid of the fission products.

The fuel rods are dissolved in acid and the uranium and plutonium contents are recovered after several processes in which the fission products are also isolated. The chemical processes are complex as uranium and plutonium have similar chemical properties and the presence of highly radioactive material adds to plant complications. Some plants have provision for the remote replacement of major components but operational experience shows that main-

tenance can be carried out after the plant has been carefully decontaminated.

The radioactivity of the fission products cannot be destroyed by chemical treatment but as they are continuously giving up energy in the form of radiation they decay and become less active with the passage of time. Some of the fission products have to be stored for an indefinite period; others will be stored for two or three years after which time they can be discharged to the sea or rivers. Any effluent associated with the fission products is rendered chemically innocuos before it is discharged.

(vii) Comparison with coal

We are now all familiar with the statement, included above of relative weights of uranium and coal having the same potential energy output, and some may feel it should not have been perpetrated yet again. It is, however, useful in pointing out some of the present day differences between burning coal and burning uranium.

Firstly we know that relatively little has to be done to coal, as mined, before it can be fed to a boiler and there is nothing in that " relatively little" which any country with its own coal cannot do for itself without the use of expensive and complicated plant. Then, with modern PF boilers, we should regard ourselves as incompetent if more than about ½ per cent of the potential energy content of the original coal remained unrealized to emerge as carbon in ash,—and the ash is worthless and nothing either complicated or clever is required to deal with it.

Contrast this with the burning of uranium. The cycle of ore extraction and purification and fabrication of fuel elements which has to be undertaken before the uranium is loaded into a reactor is described above. Even if natural uranium is to be used as fuel this work increases the cost of uranium by a factor of three over its cost as delivered ore and requires much expensive and complicated plant: if enriched fuel is to be used, then the largest, most costly and complicated plant of all, a gaseous diffusion plant, is required and the value of the uranium increases enormously. Also, with present day reactors, we shall regard ourselves as competent if we are able to utilize ½ per cent of the potential energy content of the original uranium as loaded, and the "ash" we shall discharge will be both valuable and lethal. This ash must be handled with great care and more costly plant is required to recover the unburnt uranium and the newly made plutonium, and to dispose of the highly objectionable fission products it contains. Thus the differences between the treatment of coal and of uranium before, during and after burning is clearly very marked.

COMPARISON OF POWER REACTOR TYPES

The neutron plays a vital role in nuclear fission and a broad classification of reactor types is based on the speed at which the neutrons are used to produce fission, namely fast or thermal reactors. In the fast reactor most fissions are caused by neutrons moving with the high speeds they possess at the time of their birth in fission; in the thermal reactor the neutrons are slowed down to low speeds by a moderator before fission occurs. The moderator slows down the fast moving neutrons by allowing them to bump about and lose energy among the atoms of its own light material. The main moderators used are graphite, heavy water, light water and organic fluids. A further classification of reactors is based on the types of coolant and moderating material used. However, one feature common to all power reactors is a primary coolant which must be circulated through the core to remove the heat produced in the fuel. The coolant circulates in what is called the primary circuit which is generally coupled through heat exchangers to a secondary circuit. The main collants are carbon dioxide, helium, liquid metals, light and heavy water and organic fluids.

No single reactor type has yet emerged for which undisputed superiority can be claimed over all others. There is not available at this stage sufficient operating experience and knowledge of the economics of nuclear reactors to enable a firm comparative assessment to be made of the more promising types and only after the

current extensive reactor research and development programmes have been completed will this be possible. In the meantime UK and the Euratom countries have embarked on large scale nuclear power installations. The first stage of the UK programme is based entirely on the gas-cooled graphite moderated reactor. Reactors of this type are also under construction in France and Italy.

(i) Gas-cooled reactors

The Calder Hall type or gas-cooled graphite moderated reactor is of course a milestone in engineering achievement but as is very often typical of pioneering accomplishments, especially in periods of intensive development, some of the features which originally were classed as advantages have in a short space of time become disadvantages or limitations. It is not so much a change in fundamental values as a shift of emphasis. A reactor burning natural uranium uses a fuel which is in relative abundance and on that account alone can be said to show advantage over a reactor type in which the use of enriched fuel is a necessity. Unfortunately the natural uranium fuel elements have to be withdrawn from the reactor and chemically processed after a relatively short period of use due to depletion of fissile content, poisoning and deterioration of mechanical properties after irradiation. The processing costs are high and the present trend is towards the use of enriched fuel to increase the fuel element burn-up and thereby reduce the amount of processing required. There are other advantages associated with enrichment, in particular it makes possible a more compact reactor at lower capital cost. If the supply of enriched uranium can be made as firm as the supply of natural uranium one of the advantages of the gas-cooled graphite moderated reactor disappears.

Gas is not an ideal medium to use for removing heat from the fuel rods, both water and liquid metals will generally do the job more effectively but there are factors other than heat transfer properties to be taken into account, in particular corrosive effects and absorption of the vital neutrons in the coolant. If liquid coolants are used in conjunction with graphite it is necessary to keep the graphite physically separated from the liquid which involves additional complication and cost in core construction. If the coolant is a strong absorber of neutrons the size of the core has to be increased, or alternatively enriched uranium can be used to compensate for the loss. Another important consideration affecting reactor safety is the possibility of losing large quantities of coolant should a failure occur in the coolant circuit. Some of the neutrons which would have been absorbed in the coolant remain in the core with a chance to produce fission and a rapid increase in reactor power possibly leading to damage through overheating. Gases have a sufficiently low absorption factor to prevent this type of dangerous situation developing.

Graphite is not an ideal moderator. It is comparatively cheap at £100—140/ton excluding processing costs but its use results in a large reactor. The combination of graphite and natural uranium in a power reactor leads to a relatively large minimum power output and correspondingly high overall capital costs. This is not a disadvantage when the nuclear power station is required for a large generating system, but the size limitation makes it less competitive over the wider range of power production.

The gas-cooled graphite moderated reactor is adaptable to take advantage of the developments which are being made particularly in the metallurgical field to produce reactor materials which are able to withstand higher operating temperatures and longer periods of use in the core before requiring replacement. The highest working temperature at which the core can operate is set by the fuel or the canning material and the higher this is the more efficient will be the associated steam power cycle. The pressures and temperatures of steam cycles of the nuclear stations at present building, 650 lb/sq. in. and 700°F (Hinkley Point), are considerably lower than the modern coal-fired station steam conditions.

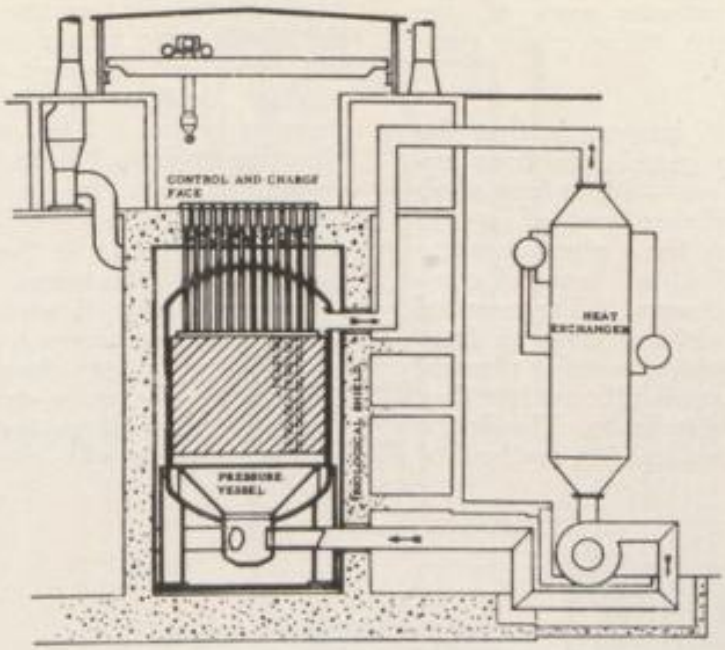


FIG. 1
CALDER HALL

One 5 MW(e) reactor of the gas-cooled graphite-moderated type is operating in France and two more 30 MW versions are building there. Design studies have been done in the U.S. but, of course, the home of the type is the United Kingdom, where five are already operating and seven others are building. Also one "export model" is being built by a British consortium in Italy.

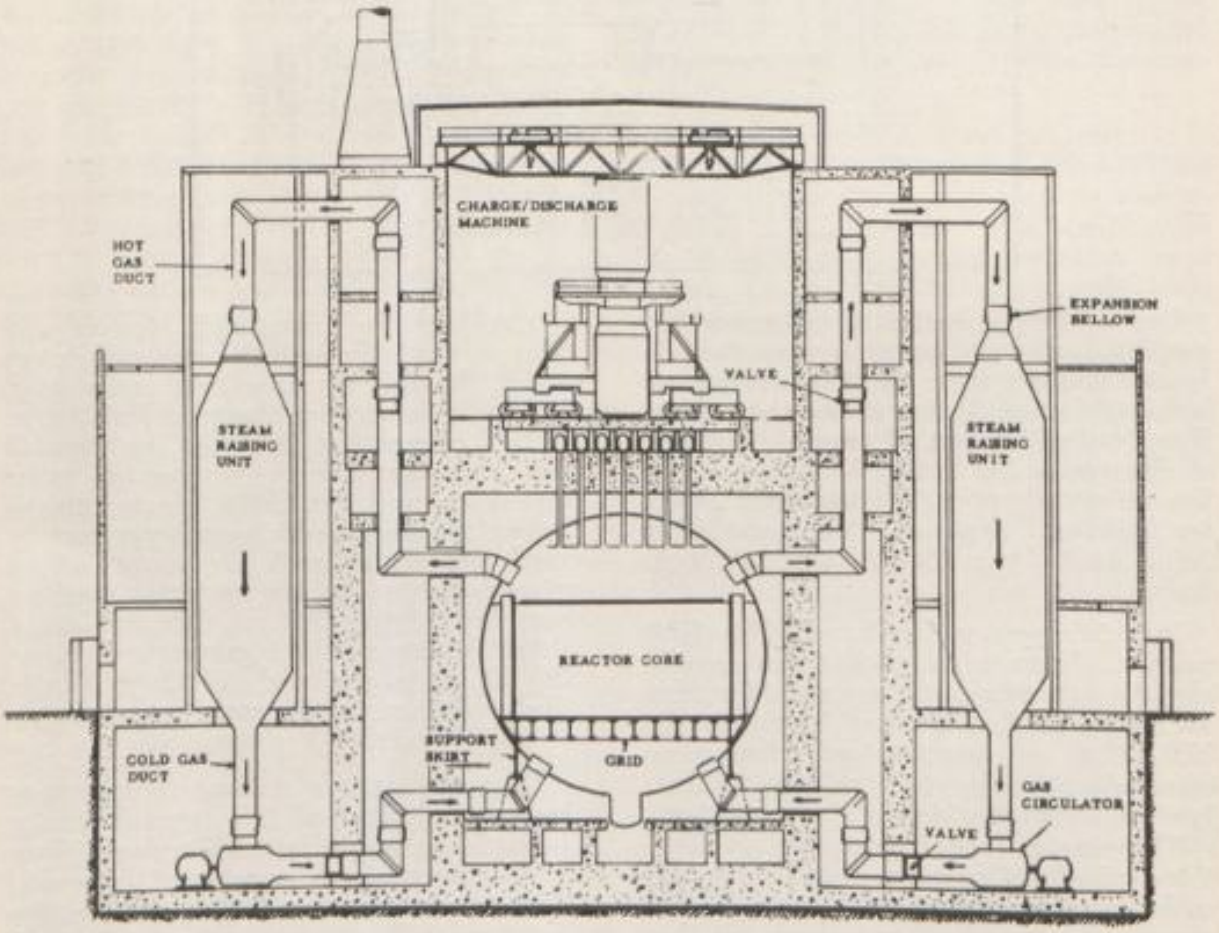
Fig. 1 shows a familiar Calder Hall reactor. Four such reactors are already already operating at Calder and Merz and McLellan, as Construction Agents to the U.K.A.E.A., are associated with four more of exactly this type at Chapelcross in Scotland, the first of which is also operating.

The reactor core is contained in a 2" thick cylindrical pressure vessel, surrounded by massive concrete shielding. The fuel elements are stacked one above another in vertical channels in the graphite moderator. There are six fuel elements per channel and nearly 1,700 channels. Coolant gas, which is carbon dioxide at 100 lb./sq. in., is circulated by centrifugal blowers and flows upwards through the core and downwards through the four heat exchangers. Access to the core for charge and discharge of fuel elements is from the top through 112 standpipes, but the reactor has to be shut-down and the circuit de-pressurised before the charge/discharge gear can be used. 48 control rods are suspended by wires from the top, the actuating mechanisms being mounted on the standpipes. Steam is generated at two pressures, about 200 lb./sq. in. abs. and 53 lb./sq. in. abs. The coolant gas enters and leaves the core at 284°F and 635°F respectively.

Four civil power stations incorporating improved designs of this type of reactor are building in the United Kingdom. Three were ordered simultaneously at the end of 1956, two by the then C.E.A. for Berkeley and Bradwell and one by the S.S.E.B. for Hunterston. In September 1957 the C.E.A. ordered another for Hinkley Point and are now considering tenders submitted for a further station, Trawsfynydd in north

Wales. Fig. 2 is a composite one not referring directly to any of the civil stations, but designed to indicate some of the development that has taken place since Calder was designed.

The first point of interest is that the cylindrical pressure vessel has been replaced by a special one—this is true of all stations except Berkeley and of course means half the stress for a given pressure compared with a cylindrical vessel of equivalent size and thickness. The nominal thickness of the vessel has gone up from 2″ to 3″ and a 3½″ thick vessel is planned by GEC/Simon Carves for the reactor they are expected to build in Japan. The design of the graphite core and its method of support within the vessel remain basically the same but improvements have led to much more effective use of space within the vessel—thus a later design will contain 70% more fuel channels than one of the original designs in the same size of pressure vessel. The working pressure has gone up from 100 lb./sq. in. at Calder to 185 lb./sq.in. in the latest published design. Access to the core for charge and discharge purposes is through standpipes on the top of the vessel, as at Calder, in all designs except Hunterston, where both top and bottom access to fuel channels is possible and bottom charge and discharge is normal. The main step forward in all designs is that charge and discharge is to be carried out with the reactor at full



TYPICAL BRITISH CIVIL REACTOR
FIG 2.

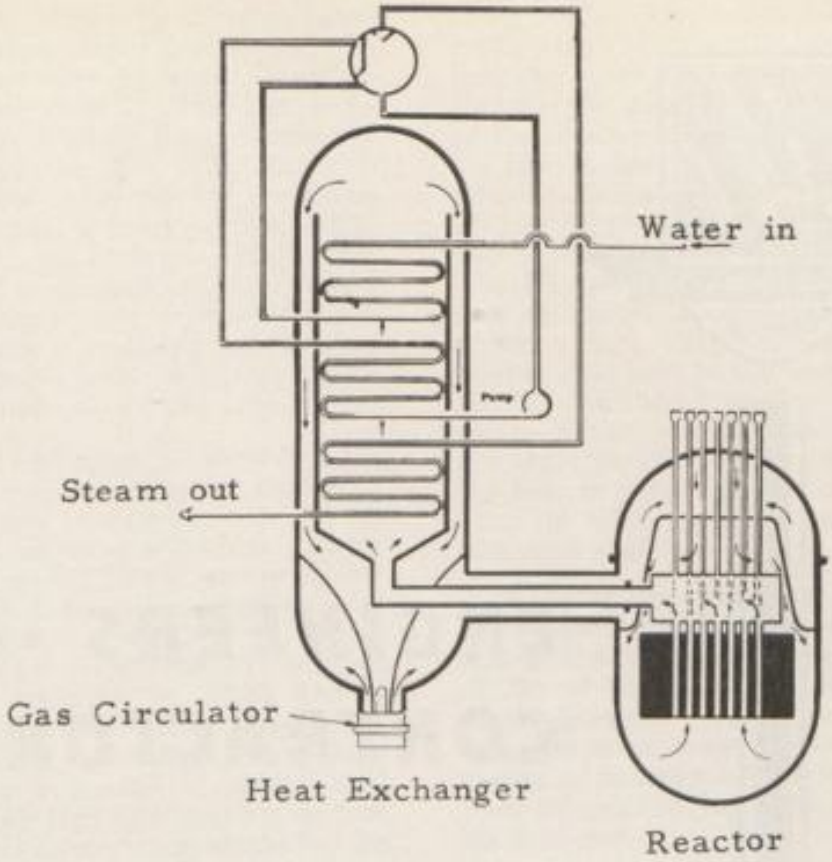


FIG 3
A.G.R.
ADVANCED GAS-COOLED REACTOR

pressure and power, but the machines to do this are very large.

The number of heat exchanger circuits has gone up from 4 to 6 or 8 and each circuit is now invariably arranged in one plane—in contrast to Calder—thus permitting the necessary duct restraint and flexibility to be provided with the minimum number of bellows pieces, which are so expensive at the pressures and in the sizes involved. The centrifugal blowers of Calder have generally been replaced by axial blowers, except at Hunterston where a centrifugal blower is housed in the bottom of the heat exchanger—thereby avoiding the difficult blower casing.

Power outputs are now about 250 MW(e) per reactor or above but specific power is under 2·5 MW(h) per ton of fuel. Dual steam cycles are used but vary greatly from design to design; at Bradwell, however, TSV conditions have been published as 730 lb./sq. in. gauge 700°F and 180 lb./sq. in. gauge 700°F. Corrected to a back pressure of 1½" this should give a turbine heat rate a bit above 11,000 Btu/kWh but, with about 10% of the output going on circulator power, the net cycle efficiency should be rather below 29% compared with about 21% at Calder.

As to the status of the gas-cooled graphite-moderated reactor as typified here, it has been economically accepted in the United Kingdom—which is not to say it is competitive with conventional types of generating plant. Current designs go about as far technically as the restrictions of natural-uranium fuel, graphite moderator,

carbon dioxide coolant and magnesium-alloy fuel-element cans permit and the major advances open to it are in reduction of capital costs. The last order placed was for Hinkley Point, where the capital cost of the 500 MW station is said to be about £120 per kW, excluding fuel, and the total generating cost should be around 0·7d. per kWh s.o. The reactor stands now as an accepted type, perhaps a poor man's reactor, but, especially if real progress is made in reducing capital costs, a serious contender in the very-large-reactor field for a number of years to come.

For marked technoligical advances in the gas-cooled graphite-moderated reactor it will be necessary to abandon some of the materials now imposing restrictions. In the advanced gas-cooled power reactor project of the U.K.A.E.A. the natural-uranium fuel rod and magnesium-alloy can of the Calder Hall type will be replaced by uranium oxide pellet enriched in U235 and a beryllium can for the first fuel charge. The full-scale plant of this design should show a considerable reduction in capital cost over the Calder Hall type and higher fuel burn-up should largely compensate for the fact that enriched fuel and beryllium cans will be far more expensive than natural uranium and magnesium alloy. It is expected that such a plant will be competitive with current designs of conventional power station in the U.K.

Fig. 3 shows diagramatically the main features of AGR, whose output will be 28 MW(e) and specific power 7·75 MW/ton of uranium. The gas outlet temperature will be about 1100°F compared with 734°F at Bradwell, and steam conditions at the TSV will be 600 lb./sq. in. 850°F.

Although the circuit of AGR is basically the same as that of its predecessors it will be seen in the figure that ingenious use is made of gas in the colder parts of the circuit to keep down the design temperature of the main pressure parts and, at the same time, to minimize heat losses. This idea has, of course, been used before in gas turbine design and in several other reactors. Gas here picks up heat in passing upwards through the reactor core and flows through perforated sides of the permanent charge tubes into a manifold in the gas space above the core. From the manifold the gas goes to the heat exchangers thruogh the internally-lagged inner section of the double duct, flows upward through the heat exchanger giving up its heat, then downwards through the double outer skin of the heat exchanger, thereby keeping down the pressure vessel temperature. The blower is built into the base of the heat exchanger, as at Hunterston, but dischargers into the outer section of the double duct back to the reactor. The cool gas is constrained to flow over the top dome of the reactor, down the sides of the main pressure vessel and then under the core to enter the fuel channels again. Thus the whole pressure vessel is in contact with cool gas.

Arranging the heat exchanger for upward flow of the gas ensures maximum natural circulation of the gas in the event of loss of blower drive. Also, as this is an experimental reactor, the whole top is designed to be removed in order to instal a core of entirely new design after sufficient information has been obtained from the first core.

The Kaiser/ACF Industries design study of a gas-cooled reactor recently completed in the U.S. was of a reactor of much the same technological standard as AGR. Perhaps further still along the road to an advanced design is the high-temperature gas-cooled reactor study, to use ceramic fuel elements, undertaken at Harwell and soon to take practical shape as DRAGON a combined O.E.E.C. and U.K. experimental reactor. A very similar design has been submitted to the A.E.C. by Philadelphia Electric Company with General Dynamics.

Another type of gas-cooled reactor which is being built uses heavy water as the moderator. The use of heavy water enables natural uranium to be burnt in a compact reactor. In this respect it scores over the gas-cooled graphite moderated type. The principal drawback of heavy water is its high cost of £10/lb. The heavy water inventory of a reactor system would be approximately one ton/MW(e) costing £2¼ million for a 100 MW(e) plant.

(ii) Water-cooled reactor, Fig. 2

The water-cooled and moderated reactor has been the principal object of development work in the US and the USSR. There are two types known as the pressurised water reactor in which the water is pressurised to prevent boiling in the core and the boiling water reactor in which the water is allowed to boil within the core. An objection to boiling in the core is the possibility of unstable operation resulting in the formation of voids but experimental reactors of this type have proved reliable. The use of light water for moderating necessitates a degree of enrichment in the fuel due to the absorption of neutrons in the water. The enriched fuel and the superior heat transfer properties of the water coolant enable a compact reactor to be achieved. The canning materials for the fuel elements are most likely to be stainless steel or zirconium alloy.

The pressurised water reactor is suitable for power station duty and can be built in smaller units than the essentially large gas-cooled graphite moderated reactor. One principal disadvantage of this type of reactor is that the power cycle steam temperature is determined by the operating pressure of the water circulated in the reactor and because of the high costs incurred by high pressure designs the pressure has to be limited to approximately 2000 lb/sq. in. At this pressure the final steam temperature at the turbine will be approximately 500°F after allowance is made for losses in the heat exchanger. This temperature limitation imposes a low efficiency on the power cycle and makes it difficult for this type of reactor to be economically competitive for power generation in large base load stations. The steam conditions can be improved by raising the temperature of the steam in an external superheater before it goes to the turbines. The reactor is suitable in units of small physical size for mobile application. Large reactors are under construction to produce 100 to 200 MW(e) for power station duty.

The boiling water reactor has several advantages over its pressurised counterpart using light water as coolant and moderator. The boiling water reactor is also pressurised but the pressure is not high enough to prevent boiling as was mentioned previously. The lower design pressure which will be about 1000 lb/sq. in. enables economies to be made in materials resulting in lower capital costs. It is also possible to dispense with the secondary circuit, an essential feature of the pressurised water reactor, which implies a reduction in the capital cost of the installation. The steam conditions for the power cycle are similar but favouring the boiling reactor because it is possible to achieve higher temperatures at the turbine inlet and higher pressures too which will be useful if superheating is adopted either within or external to the core.

Characteristic of both types of reactor is a low ratio of fuel to water, resulting in high outputs from quite small reactors, and poor conversion factors—0·5 to 0·7 compared with 0·8 to 0·85 in gas-cooled graphite-moderated reactors. That means that whereas the gas-cooled graphite-moderated reactor produces 0·8 atoms of Pu 239 for every atom of U235 burnt, the water reactors produce about 0·6 atoms of Pu 239. When using light water, which nearly all of them do, enriched uranium fuel is essential.

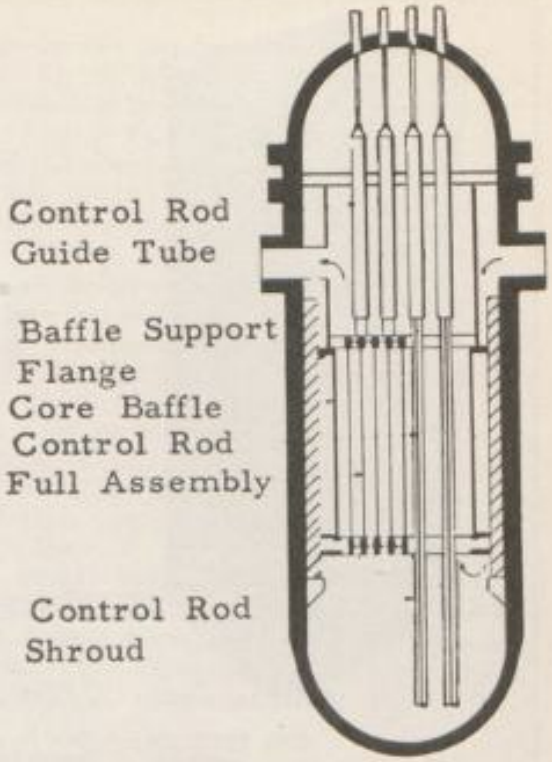
There can be no doubt of the effectiveness of pressurised water reactors as mechanical machines, for the performance of the American submarines Nautilus and Skate has received much publicity and Sea Wolf's original sodium-cooled reactor has been replaced by a pressurised water plant to bring her into line with the rest of the flotilla. Two power reactors are operating ashore, the 60 MW Shippingport reactor and the 2 MW APPR1 (army package power reactor). Two large scale power producers are building in the U.S., the 134 MW Yankee plant designed by Westinghouse and the 275 MW Indian Point plant, designed by Babcock and Wilcox, of which 112 MW comes from an oil-fired superheater. The completion date of the latter plant has recently been put back by one year. The U.S.S.R. are building a station at Vorenezh to contain two 210 MW units and are planning a second of similar size for Leningrad. Also they have three 22,000 s.h.p. pressurised-water reactors

afloat in the ice breaker "Lenin" whilst the U.S.A. are building their first non-military ship-propulsion unit, a 20,000 s.h.p. plant for the "Savannah."

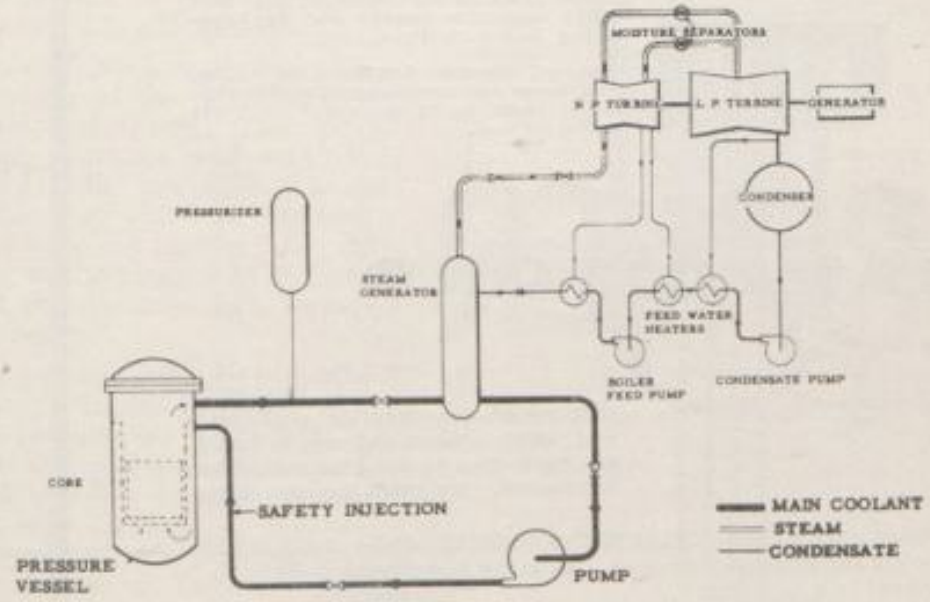
To typify the pressurised-water type, Fig. 4 shows the Yankee plant reactor. In this 134 MW reactor design the pressure vessel is relatively small, being only about 9 feet in diameter by 32 feet high, but its main barrel is 8 inches thick since it has to withstand a working pressure of 2000 lb./sq. in. abs. Its material is mild steel internally clad with stainless steel. The fuel is uranium oxide enriched to about 4·5 times the natural concentration of U235, and is made up in pellets into long rods canned in stainless steel tubes 0·3 inches in diameter. A cluster of about 300 of these rods is treated as a single assembly, and there are 76 such assemblies. Control rods number 32, and are cruciform in section.

Light water is used as both coolant and moderator, and flows down the outside of the core and up past the fuel, undergoing the comparatively small temperature rise of 38°F in the process, from 486°F to 524°F.

The top head of the vessel has to be removed for refuelling operations, which



YANKEE
PRESSURIZED WATER
REACTOR
FIG 4



YANKEE
COOLANT CIRCUIT. FIG. 5.

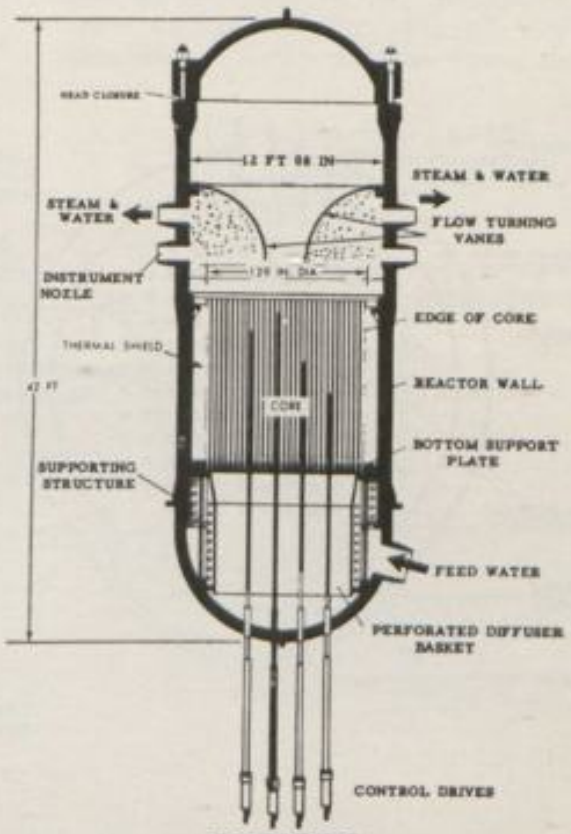
are performed under about 20 feet of water in a tank above the head. The reactor is naturally shut-down for this purpose.

Fig. 5 shows diagrammatically the Yankee coolant circuit. The primary coolant water is pressurised by the pressuriser, and is pumped through heat exchangers in four parallel circuits. Saturated steam is generated in the secondary circuit at 465 lb./sq. in. abs., and the steam cycle includes a considerable measure of water extraction to produce a "net cycle efficiency" of about 28%.

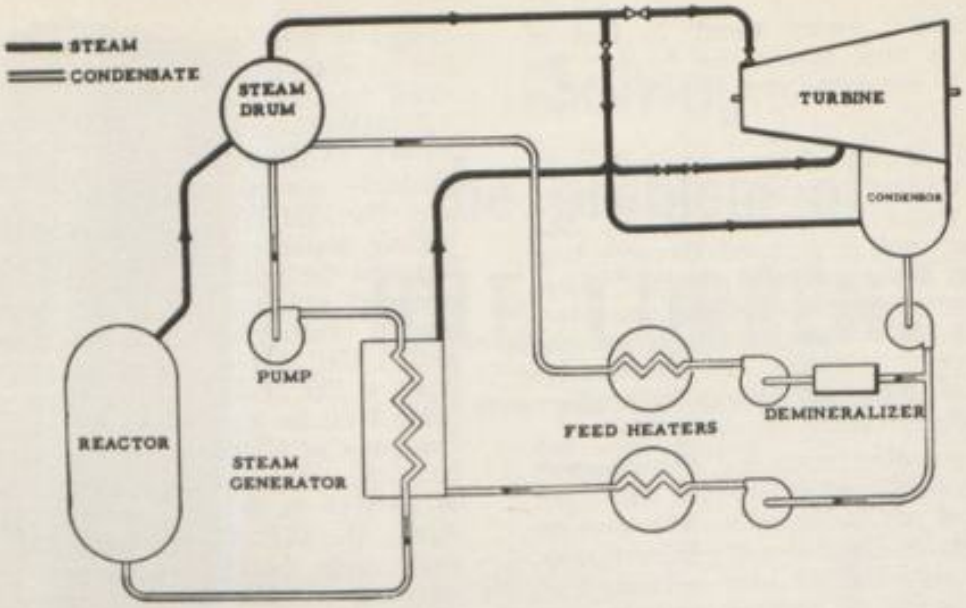
Total operating costs for Shippingport have been published as 64 mills. (5½d.) per kWh s.o., of which 33½ mills. (3d.) went on fuel cost alone. Until recently these figures were the only factual ones published of operating costs of nuclear stations, but they should not be taken as indicating the potential of pressurised water reactor. The Shippingport plant was originally designed as the propulsion unit for an aircraft carrier and was constructed ashore to demonstrate the feasibility of generation of electricity by this type of reactor. This it has done. Later plant should show appreciable price reductions all round (for example fuel costs at Indian Point are estimated at 6·95 mills. or 0·6d. per kWh s.o.) but unit costs will still be high.

The only other factual operating costs published anywhere in the world are for a six month period of APPR1. Their running costs (fuel, operation and maintenance) total 28·4 mills. per kWh s.o. or 2·4d. More than half this was for fuel. Capital charges were not quoted fully. In view of the size of the plant, 2 MW, these figures are not outrageously high, especially for a first design.

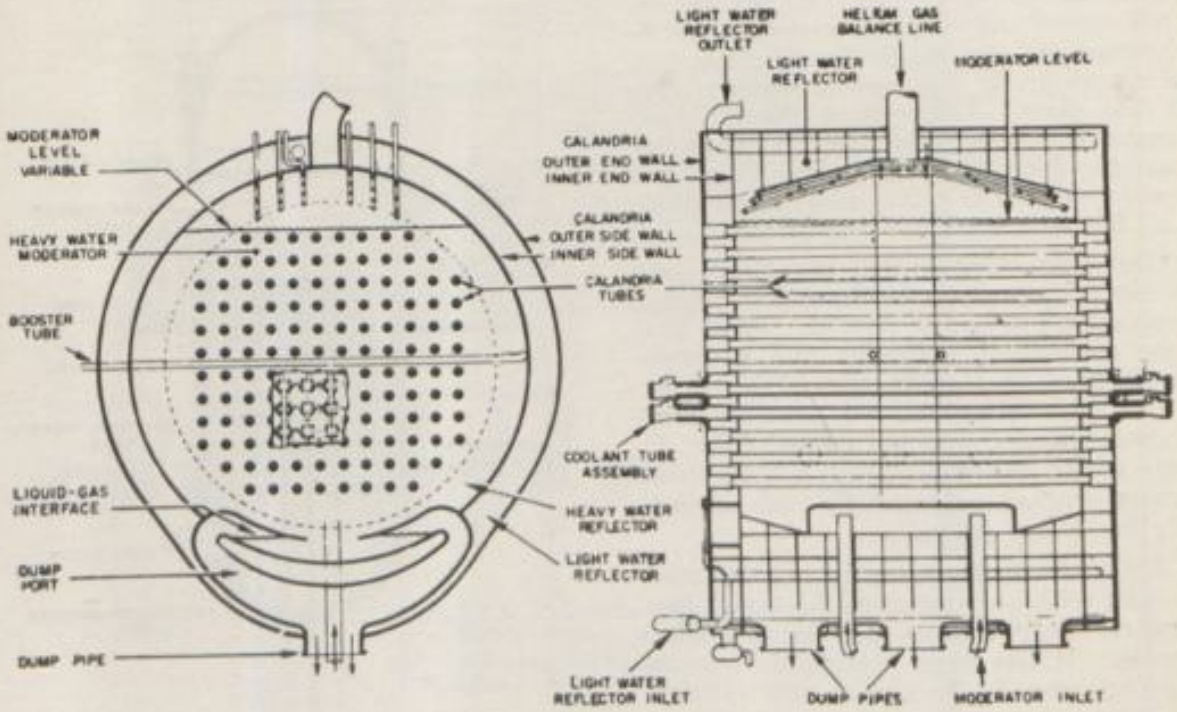
Boiling water reactors might be expected to start with an advantage in capital cost because their circuits can be relatively simple. It has been shown that steam can be passed directly to the turbine, omitting any heat exchanger, without the turbine becoming unduly radioactive. However the design of boiling water reactors is not as far advanced for it was first bedevilled by fears of reactor instability and, now that it is known that potential instability can be accepted, design is still handicapped by uncertainties in operating limits. However three small reactors are working in the U.S., the 3·5 MW(e) Borax IV., the 5 MW(e) VBWR (Vallecitos boiling water reactor) privately owned and operated by G.E., and the 5MW(e) EBWR (experimental boiling water reactor) at Argonne. The last was designed for 20 MW(h) but has operated satisfactorily at 60 MW(h) and is now undergoing small modification to permit 100 MW(h) operation. One large plant, a 192 MW(e) duel-cycle version, is being built for the Commonwealth Edison Company of Chicago at Dresden, Illinois, by G.E. The Russians are building a 50 MW(e) single-cycle version. Significantly, the G.E. tender for a 150 MW(e) dual cycle boiling water reactor was accepted by SENN (Italy) from eleven offers of both gas-cooled and water-cooled reactors. The accepted offer worked out at £106/kW compared with £133/kW



DRESDEN
BOILING WATER REACTOR.
FIG 6.



DRESDEN
COOLANT CIRCUIT FIG 7



N. P. D-2

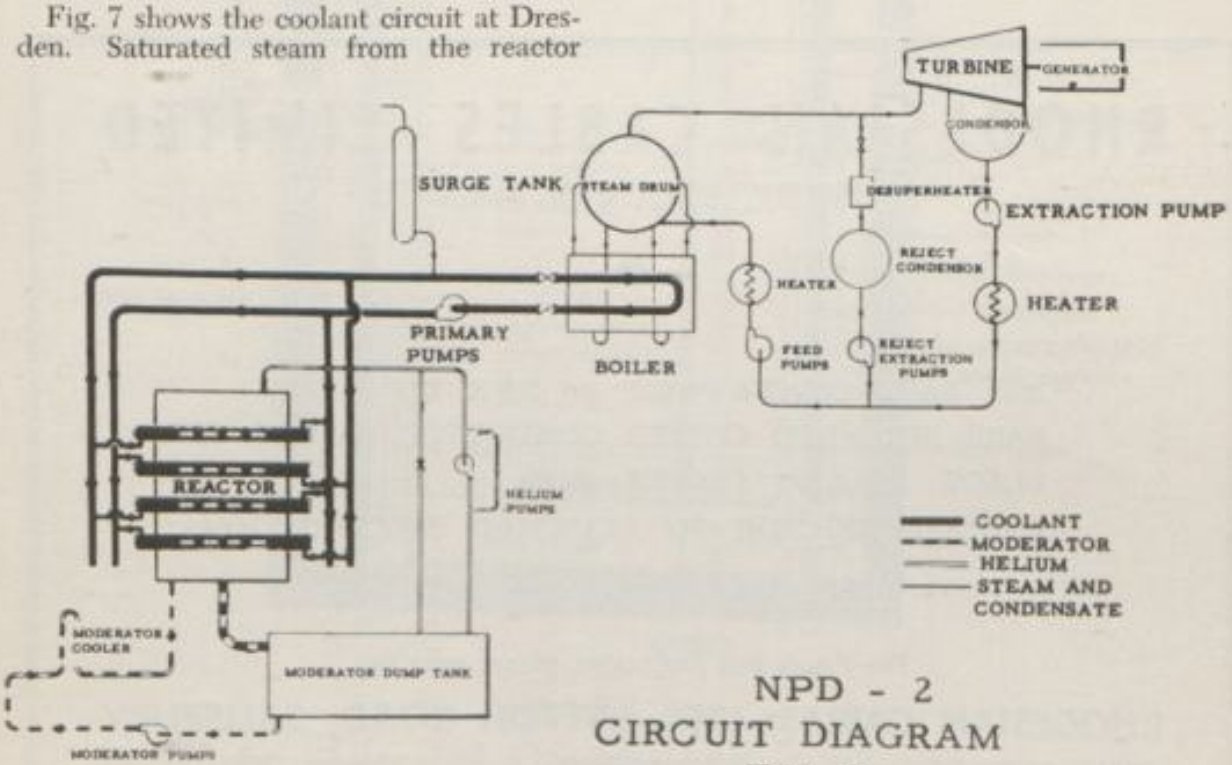
HEAVY WATER MODERATED AND COOLED
REACTOR
FIG 8

for the most attractive gas-cooled offer. Paradoxically, however, Baden Württemburg in Germany are now considering tenders from abroad for a 100 MW(e) reactor and they have announced their decision not to consider any gas-cooled versions or the G.E. offer of a dual-cycle boiling water reactor any further. This leaves pressurised water reactor offers only under consideration.

As two dual-cycle boiling water reactors are building, Fig. 6 shows one of them, the Dresden reactor. The pressure vessel of the reactor, whose output is 180 MW, is similar to the Yankee PWR vessel, although somewhat larger and of thinner material, being about 12 feet in diameter, 42 feet high and 5¼ inches thick. Light water is again both moderator and coolant, but here it is allowed to boil in the core and the working pressure is only 1040 lb./sq. in. abs. Fuel, again, is uranium oxide, but enriched to only about twice the natural concentration of U235 and made up in pellets into ½ inch diameter rods canned in Zircaloy 2. The temperature rise of the coolant in the core is 38°F, from 505°F to 543°F.

Fig. 7 shows the coolant circuit at Dresden. Saturated steam from the reactor passes first to a steam drum and thence directly to the H.P. turbine, which differs from those of pressurised water designs in being subject to active steam. At the same time, water from the steam drum is recirculated back to the reactor through a secondary steam generator in which steam is produced at 460 lb./sq. in. abs. and fed to an intermediate stage of the H.P. turbine. Water separation is again a prominent feature of the turbine cycle.

The use of heavy water in place of light water in water-cooled and moderated reactors is about to be tried in a boiling-water version at Halden. This is essentially a Norwegian/Dutch project but OEEC and the U.K. are also participating. A pressurised water version is being built, the 20 MW(e) Canadian NPD2 (nuclear power demonstration 2) shown in Fig. 8. Canada undoubtedly has more heavy water experience than any other country. An outstanding advantage of the heavy water reactor is that natural uranium or preferably its oxide, can be used as the fuel and taken to high burn-up, although this will necessitate a larger pressure vessel than if



NPD - 2
CIRCUIT DIAGRAM
FIG 9.

enriched fuel were used. The many difficulties to be overcome in the design, fabrication and construction of large pressure vessels are nowhere more keenly felt than in water reactor design, and the lower design pressure of boiling types makes them the more attractive on this score, too. The NPD2 reactor however differs in two important respects from those shown previously. It uses a pressure tube design, and so avoids a pressure vessel and its problems, and it has no control rods.

The heavy water is contained, effectively at atmospheric pressure, in an aluminium calandria vessel in the shape of a horizontal cylinder with 132 horizontal axial alminium tubes. The vessel is 17 feet in diameter by 15 feet long, and is mostly only ½ inch thick. The tubes are 4 inches in diameter and 0·054 inch thick. Into each tube fits a zircaloy pressure tube containing the heavy water coolant, at a pressure of 1113 lb./sq. in. gauge, which flows in alternate directions in adjacent pressure tubes and which undergoes a rise in temperature of 45°F in passing through the core.

Fuel is natural uranium oxide, in quite short fuel elements, each being a cluster of seven rods canned in zircaloy. Charge/discharge is remotely controlled on-load, and in effect the fuel elements progress steadily through the core from one end to the other as irradiation proceeds, thus achieving a very uniform burn-up throughout the charge.

Control of the reactor is mainly by variation of the moderator level, and Fig. 9 indicates the method. The moderator is supported in the calandria by a pressure of helium gas, and an alteration of gas pressure creates an alteration of moderator level. In emergency all the moderator can be discharged into the dump tank in about 15 seconds. A moveable enriched-fuel rod is used as a "booster" for certain conditions.

The heavy-water coolant is circulated through a heat exchanger to generate light-water steam which is supplied to a turbine at 400 lb./sq. in. gauge, 450°F. The net electrical output of the plant will be 17 MW.

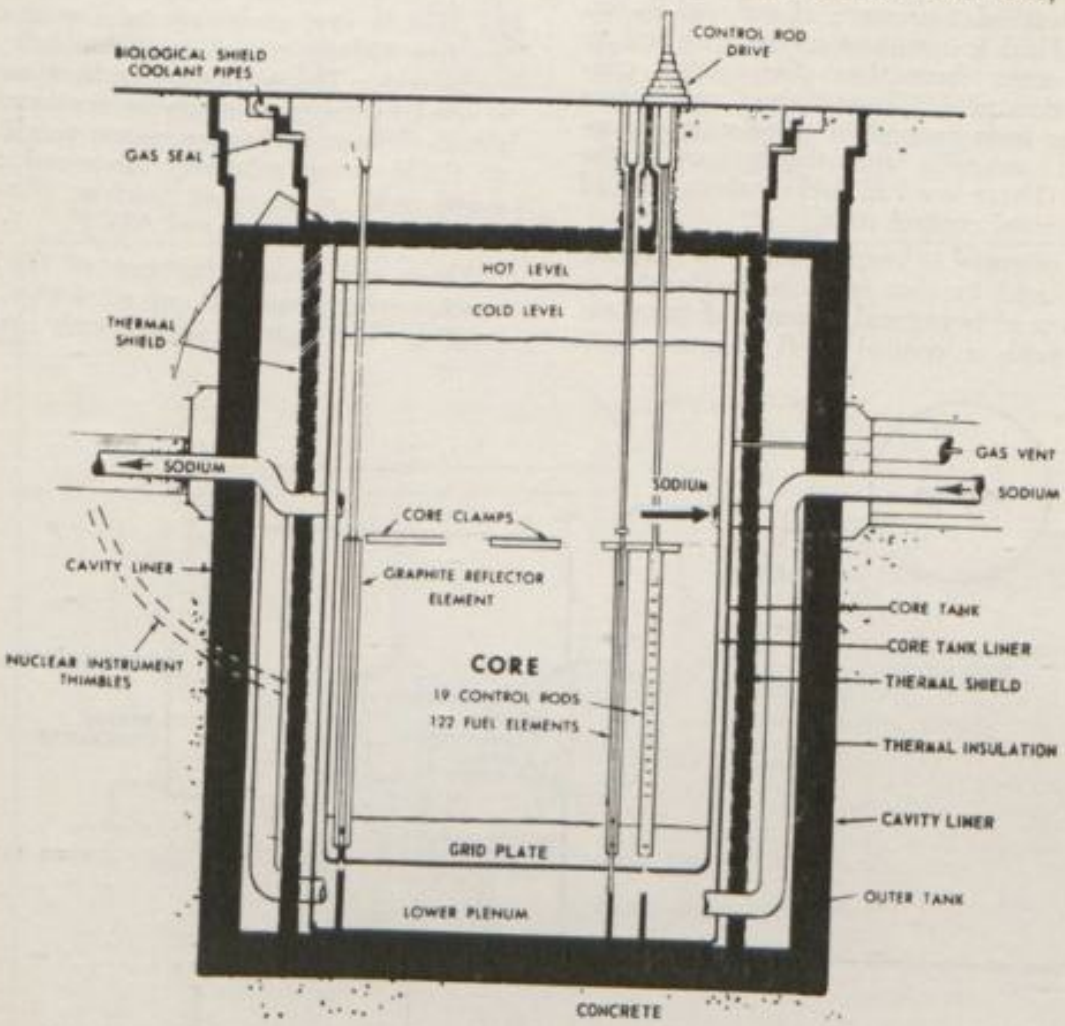
Stringent precautions are, of course, taken to prevent appreciable leakage of heavy water, which is a very expensive commodity.

There is one other tpe of water-cooled power producing reactor actually operating, the water-cooled graphite-moderator reactor. As a producer of electrical energy it is a Russian monopoly, and they commissioned a 5 MW version at Obninsk in 1955. Part of a 6 x 100 MW version at Troitsk, Siberia, is already operating and a 4 x 100 MW plant is building in the Urals.

(iii) Liquid-metal-cooled reactors

The principle liquid metal coolants are sodium and a sodium-potassium alloy, and both have excellent heat transfer properties and are poor neutron moderators. Although perhaps most necessary for fast reactors, where the core is so compact that heat removal is very difficult, liquid metal coolants are being used for both thermal and fast reactors.

In the thermal reactor group sodium-cooled graphite-moderated reactors have received much attention and one, called



HALLAM
SODIUM GRAPHITE REACTOR
FIG 10

SRE (sodium reactor experiment) has operated in the United States, but not, apparently, for very long or without excitement. A 75 MW(e) reactor is planned there at Hallam. The U.S.S.R. are building a 50 MW version but the U.K. have announced that they have done design studies on the type and decided not to go ahead with it. Fig. 10 shows the proposed Hallam reactor in Nebraska.

The core of this reactor is contained in a comparatively thin stainless-steel cylindrical tank, some 17 feet in diameter and 28½ feet high, which has to deal with a coolant inlet pressure of only 46 lb./sq. in. Fuel is uranium metal enriched to rather over three times the natural concentration of U235 and used as clusters of long rods canned in zircaloy and supported vertically from the bottom of the tank. There are 192 fuel clusters, and 18 boron steel control rods.

It is essential to keep sodium and graphite apart, and to this end the moderator is built up of hexagonal columns of graphite, each with a central axial channel, both channel and exterior of the brick being lined with zircaloy sheet.

The primary sodium coolant enters and leaves the tank at about the same horizontal level, but on entering passes down outside the core to enter the channels from the lower end. The sodium is circulated by centrifugal pumps through three parallel circuits, the system pressure drop being 45 lb./sq. in., and rises in temperature from 500°F to 925°F in passing through the core.

Fig. 11 shows the coolant circuits. As the primary sodium is highly radio-active its heat is first given up to a secondary inactive sodium circuit in a shielded heat exchanger. The secondary sodium circuit is used to generate steam in another (unshielded) heat exchanger, steam conditions at T.S.V. being relatively advanced compared with most other nuclear plant at 800 lb./sq. in. gauge and 825°F.

There are several features of the fast reactor which make it an attractive proposition for future large scale power

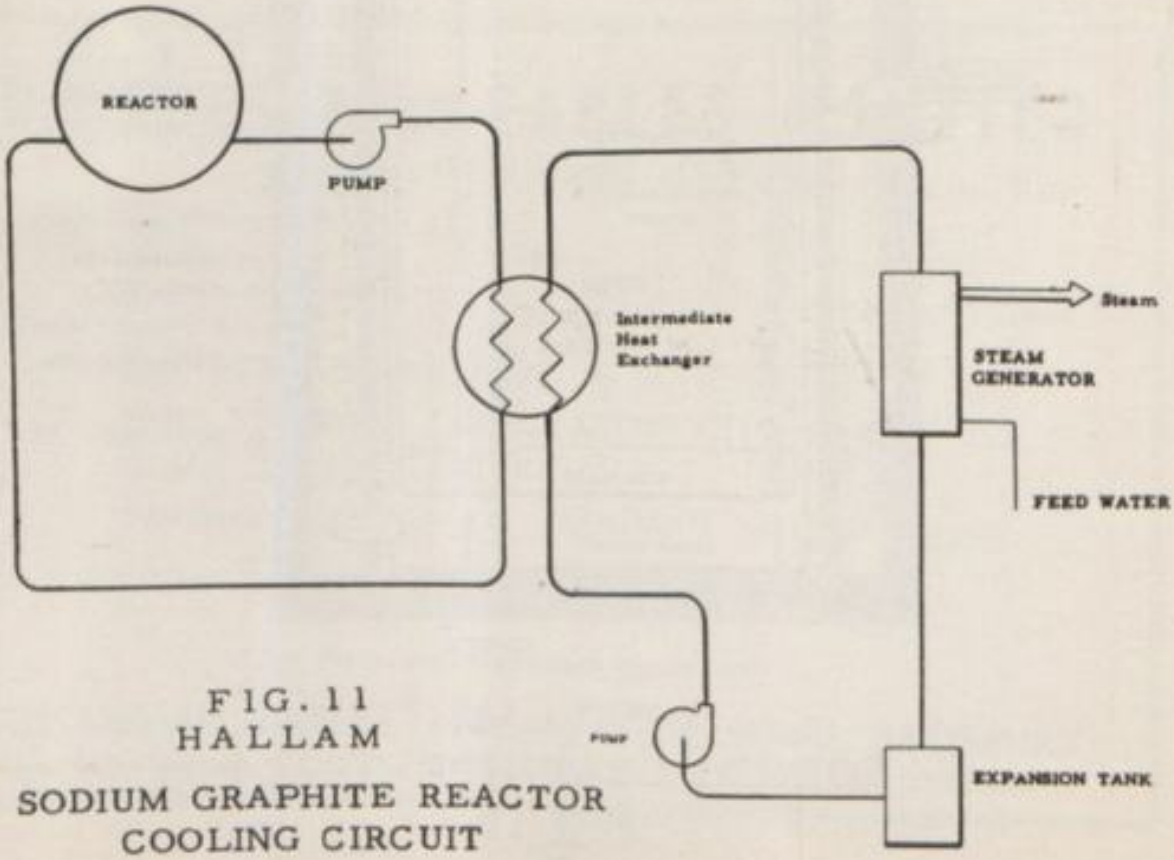


FIG. 11
HALLAM
SODIUM GRAPHITE REACTOR
COOLING CIRCUIT

generation, but before it becomes a reality many engineering problems have to be solved. The first apparent advantage is the absence of a moderator which in thermal reactors accounts for a considerable proportion of the reactor volume. The bulk of the reactor is very much reduced and savings in capital costs will be made. A much more significant advantage is the high conversion ratio which can be achieved, so that the reactor produces more fissile material than it burns. In one system the uranium isotope U238 would be converted to plutonium in the 'blanket', which surrounds the fast reactor core, at a rate faster than U235 or plutonium is consumed in the core. In this way the fast reactor offers utilisation of U238 beyond anything possible in thermal reactors. However, the initial fuel charge is highly enriched, and the fuel cost is correspondingly high.

It will still be necessary to withdraw the fuel elements from the core after they have been in service for a certain period, both on account of depletion of fissile content and irradiation damage to the fuel element. At this stage only a fraction of the enriched fuel in the element will have been burnt but reprocessing has to be carried out because of the deterioration in physical and mechanical properties of the fuel element. If frequent fuel changes are required due to distortion of the elements and associated narrow coolant passages high processing costs could offset the economies made in capital expenditure. The fast reactor, unlike the thermal reactor, is not troubled by fission product 'poisoning' and this could simplify the reprocessing techniques. The future economics of this type of reactor are very much dependent on the costs of fuel and fuel processing, which at present impose

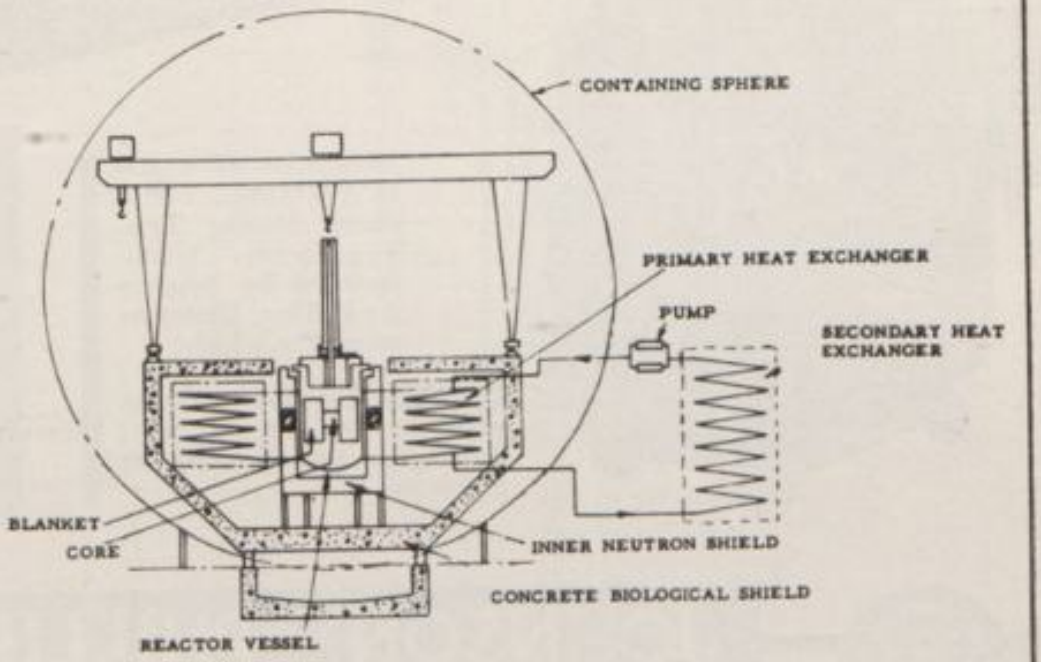


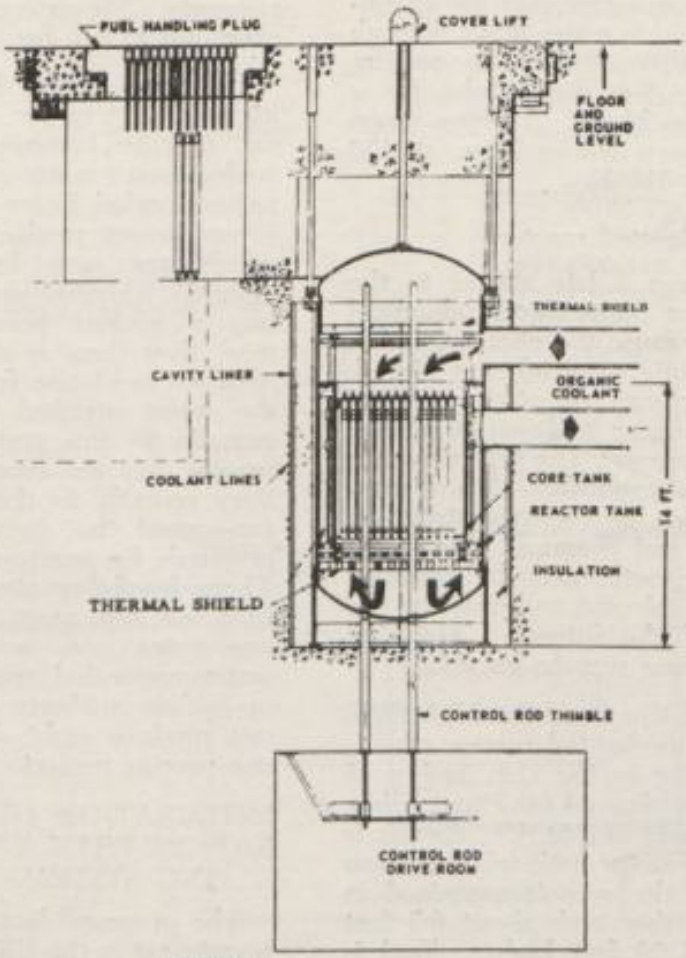
FIG 12
DOUNREAY FAST REACTOR

a considerable penalty on the feasibility of the fast reactor as a future large scale power producer. It could possibly find a greater application as a mobile power unit or alternatively as a peak or intermediate load plant if capital cost economies materialise after the engineering problems have been solved.

In the U.S.A. the reactor known as EBR1 (experimental breeder reactor 1) has been operated successfully, but it was very much a pilot plant having an electrical output of only 200 kW. A 20 MW(e) version, EBR2, is now being built. Also building in the U.S. is the 104 MW(e) Enrico Fermi reactor. The U.S.S.R. have a 5 MW(h) fast reactor working and have planned 50 (MW(e) and 250 MW(e) versions to follow in succession. In the U.K. the Dounreay fast reactor is still building and is the subject of Fig. 12.

Probably the most remarkable feature of the fast reactor is the very compact core within which a high heat release takes place. At Dounreay the core is 21 inches in diameter and 21 inches high, and the heat release is 60 MW.

The reactor consists of a highly-enriched core surrounded by a blanket of natural or depleted uranium in which most of the 'breeding' of new fissionable material takes place. Liquid sodium coolant removes the heat generated in the core and blanket, which are contained in a stainless steel vessel roughly 20 feet high and of maximum diameter 14 feet.



PIQUA
ORGANIC MODERATED REACTOR
FIG 13

Fuel elements are of uranium metal canned in niobium and vanadium, and are tubular. They are supported from the bottom and are arranged on a pitch of 0·93 inches, which makes a striking comparison with the 8-inch pitch of graphite-moderated thermal reactor fuel elements. There are no control rods, control being achieved by moving certain of the fuel elements.

As in the sodium-graphite reactor there are primary and secondary sodium circuits, and there are 24 primary and 12 secondary circuits in parallel. Twelve independent diesel generating sets supply the coolant pumps, each supplying a set of two primary and one secondary pump and helping to ensure integrity of the coolant supplies. Sodium/water heat exchangers are of unusual design in which water flows through a central tube, surrounded by four sodium tubes bonded to the water tube by a copper 'conduction block.' Turbine steam conditions are very conservative at 150 lb./sq. in. gauge, 518°F.

(iv) Organic-moderated reactor

This reactor was a late starter in the race to produce economical electrical energy largely because the effect of radiation on the organic material was feared. Now more is known about it and the reactor shows promise without, of course, any certainty of success. The type promises high temperature capability at low pressures and absence of corrosion troubles, induced activity and chemical hazards. If proved, such a reactor may be expected to have low capital cost and may be the small reactor of the future. However there is a very long way to go yet.

One reactor of this type, the 15 MW(h) OMRE (organic moderated reactor experiment) is operating in the U.S. and a 12 MW(e) version is planned for Piqua, Ohio, which is the subject of Fig. 13. As this is another type of reactor with relatively low collant pressure, the core is contained in a comparatively thin tank about 6·5 feet in diameter and 20 feet high. Fuel is uranium metal, enriched to about 2·7 times the natural concentration of U235, made up into plates and canned in aluminium—a very mundane material compared with some of those we have mentioned. There are eight control rods. Coolant and moderator is a commercially available mixture of terphenyls known as Santawax R, which enters the vessel at 35 lb./sq. in. gauge and 575°F and leaves at 617°F, there being two circuits in parallel.

Fig. 14 shows the coolant circuit at Piqua. The main features are conventional, but because the organic coolant polymerises under irradiation a shunt purification and make-up system has to be provided. Polymerisation is estimated to take place at the rate of about 0·5 lb. per thermal megawatt-hour, and make-up has to be provided at that rate. 75 lb./hr. of coolant is circulated through a packed-column fractionating still to extract the polymers. Steam conditions in the Piqua plant are 415 lb./sq. in. gauge and 550°F.

The reactor types dealt with above make up only part of the picture; the list does not include homogeneous reactors, gas-cooled heavy-water moderated reactors or sodium-cooled heavy-water moderated reactors, power producing versions of all of which are now being constructed or planned. Should one wish, or need, to buy a nuclear power-producing reactor now, then there is clearly a wide variety of types to choose from, but, to return to the point stressed in the introductory remarks to this section, no one type of reactor has yet emerged as outstanding. Very recently in the U.K. the Admiralty announced that they had received eight proposals for reactors for ship propulsion. These feasibility studies included practically all the types mentioned here and one extra one, a steam-cooled heavy-water-moderated reactor, and this affords up-to-date evidence that free competition can produce eight different proposals for one reactor project.

INTEGRATION OF NUCLEAR GENERATION WITH EXISTING GENERATING SYSTEMS

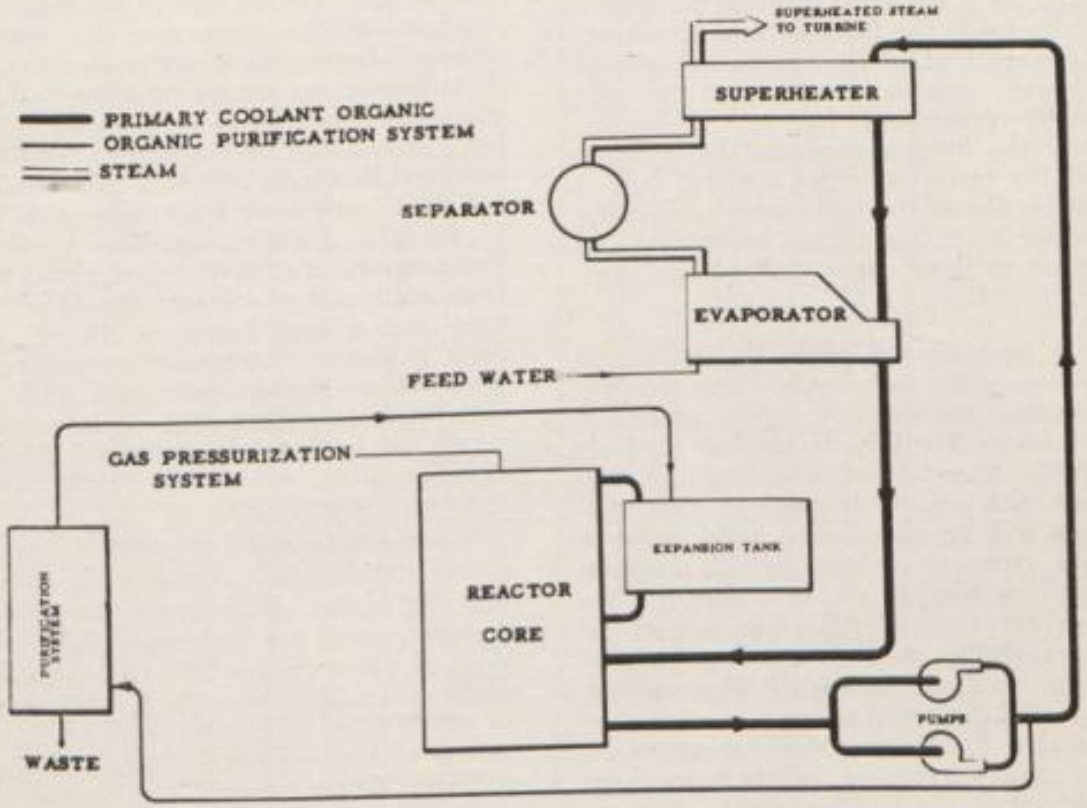
The proposed large scale nuclear power investment in the UK and Europe has been stimulated principally by the apparent inability of conventional fuel supplies to keep pace with the increasing fuel requirements of the generating stations. By 1966

nuclear power plant capacity in the UK is expected to reach 6000 MW, approximately 15 per cent of the total generating capacity, and operating as base load stations will produce about 25 per cent of the total energy output. Forecasts have been made suggesting that the nuclear stations under construction in the UK will have overall generating costs which will be competitive with the conventional base load power station by the early 1960's. In contrast to the trend in Britain, the American forecast is that nuclear fuels might be necessary in the US in about 25 years' time. The American civil reactor programme is therefore directed towards research and development, investigating a wide range of reactor techniques and acquiring operating experience. American industry is building power reactors for export.

Before embarking on a conversion to nuclear power generation the incentives to do so should be thoroughly examined and translated into hard economic facts. There does not appear to be any other sound basis on which to make the assessment, unless it is admissible to sacrifice economic considerations for prestige. The incentives are the prospect of reducing generation costs and the prospective use of uranium fuel, where the rate of supply of conventional fuel is likely to be exceeded by the demands of the generating stations. It can be argued that there is an additional incentive in limited cases to introduce nuclear power earlier than is economically justified in order to establish techniques and acquire operating experience to be used for commercial advantage in a competitive market. This clearly does not apply to an importing country.

(i) Economic considerations

The selection of new power plant for inclusion in a generating system is based



PIQUA COOLANT CIRCUIT
FIG 14

on an economic study taking into account all the relevant factors which could influence the final overall cost of the electricity sent out to the consumers. The location of the site, the proximity of the site to main load centres and the availability of coal and water are all major items which have considerable bearing on the final cost of power.

The nuclear station is more flexible in the choice of site principally because the fuel transport charges constitute a negligible proportion of the total fuel costs. It can therefore be located practically anywhere so far as fuel supply is concerned but the coal-fired station should be located as near as possible to the coal field supplying its fuel to save transport costs. A 200 MW(e) station could be fuelled with approximately 100 tons of uranium annually whereas the equivalent coal-fired station would require in the same period 700,000 tons of fuel. The 100 tons of uranium is not the total transport load as allowance must be made for the return of irradiated fuel elements which have to be transported in heavy shielded containers to the chemical processing factory. However, even if the load is increased by a factor of 50 the transport costs are still only a small fraction of the fuel costs. In choosing a site for a nuclear station preference can be given to those areas without coal supplies.

It is desirable to locate the station at the centre of the main loads where possible to minimise transmission capital costs and power losses. Possibly the nuclear station's flexibility gives it an advantage in this respect although it is unlikely that permission will be obtained to build a power reactor close to a town which imposes a small restriction on flexibility. The over-riding consideration might well be the availability of suitable water supply for the cooling systems. The nuclear station will generally require more cooling water due to the lower efficiency of its steam power cycle in which more heat is rejected to the cooling water. For example, the Hunterston station of the SSEB will use 50 per cent more water to carry away the heat rejected in the steam cycle for each kilowatt of power produced than the new station planned for Komati with steam conditions of 1250 lb/sq. in. and 950°F. This factor would only influence the choice of site if the water supply were very restricted, but it does affect the comparative costs of the circulating water systems including cooling towers if they are used.

The total annual expenditure incurred by an authority in generating power at any one of its stations is divided into fixed and running costs of which the principal items are respectively interest and depreciation and fuel. The total average cost of a unit generated by any one station will fall as the station produces more units and where the capital cost of plant is high it is essential to provide continuous load or a high load factor for the station so that the fixed charges can be spread over the maximum number of units. It is assumed that the high capital cost is associated with a plant having low production costs. Nuclear stations come into this category although the so-called low production costs do in some cases exceed those for coal-fired stations where coal is very cheap. It has been estimated that the first of the CEGB stations (Bradwell 300 MW and Berkeley 275 MW) will have total generation costs of 0.7-0.77 d/kWh including a running cost component of 0.19-0.25 d/kWh. These costs are based on an interest rate of 5 per cent and a load factor of 75 per cent. Built in South Africa such stations would give rather higher unit costs and it is significant to reflect that such a station could not legitimately command the base load position on several South African systems.

The capital cost per kilowatt of a nuclear power station varies considerably with the unit size of the reactor as illustrated by the figures quoted for building a Calder Hall type of plant in the UK. The estimated costs are £160/kW with a reactor rated at 40 MW(e) falling to £97/kW as the rating of the reactor is increased to 400 MW(e). Other types of reactor will show a similar trend, although the price per kilowatt based on comparable unit sizes will not necessarily agree closely with those quoted. Estimated capital costs of

boiling water reactors have been quoted by American authors as £107-122/kW and £89-107/kW for plants of 24 MW(e) and 200 MW(e) respectively. Unless there are very special circumstances arising from the non availability or alternatively extremely high cost of conventional fuel it will be uneconomic to install other than large units; this generally restricts the application of nuclear stations to large generating systems which can absorb the station and allow it to work at high load factor. Apart from the economic consideration of high load factor operation it is important that the unit size should be related to the overall size of the system and the component plant so that unavoidable plant failures can be accommodated without too much inconvenience to the consumer. As the maximum unit size is increased, it is prudent to increase the spare capacity on the system to take account of the larger unit.

(ii) Peak load problems

The generating systems of the large national undertakings and public utilities supply power to meet the various requirements of mining, industry, transport, the domestic consumer and others, which vary from hour to hour. The variations of load are plotted to produce the daily load curve, typical of a South African undertaking, Fig. 15. This shows the two power peaks occurring during the day and the minimum demand during the night, which

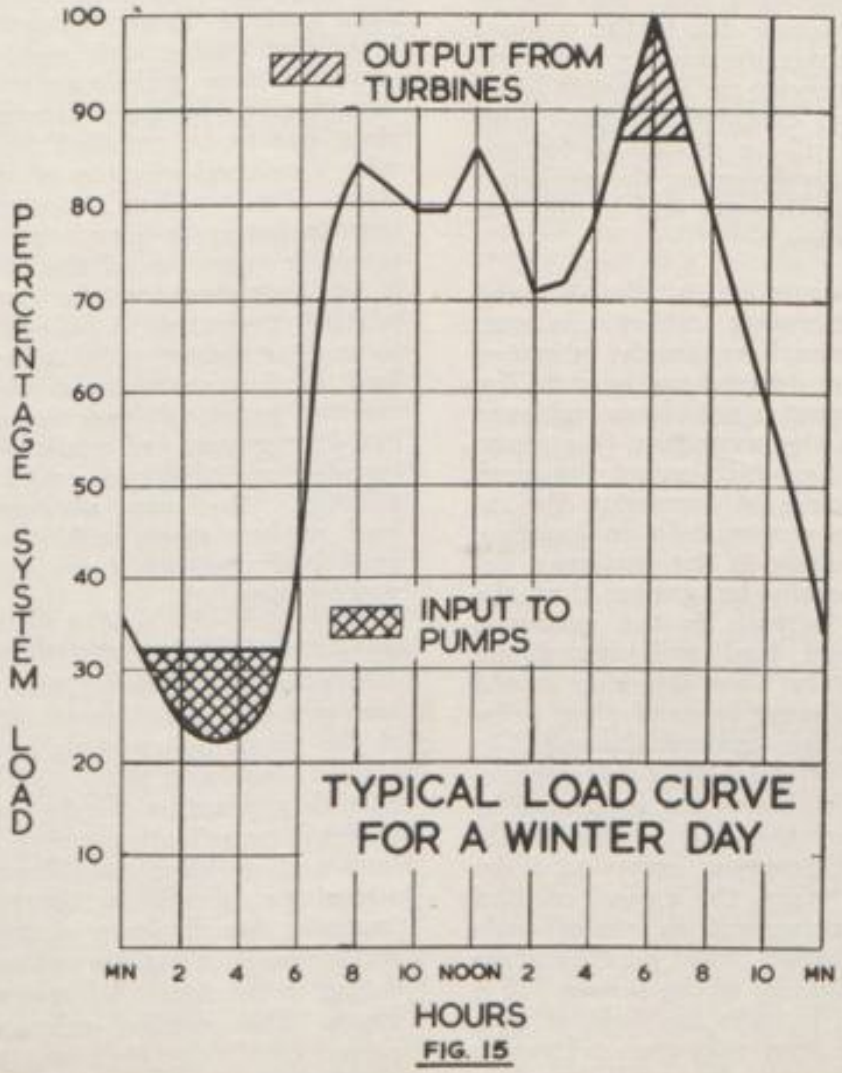


FIG. 15

are typical of power systems. As the demand on the system fluctuates the load carried by individual generators is adjusted to suit requirements; others will be shut down for a short period between the daytime peaks and overnight. If the system is to be operated with maximum economy it is necessary to allocate load to the various stations in the system on the basis of their running or production costs. The groups of stations with the lowest running costs will share the base load, which is the minimum demand on the system, operating continuously throughout the year apart from a short period of say four weeks set aside for maintenance work and other occasions when a plant defect necessitates an unscheduled shutdown to enable repair work to be done. The intermediate groups with higher generating costs will not be required continuously due to the reduced demands for power during the night and may possibly generate on a two-shift basis. The final group contains the peak load stations which will be generating for one to two hours daily excepting the weekends when the system demand will be too low to require their use.

New plant has to be installed to keep the system generating capacity in step with the load growth so that the estimated annual maximum demand can be met. The ideal in this respect is not always achieved due possibly to the occurrence of extreme weather conditions influencing the peak and the alternative of increasing the reserve capacity is economically unattractive. The annual increase in the maximum demand will generally be greater than the corresponding increase in the minimum demand or base load and accordingly taking a short term view provision should be made for different types of plant to be installed which are economically suited to the load factor at which they will operate, some at base load and the remainder at intermediate and peak loads. This simplified picture is, however, complicated by trends in fuel prices, the capital costs of plant, the improvement in steam cycle efficiencies as higher steam conditions are adopted, and the size of the system. It is not unusual to provide the bulk of new plant for base load operation relegating some of the existing plant in this category to a lower load factor duty and similarly a fraction of plant in the intermediate groups is transferred to the peak group. In this way the requirements for peak load plant are met principally from existing plant relegated from higher duties in the course of system expansion.

Typical load growths for industrialised communities show that electric power demands are doubling in a period of 10 to 12 years and if a policy of expansion with base load plant is pursued it is inevitable that after a period of operation on base load the plant load factor will start to fall, the length of the period depending on the size of the night load in relation to the maximum demand and the annual load growth. The respective periods for night loads of 25 and 40 per cent with a 7 per cent load growth are 5 years and 8 years. If these periods are to be extended then special peak or intermediate load plant has to be installed in combination with a reduced quantity of the base load plant. This problem is accentuated when nuclear power is introduced because the economic operation of the nuclear station is so dependent on the load factor at which it generates. A full-scale conversion to nuclear power could absorb the base load in five years under the conditions assumed previously and thereafter a combined programme of nuclear and conventional plant additions would have to be adopted. One way of combining base load nuclear plant with intermediate or peak load plant is to use externally fired superheating.

(iii) Separately fired superheating

Mention has already been made of the low pressure and temperature conditions of the steam power cycle associated with current reactor technology, and of the possible application of external or separately fired superheating using conventional fuels such as oil or coal. The two principal advantages of superheating are firstly, it improves the efficiency of the steam cycle and secondly, it enables an increased power output to be obtained from each pound of steam. The practical order of increase in output for Calder Hall type reactors is 30

per cent. Although improvements in steam cycle efficiency are always very acceptable it is the second point which is of particular interest as it has direct bearing on the problem of combining the nuclear station as a base load plant with other thermal plant to meet the load regime.

One possible duty for the combined nuclear plant and externally fired superheater would be to generate as a base load station with the reactor supplying all the heat required for the steam power cycle at the best steam conditions which the reactor could achieve, and the superheater would be used to increase the power output of the generators as the system demand increased with the approach of a peak period. The superheater could supply part of the peak load or alternatively it might be suited to intermediate load factor duty between the base load and the peak depending on the price and availability of coal or oil.

The size of the turbines, generators and auxiliary plant would be determined by the maximum power output obtained when using superheated steam, and the economic rating selected for the turbines would most probably be equal or nearly equal to the turbine output with the reactor alone supplying heat to the steam cycle. The final choice of economic rating and turbine arrangement will be influenced by the amount of use to be made of the superheater, that is peak or intermediate load factor duty. The incremental capital cost/kW of the power obtained by superheating will be distinctly lower than the capital cost of a conventional station. For example, the incremental costs of turbine and generators would be favourable because an already large unit would be made larger and capital costs/kW fall with increasing unit size. The conventional station plant would comprise smaller units at higher capital cost/kW. The size of the circulating water system would not increase in the same proportion as the power output as the heat rejected in the steam cycle with superheating is only marginally greater. The operation of the superheater station would be very flexible. The additional load could be brought on quickly or if necessary in small increments without incurring the usual penalties on production costs associated with part load operation of conventional plant as the turbines would be operating close to their economic design point.

In those regions with insecure supplies of coal an increase in coal consumption for power generation purposes above the level which stimulated the conversion to nuclear power might not be admissible and taking the long term view it is apparent that this situation will arise. The building of new coal-fired stations will then be possible only when obsolete coal-fired stations are withdrawn from service. It will also become necessary for nuclear stations to accept lower load factors on two shift operation and the economic objections to such an arrangement have already been emphasised. Two shift working introduces operational difficulties on the reactor due to the thermal cycling which would result and although it is technically possible there would be economic penalties incurred. More operating experience is required on this aspect. An alternative to two shift working is the use of energy storage schemes which can provide a load for plant which normally would not be required continuously throughout the day. Pumped storage and underground air storage are two methods of storing this excess energy for use at times of peak demand.

(iv) Pumped storage

In the pumped storage scheme energy is stored during the night hours when consumer demands are generally low by pumping water from a low level to a high level reservoir. The power used by the motor driven water pumps is supplied by generating plant which would otherwise be operating below its rated capacity or possibly taken off load completely if the consumer requirements only were being supplied. At some time during the morning, prior to the occurrence of the peak demand, pumping is discontinued so that the power taken by the pump motors can be diverted to the consumers. Later in the

day the water stored in the high level reservoir is passed through water turbines driving generators to produce power which is used to supply part of the peak load.

Fig. 15 shows such a load curve for a winter day in which the load varies between 100% at the afternoon peak and about 22% in the early hours of the morning. With the pumped storage scheme indicated (in idealized fashion) by the slide, the addition of pumping at a rate equal to 11% of the peak load means that additional thermal plant equal to 11% of the load generates continuously throughout the day instead of coming off line in the morning. Then the shape of the curve is such that the top 13% of the load can be carried by the pumped storage plant and thus thermal plant equal to 87% of the load is required instead of 100% without pumped storage. The energy generated at the time of peak, represented by the upper hatched area, is about two-thirds of the energy used during off-peak pumping, represented by the lower hatched area. The energy output of the thermal plant is thus increased, but, if pumped storage is economically justifiable, the overall cost to the system is less than with 100% thermal generation. Also the load carried by the thermal plant varies between 33% and 87% instead of between 22% and 100%.

The requirements for such a scheme include the two reservoirs and advantages should be taken of any topographical features which can be adapted to store water some hundreds of feet above a low level reservoir. Storage heads vary over a considerable range from the low head (90 ft.) Niagara scheme in Canada to the high head (3,000 ft.) plant in Austria and Switzerland. The capital costs of an installation tend to fall as the operating head is increased due to a reduction in the physical size of plant, and the smaller buildings to house the plant show corresponding economies. These savings are partially absorbed by the increased costs of the longer pipelines connecting the station at the lower reservoir to the high level reservoir.

The plant will comprise the pumps driven by electric motors and the water turbines driving generators. These machines can be combined into a single unit of reversible pump-turbine and reversible generator-motor. The application of the reversible single stage pump-turbine unit is at present limited to heads not exceeding 600 ft., although Merz and McLellan are considering an application at 1200 ft. head for a 400 MW pumped storage scheme.

Although in the classical pumped storage scheme the high-level reservoir is positioned on a convenient high hill or mountain, there is no reason why the upper reservoir should not be at ground level and the low reservoir and generating plant underground. In this way advantage might be taken of worked-out mines, which offer the possibility of high heads and thus of small storage capacity and plant. Handling in of plant is a major problem in underground generating stations but underground pumped storage could be attractive where existing shafts can be cheaply adapted to permit such handling.

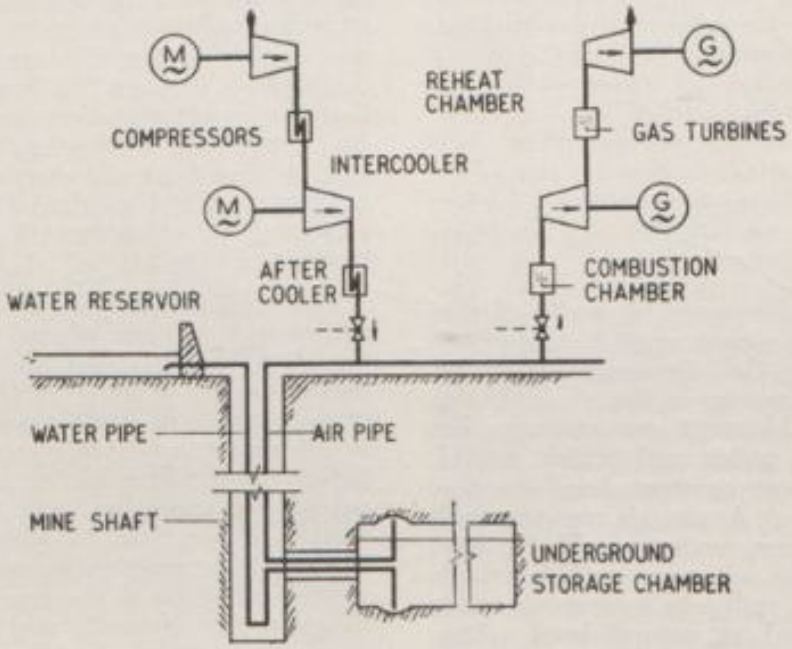
The capital costs of schemes which have been investigated for sites in the UK are in the range of £31-55/kW excluding transmission costs. The variation in cost is due principally to the different site conditions affecting the nature and extent of the civil engineering work which accounts for £16-36/kW of the station costs just quoted. The running costs are basically the running costs of the stations supplying the power for pumping with a pumped storage efficiency factor applied to which must be added the normal production costs such as salaries and wages, repairs and maintenance. The overall efficiency of the scheme will be close to 67 per cent so that on average for each 100 units used to drive the pump motors 67 are returned to the system over the peak periods. The remaining 33 units are taken up by mechanical and electrical losses in the plant, frictional losses in pipework and wastage in operation. The equivalent fuel cost component of the pumped storage station running cost is therefore 1/0.67 x weighted running costs of the stations supplying the pumping power to which is added a small

component for other production costs mentioned previously. This latter cost is similar to that incurred on conventional hydro-electric plant.

Pumped storage is not restricted to daily operation and may be used on a weekly or seasonal basis. It has substantial operational advantages in that plant can be put on full load from standstill in 5 to 10 minutes. In contrast, thermal peak load plant is generally left running at part load, ready to increase load as required. In this way the peak load thermal plant generates more units than it would be allowed to under ideal conditions. It is however, always necessary to keep some spare capacity immediately available in the form of plant operating at part load.

In making comparisons of overall generating costs for nuclear and coal-fired stations it has been emphasised throughout that high load factor is of first importance to the nuclear station. The capital costs of nuclear stations are so high in relation to coal-fired stations that if there is to be any serious competition from the nuclear station its running costs must be able to show appreciable savings when compared with the costs of the coal-fired station. Assuming this is the case it is apparent that the combination of pumped storage and nuclear station improves the prospects for the latter which is able to produce more units. The nuclear station also benefits from the subsidy resulting from the addition of relatively low capital cost pumped storage plant and thereby becomes less unattractive economically.

In a system in which pumped storage is being used in conjunction with coal-fired stations the introduction of nuclear power on merit for base load operation is not likely to prejudice the economics of the pumped storage scheme. If the nuclear station operates as a purely base load station to meet consumer demands it cannot contribute any power for pumping purposes; alternatively if the nuclear station is required to supply pumping power it will do so economically provided it is able to achieve the load factor at which it competes successfully with the coal-fired stations which were previously supplying the power.



SCHEME USING COMPRESSED AIR STORAGE

FIG. 16

(v) Compressed air storage

Fundamentally the principles of storage using compressed air are similar to those described previously for pumped storage. The motor-driven water pump is replaced by a motor-driven air compressor and the water turbine by a gas turbine. A large reservoir is required for air storage which would be too costly to fabricate from steel and use would have to be made of underground caverns, or, again, possibly disused mines to give the volume and mechanical strength necessary to contain the pressurised air. Fig. 16 shows a typical scheme.

During the off-peak period the compressors pump air under pressure through a shaft or tunnel connecting the above-ground plant with the storage cavern where the air is stored until required when it is then piped to combustion chambers and heated prior to passing through the gas turbines. It is the normal gas turbine cycle to which has been added a storage vessel between the compressor and combustion chamber. The gas turbine however is able to deliver its full output as electrical power instead of only approximately ⅓, as in the normal case when the gas turbine drives the compressor as well as the generator. The cost/kW of electrical output of the gas turbine is therefore approximately ⅓ that of the normal plant, but this saving is partially offset by the additional costs of the separate motor to drive the compressor, and the storage facilities which have to be provided.

If maximum use is to be made of the storage volume means must be provided for maintaining the air reservoir at or near constant pressure as the air is drawn off. This could most conveniently be achieved by a water seal which would impose an almost constant head on the storage chamber. As the air was pumped into the chamber, water would be displaced from the chamber and pass up the seal pipe to spill into a reservoir most probably situated at ground level. The reverse action would take place as the air was used, water passing from the reservoir down the seal pipe into the air storage chamber. The probable operating air pressure to suit industrial gas turbine practice would be in the region of 200 lb/sq. in. for which the head required to maintain the water seal would be approximately 500 ft.

CONCLUSION

The principal variable affecting the cost of producing power in different parts of the world is the price of coal and in some countries sufficient supplies of coal cannot be won to sustain the expansion of power generation systems. These countries look to nuclear power to solve their problems, if not immediately perhaps in the very near future. In South Africa coal is cheap and there are excellent reserves for meeting the requirements of the power stations for many years to come. The wide diversity in the price of coal which varies from 7/- to 8/- per ton at some of the pithead power stations to 54/- per ton at Cape Town tends to focus attention on the expensive coal at Cape Town rather than on the very cheap coal at Taaibos. Coal at 54/- per ton is still a cheap fuel when it is compared to the cost of generation of nuclear stations. In the UK for 1957 the average price per ton of coal supplied to electricity undertakings was 85/- including 17/- for transport and distribution charges. It is now estimated that the nuclear stations in the UK will be competitive with the best coal-fired stations in 4 or 5 years' time on the assumption that the price of coal will have increased by approximately 12 per cent in that time.

The tendency is for coal prices to rise, for example the cost of coal at Cape Town has risen from 31/- per ton in 1948 to the current price of 54/- which represents a price increase of a little over 70 per cent in 10 years and if this rate of rise continues the nuclear station could be competing economically with the coal-fired station in less than 10 years' time. It is reasonable to anticipate a reduction in the capital cost/kW of the nuclear station as development proceeds and reduced running costs with the benefits resulting from improved fuel element technology.

There is little prospect of extensive economic nuclear power in South Africa in

the immediate future and only by making many assumptions of price trends for coal and the cost of nuclear stations is it possible to forecast when it is likely to be competitive in those parts of the country where coal costs are high. If large capital investments in rail transport are required to carry coal to those areas remote from the coal fields or alternatively if transmission lines have to be built to supply power direct, then the economic trends have to be carefully assessed. The improvement in reactor technology during the next 5 or 10 years will no doubt be appreciable and where it is possible to postpone nuclear power installations until these benefits are available it will be sound economic policy to do so.

TEA ADJOURNMENT.

On Resuming at 4.00 p.m.:

THE PRESIDENT: I call upon Mr. de Villiers to propose a vote of thanks to Mr. Powell.

Mr. I. DE VILLIERS: Councillor Ross-Spencer, Mr. President, ladies and gentlemen: The wonderful achievements that have brought to the world nuclear power have inevitably given rise in a few years to a massive technical literature in many fields and in many languages. As yet, this literature is largely the domain of the specialist and not the familiar environment of the practising engineer engaged in the power supply industry. It is, however, most important for him, already rich in experience in the use of fossil fuels and water for power generation, to be aware in a broad way of nuclear power developments which might materially influence his planning for the immediate and remote futures.

The interesting paper delivered this afternoon gives him concisely the required kind of information. It has the additional merit of stressing the fluid state in the development of reactors and the consequent advantages of delaying their installation, if circumstances permit, until the benefit resulting from improvements in reactor technology within the next few years will become available. It also emphasises that the incentives for embarking on a programme of nuclear power generation should be carefully examined. This is a timely warning, because the glamour associated with the spectacular advances in the new applied science has captured the imagination of the public and in such a climate, the urge for prestige and the infectious enthusiasm of those engaged in the development of reactors, tend to militate against giving purely economic considerations their full weight in assessing when the first reactor is to be installed.

It is clear that sooner or later, there will be reactors in every country and it is, therefore, necessary for every country to give immediate consideration to the training of a number of men who will, when the time comes be competent to assist in choosing the best type of reactor for a particular application and who could form the supervising nucleus of the complement of skilled personnel required for the subsequent operation of nuclear plant.

The author has drawn attention to the importance of running nuclear stations at high load-factor and has mentioned the difficulty of attaining this mode of operation in the face of the shape of the typical daily load-curve of most power systems, with its relatively small minimum demand at night. It should be noted that even when coal or oil costs are fairly high, the shape of this load-curve may well require the installation of both nuclear and new conventional plant to meet load growth in the most economical way, because the additions in generating plant to meet peak loads will be greater than the increase in the night load for any period. In this connection, separately fossil-fired super-heating to give nuclear plant a peak rating has much to commend it. It has also been pointed out that the day will come in some regions when the use of fossil fuels, even for the partial supply of future load will not be economic nor even possible and nuclear stations will then have to operate at poor load factors. Quite apart from economic considerations, there are technical difficulties associated with such operation. With present reactor designs, little thermocycling can be permitted and there is a lower limit of output determined by criticality that might be of significance in the not so large reactor units.

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The most attractive solution is undoubtedly the creation of a good load factor for the nuclear plant by pumped storage if the civil works are not too expensive. Compressed air would represent an ingenious and novel answer to the problem.

Before the introduction of nuclear power in a country, there are a number of aspects, not wholly concerned with the economics of power generation, to be considered. One of these, for example, is the siting of the reactor. Although the general tendency is for a reactor to be considered as falling more or less into the same class as some chemical plants as far as the danger to the community is concerned, there must be constituted a set of nationally accepted siting restrictions to safeguard the populace. There is also the question of insurance of the plant, the people engaged in the production of nuclear energy and the general public in case of accidents. There must also be inter-Government agreement in connection with the nuclear fuel between the Government of the seller of nuclear fuel and that of the fuel user. Such an agreement will generally include an undertaking that the fuel, equipment and information supplies under the agreement and any fissile material derived from the use of the fuel will be used only for civil purposes. Specific safeguarding provisions of a standard pattern in line with the provisions of the statute of the International Atomic Energy Agency will also be required. The machinery for solving these ancillary problems has been given a great deal of thought and most of the practical difficulties have been overcome.

The author mentioned that there is little prospect of extensive economic nuclear power in South Africa in the immediate future. As many of you know, our Government has appointed a "Commission of Enquiry into the Application of Nuclear Power in South Africa" to examine this problem carefully on broad economic lines in the national interest. It must be remembered that while we have a great deal of coal, we are also uranium producers and it is also necessary to haul coal long distances to the coastal regions. The haulge of such coal may, or may not, be desirable from the point of view of the Railways. All these considerations must be taken into account by this Commission in its deliberations.

In conclusion, it gives me great pleasure to propose that a sincere vote of thanks be accorded to Mr. Powell for coming a long way to our country to deliver his most informative and valuable address.

THE PRESIDENT: Thank you, Mr. de Villiers. I think Mr. Chris Downie will second this vote of thanks.

Mr. C. G. DOWNIE (Cape Town): Councillor Ross-Spencer, Mr. President, ladies and gentlemen: I know nothing about nuclear physics, nuclear engineering, nuclear reactors, and the various complicated ancilliaries that are associated with nuclear technology other than what I have been reading about these matters over the past 10 years, and from the precious little that I was able to learn from a very interesting series of extra mural lectures that were given at the Cape Town University by Dr. Goodlet two years ago. I have had the privilege of being shown over a nuclear power station, namely the Chapel Cross Nuclear Station, when I was in England, last November, and this was a month or so before this power station went critical.

Mr. Powell's paper has covered a very wide field and has opened up to us a vista of engineering science and achievement which is almost breathtaking in its manifestations and future possibilities. The presentation of a paper on Nuclear Power to our Association can be regarded as an historical event in the annals of the A.M.E.U. It has introduced this subject to us for the first time. The paper and the discussion on it will be a valuable contribution to our Association's proceedings.

Mr. Powell, as you know, is one of the partners of the well-known firm of Consulting Engineers, Messrs. Merz & McLellan. The construction and commissioning of the Chapel Cross Nuclear Power Station, Britain's second nuclear station, was carried out under the control of Messrs. Merz & McLellan, acting as agents for the British Atomic Energy Authority's Industrial Group and is the first occasion on which a private

firm has been employed in this way on a major nuclear power project. The official opening of the Chapel Cross Power Station took place on the 2nd of this month—that is Saturday week ago, and I would like to take this opportunity of congratulating Mr. Powell, who was the partner mainly concerned with the Chapel Cross project, on that event.

Messrs. Merz & McLellan's contribution to the development and progress of Electricity Undertakings in Southern Africa has been a great one, and it has been most fitting, therefore that a partner of that firm should be here today "to pave the way" for us on the road to nuclear power. It is coming sooner or later. As to when it will actually arrive is very much a matter of economics and finance in which the price of coal and the cost of transporting it will have a considerable influence.

No doubt, Mr. President, your having invited me to undertake this very pleasant duty arises from the fact that I come from the Cape, where there has been much talk and publicity on the prospects of nuclear power being produced there for the first time in this country. There is, as you know, a special Government appointed Commission going into that question, and we look forward to the publication of their report in due course.

We have at the Cape a very enthusiastic band of scientists, engineers, and industrialists who are taking a keen interest in nuclear physics and nuclear power. A Nucleonics Society has already been formed. This Society in conjunction with the Universities of Cape Town and Stellenbosch, are aiming to get a Nuclear Research Institute established at the Cape. I personally feel that the Cape would be an appropriate place for such an establishment and although I do not belong to the Cape Nucleonics Society, no-one more than I do, wishes them every success in the achievement of their object.

I suspect, however, that I am not very popular with the Cape Nuclear Power enthusiasts, because I am still more enthusiastic for the time being, over coal burning power stations, than I am over uranium burning ones. We engineers who are deeply concerned with the cost of production and supply of electricity are not so gullible as some of our employers—one of them in particular—seem to think! Our job is to produce and supply electric power at the lowest possible cost. We are very much concerned with the economics and finance of electricity undertakings, and I am darned if I am going to become enthusiastic about the production of power where the means of production involve the spending of twice as much valuable capital as compared with that required by our present thoroughly proved, and a most 100% reliable present means of production—i.e. coal-fired power stations. If, however, the powers that be are prepared to heavily subsidise nuclear power, then it is another matter, provided, again, that the nuclear power plant decided upon is one that has been through its growing pains, where the difficulties and snags have been permanently overcome and one whose availability can be relied upon to be just as good as that of conventional power plant.

From several people who are in the know, and who are in close touch with nuclear engineering and nuclear power production, whom I have had the opportunity of talking to, I have got the impression that several features of the various types of reactor so far developed have still to be proved. These are difficulties and headaches still to be overcome. There may even be difficulties that have not yet emerged. The nuclear power stations now being built in the United Kingdom for the Central Electricity Generating Board are mainly experimental and still to be thoroughly proved as to their operation and maintenance, their reliability and availability.

My own views are that we in this country with our vast and cheap supplies of coal are very fortunate in that we need not become seriously concerned yet in the commercial production of electric power from the atom, other than to keep ourselves fully informed and to watch developments and also this is very important: to encourage the establishment of facilities and opportunities for the education and training of those of our young people who wish to make Nuclear Science and Engineering their careers.

Mr. Powell in his paper has said that before embarking upon a conversion to nuclear power generation, the incentives to do so should be thoroughly examined and translated into hard economic facts, and in concluding his paper states that where it is possible to postpone nuclear power installations until the benefits of improvements in reactor technology are available it will be sound economic policy to do so.

I think that we in South Africa are fortunately in the position of being able to await the results of experience and improvements.

It may be a somewhat crude analogy, but I have heard it explained that the present nuclear reactor is somewhat like the reciprocating steam engine as a prime mover —we can wait until nuclear power technique and development reach a stage of streamlining akin to the modern steam turbine as a prime mover.

Even with coal at 50s. a short ton at Cape Town today, I think we have a good many years to go before hard economic facts will enable us to exploit nuclear energy for the production of electricity. I am assuming, of course, that the transport of coal from the coal mines to distant power stations will always continue to be as reliable and regular as they are today.

With these few remarks, Mr. President, I have very great pleasure in seconding the vote of thanks to Mr. Powell for his most interesting paper.

THE PRESIDENT: Thank you Mr. Downie.

I understand that Mr. Powell will probably reply from time to time as questions are raised.

Before I open the paper for discussion, I give Mr. Powell the opportunity to reply to Mr. De Villiers and Mr. Downie.

Mr. A. E. POWELL: Mr. President, I thank Mr. De Villiers and Mr. Downie for their very kind remarks. Having to undertake a visit to South Africa is no reason for commiseration. I received the invitation to deliver the paper with very great pleasure. It has given me the opportunity to see something of South Africa and I wish my stay were longer. It would appear that Mr. De Villiers, Mr. Downie and I are very much in agreement and there is thus no need for me to enlarge on sections of the paper, but Mr. Downie's remarks have raised an aspect on which there might be some misconception. Sir Christopher Hinton said in a public lecture that a nuclear power station was 1% physics and 99% engineering. Physicists might get their necessary answers on reactor types but it remained for engineers and metallurgists to turn any of these types into working propositions. Thus it was not only a case of encouraging the physicist; the men to be trained were those who must design against the thousand and one engineering difficulties which immediately crop up in meeting the physicists demands.

I hope that I have stressed sufficiently in the paper that the operation of reactors to suit the load was an important factor in the economics of nuclear power. A reactor could readily be made to operate at reduced loads and the reactors at Calder Hall and Chapel Cross could follow load changes just as readily as thermal stations. What a reactor did not like was to be shut-down and started up again, and not least of the reasons for this dislike was the fact that it involved thermal cycling of fuel element cans.

Mr. De Villiers has mentioned the question of transport. It is perhaps worth underlining the fact mentioned in the paper that although the fuel required in a nuclear station is about one seven-thousandth of that required by a thermal station, there is a transport problem associated with the irradiated fuel from a nuclear station.

THE PRESIDENT: Thank you Mr. Powell. I am sure many members have come prepared to contribute to the discussion. The paper is now open for discussion.

Mr. A. R. SIBSON (Bulawayo): Mr. President, it would be idle for most of us here to attempt to subject Mr. Powell's paper to any sort of critical analysis, insofar as the main subject matter is concerned.

Before making the one or two quite unimportant remarks that I have to make, I would like to add to what has been said

already in thanks and appreciation to Mr. Powell for his sterling effort in producing this paper which will go down in the history and annals of this Association.

It is not surprising that with so sudden a change that nuclear power has introduced to Power Station economics in Britain—I refer to the relation between standing and running charges—the question of either attempting to improve load factors, or to produce some means of power storage, should have been re-emphasised once again.

One of the things that we perhaps tend to over-look in this country is that the very circumstances that have given rise to this new incentive in Britain exist in this country and always have done. Possibly because there has been no such marked change here at any moment of time, the need for similar attention to these problems has been somewhat under stressed.

The figures that Mr. Powell gives of relative costs between standing and running charges are of very much the same order as the figures that are being obtained in the average thermal station in this country and, if it is right, and I believe it is, for attention to be paid in Britain to some form of load control, or alternatively power storage, on account of the introduction of nuclear power, then it is equally proper for us to give consideration to these matters here.

In the country from which I come, it is likely to become even more important because there, with running costs virtually nil and capital costs, in the case of the major hydro scheme, occupying almost the whole of the annual revenue and expenditure account, the need for either load control or power storage is even greater than in the Union.

I would like to ask Mr. Powell one question, and that is why, with regard to the various methods that he has outlined for power storage, no reference is made to steam accumulation, this is a system which has been adopted on occasions even in the days before nuclear power introduced its new challenge. I know that it has not always been entirely successful, but I think possibly some of the other methods that have been suggested have just as many complications attached to them as steam accumulators have. It seemed to me, when he was describing one of the stations which was already provided with mixed pressure turbines, that it was an ideal case for the use of either some form of steam accumulation or hot water accumulation.

Mr. President, the way that lies before us in this country is, I think, to attempt to introduce as much incentive as we can for the reduction of peak loads. Some of us have various means that have been employed to encourage consumers to limit loads at peak periods, but I think a good deal more could be done on these lines, and I do suggest that if we think that the point that Mr. Powell has made is important, and I think his coming here has brought this matter once again to our attention—our line of approach would probably be, initially at any rate, to reconsider the various ways in which our load curves can be improved.

Thank you, Mr. President.

Mr. A. E. POWELL: In reply to Mr. Sibson, Mr. President, I want to comment on the fact that the United Kingdom is not as fortunate as South Africa in the pumped storage sites available. I know of several suitable sites in the Union but there are not as many in Britain as one would like. Many schemes have been considered and it is probably known that one is about to start close to Glasgow, which would, in fact, be worked in conjunction with the Hunterston nuclear power station.

Mr. Sibson had asked why there was no reference in the paper to steam accumulation. It is a fact that steam accumulation came into being many years ago but has not achieved the popularity it might have done. I feel certain that the cost of storing the quite limited amounts of steam which steam accumulation schemes offer militate against their general adoption and they are probably more suitable for factory use and for smaller installations than for large electrical supply systems such as dealt with in the paper.

Mr. D. MURRAY NOBBS (Port Elizabeth): Mr. President, in the first place, I would like to add my appreciation of the

comprehensive paper which has been submitted by Mr. Powell to this convention.

Although an increasing number of specialised works on nuclear energy are to be found from time to time in the various technical publications, it is seldom that we come across papers surveying in a more general manner the very wide field covered by Mr. Powell.

Early in the paper figures of the reserves of Uranium in various countries are given, and at first glance, they may seem small when compared with the demand that will ultimately be created when the use of this fuel becomes wide-spread.

The progress of the British power industry in recent years has been marked by coal shortages and steadily increasing prices. That country's fuel problems were accentuated by the Suez Canal crisis in 1956 when her oil supplies were reduced very considerably, and when doubts were expressed regarding the wisdom of using oil for power generating purposes. There is little doubt that these shortages have given considerable impetus to Britain's nuclear programme, but it may be possible that this programme could be adversely affected by inadequate supplies, or considerable increased prices of Uranium ore, for which she is dependent on overseas countries. It would be interesting to hear the author on this point.

It has been mentioned by Mr. Powell that owing to the high processing costs of the natural Uranium fuel elements, the trend is towards the use of enriched fuel. In this event, would the fissile material produced by the fast breeder reactor be used for this purpose, and would such a reactor ultimately reduce Britain's dependance on other countries for nuclear fuel supplies?

If total dependence on overseas sources of fuel is regarded as undesirable, our interest, in the present state of the art, would be confined to graphite moderated or heavy water moderated reactors. The former have to be physically large to achieve criticality, but once this size is reached the heat output can be multiplied without corresponding increase in size of the reactor pressure vessel. For this reason high outputs are essential to reasonable capital costs. It is, for example, anticipated that a reduction of 20% in capital costs will occur in the current U.K. programme by 1962, solely as the result of output increasing from 300 MW to 500 MW.

It is expected that progress with ceramic fuel elements will, as the result of higher possible steam conditions, bring about further reductions in capital and fuel costs with this type of reactor, but I believe I am right in saying that this line of development would still further increase the optimum designed capacity of the generating station, and that with ceramic elements, some enrichment of the order of one percent, would be required. Mr. Powell's comments in this connection would be interesting. It would also be of interest to learn something of the optimum capacity of the heavy-water-moderated reactor, and the possibilities of any appreciable reduction in the foreseeable future in the present capital cost of about £10 per lb. of heavy water. It may also be interesting, in the case of the gas-cooled reactor, to speculate on the possibilities of helium becoming more generally available, as this gas has advantages over the currently used carbon dioxide, i.e. the gas-cooled graphite moderated reactor.

Mr. Powell did deal with the organic-liquid-moderated reactor, which is one of the many reactor types currently under investigation in America. Whereas the U.K. has had to plump for a reliable "first generation type of reactor—because of their limited fossil fuel resources, the Americans having much larger coal reserves, have admitted the present uncertainty in regard to the optimum reactor types, by undertaking concurrent investigations into many different types—concerning coal resources, South Africa is in a similar position to the U.S.A. and can, therefore, afford to "sit on the fence" until the picture clarifies. As a point of interest it has been forecast that nuclear fuels will only be necessary in America in 25 years' time.

When one considers the various types of reactors at present being investigated, it is evident that much research and experiment will be necessary before the ideal reactor becomes available, i.e. a reactor that can be made of cheap and lasting materials, that will be safe and simple to operate and

control, where the costs of fuel fabrication and processing will be low and where high heat-rating per unit volume and per £'s worth of fuel will be achieved. In this connection, it was stated at the Geneva Conference in 1955, that 900 different types of reactors were possible and that about 12 had been selected for development by five nations. This would suggest that, regardless of the advances made to date in the matter of power generation by nuclear means, a reactor that will conform to all the requirements mentioned is something that is still remote. I think this is important as far as South Africa is concerned.

In the course of his paper, the author when referring to the commercial processing of radiated fuel elements, gave us some indication of the hazards associated with the disposal of radio-active fission products.

Reactors are designed so that should a serious failure occur within the pile, such as melting and vapourisation of fuel elements, the radio-active materials would be confined within the reactor shell so that contamination from this source is reasonably remote. When the Plutonium is extracted from the irradiated fuel elements, however, the final wastes from the separation process are highly radio-active, and it has been estimated that the arisings in this respect from the United Kingdom nuclear energy programme might amount to six million gallons per year which must be stored for many years without possibility of escape. In this regard there is some hope that if certain long-lived components can be separated from the general fission products, the volume of material requiring storage indefinitely, will be reduced. The activity of Stontium 90 for example, remains for many years, and if this fission product were uniformly distributed over the area of the United Kingdom at the rate at which it will be produced by the U.K. atomic energy programme, the resulting radiation activity would be far above the limit at which life can exist.

During his visit to South African in 1957, Mr. B. L. Goodlet stated:—

"It must be understood that the rigid control of fission products is a corollary to the use of atomic energy, and the problems of ensuring that no dangerous escape ever occurs, in spite of the lapse of years, industrial strife, and possible enemy action, are of the first order of magnitude."

The adoption of nuclear energy for the generation of power can, therefore, be most hazardous to health if rigid containment procedures are not observed. This is indicated by the fact that a lethal dose of Plutonium, if ingested, is 1 microgram.

The medical treatment of cases arising from radiation accidents is progressing and it was recently reported that successful grafts of healthy bone marrow had been achieved in five scientists who received a dangerous dose of radiation in an accident. It may well be, therefore, that the progress in Medical Science may be able to keep pace with the demands that can be made upon it by nuclear fission and thereby minimise the possible effects of the hazard which no doubt exists under present circumstances.

Mr. Powell points out that there is little prospect of economic nuclear power in South Africa in the immediate future, but guardedly suggests that improvement in reactor design in the next five years, coupled with the threatening prospect of large capital expenditure on rail transport to carry coal from coal fields, or alternatively, heavy transmission costs, may be influencing factors in the development of nuclear stations in those areas remote from the source of fuel supply.

While pursuing this same question overseas in 1955, I gathered the impression that when the price of coal delivered to the power stations reached a figure of 90s. per ton, then the atomic power station became competitive with the conventional coal burning station. In the meantime, and with the developments that have taken place in nuclear power during the past few years, this figure may be substantially reduced, but nevertheless, this is only one factor of the many that have to be taken into account when considering the adoption of nuclear power.

If we consider Cape Town or Port Elizabeth in this respect where the cost of coal delivered is around 54s. per ton, the

largest reactor that could be operated at the load factor necessary to justify its use, say 75% would be one approximately equal in output to the night load, somewhere in the region of 40 to 50 MW. Any larger unit would obviously result in a reduction in reactor load factor, heavier capital charges and increased cost of electricity. I would estimate on the basis of figures available in the U.K. that a nuclear station of this capacity would cost at least £150 per kW installed which is double the cost of a medium pressure conventional coal-burning station in this country. Again, this base load can only be increased appreciably by interconnecting centres of load demand and with such centres separated by considerable distances would involve expensive transmission systems and still only obtain a base load which would be fractional compared with the maximum demand. I am sure, Mr. President, that those are some of the points Mr. Powell had in mind when he said that before embarking on a conversion to nuclear power generation, the incentive to do so should be thoroughly examined and translated into hard economic facts.

After inspecting Calder Hall Atomic Establisment, I realised that nuclear power propects are major industrial achievements involving a wide range of processes, plant and equipment quite foreign in many respects to those we are accustomed to in the construction of conventional stations. It was also clear that at the present stage of development the nuclear power station could only be of economic service to large integrated power systems and that its application to South African conditions would be beyond the financial, industrial and manpower resources of this country, for many years to come. I must qualify this statement by expressing the view that this period of time will depend on the progress of reactor design in countries overseas. However, in the meantime, there is much to be said for the construction of an experimental reactor in this country whereby the nucleus of a technical force can obtain training and experience in preparation for the time when nuclear power can be considered in earnest in South Africa.

Mr. Powell, in his reference to pumped storage mentions a figure 67% overall efficiency, but I would assume this figure would be appreciably lower in the case of compressed air storage, due to heat lost during and after compression of the air.

The use of separately fired super-heaters, as described by the author, would assist in overcoming the heavy erosion of turbine casings and blading that occurs when comparatively low pressure and temperature steam is admitted at the turbine stop valve and expanded to a vacuum of around 28½". At the same time, turbine performance would be greatly improved by the higher available heat drop and lower moisture losses, but these benefits would be a maximum provided the super-heating process was continuously used for base load purposes and not for peak load operation.

Intermittent variation of steam temperature to the turbine, of some 400° or 500°F., would present problems to the turbine designer, both thermodynamic and metallurgical, the latter due to the thermal cycling of the heavy components.

In conclusion, I would like to say that as we in South Africa are far removed from the scene of developments taking place in the generation of electric power by nuclear means, it has been very informative indeed to have such a bulk of information presented to us in such clear and concise manner as has been achieved by Mr. Powell.

Mr. A. E. POWELL: Ladies and gentlemen, Mr. Murray Nobbs has raised a large number of points, and I think it would be difficult to deal with all of them without keeping you here for a very long time. What I therefore propose to do is to reply fully in the written reply.

WRITTEN REPLY BY Mr. A. E. POWELL

There is always uncertainty what fuel will cost in future when an undertaking chooses additional plant for its system and new plant must be chosen in the light of the best assumptions and predictions. Britain's nuclear programme may have been based on wrong information as far as coal supply

was concerned but this has probably meant that the programme's speed has been higher than necessary, not that the programme should not have been undertaken. Certainly acute shortage of uranium ore or a marked rise in its price relative to the price of other fuels bought overseas would cause the programme to be reconsidered, and decisions will always ultimately be made on economic grounds. Britain has not undertaken such an enormous programme merely for novelty or prestige reasons.

Power-producing thermal reactors at this time use uranium fuel, natural or enriched, and although the Calder-type-reactor fuel element will contain more fissile plutonium than fissile uranium U235 when it reaches the end of its irradiation to 3,000 MWD/ton, it is still not clear that plutonium can be used with advantage in such reactors. The Americans are working hard on this question and are building a reactor to investigate re-cycling of plutonium. Also they have successfully operated MTR (Materials Testing Reactor) on plutonium with U238, instead of on enriched uranium, for one short-lived fuel charge. Generally, however, the development of the fast reactor may be regarded as a desirable adjunct to the British reactor system more because it is expected to burn the plutonium produced in the thermal reactors, and to convert to plutonium some of the depleted uranium left over after irradiation in the thermal reactors, that because it should produce a fuel which may prove burnable in later designs of thermal reactor. The electrical load in Great Britain increased by a factor of 23 from 1920 to 1957 but the fuel consumed only increased by a factor of 8 in the same period. It is likely that the ratio of increase in energy generated to increase in fuel imported will be more impressive still with nuclear plant but Britain will remain dependent upon overseas supply of uranium and thorium ores with or without the fast reactor.

In a broad sense the term "ceramic fuels" might be taken to refer to the metal-sheathed fuel elements of AGR, for instance, when Mr. Nobbs' figure of 1% for enrichment is of the right order. I prefer to reserve it, however, for the type of fuel element proposed for the high-temperature gas-cooled reactor of the DRAGON project now in hand at Winfrith Heath. There the fuel is expected to be uranium carbide dispersed in graphite and canned in graphite, but then, instead of an enrichment to about 1 per cent., the proposed fissile material is almost pure U235. I find difficulty in understanding what was meant by "optimum designed capacity." Generally the old law, that the larger the plant the cheaper the cost per unit sent out, will always apply so that any limit on size would seem to be imposed more by prudence in assessing the present state of the art rather than any other factor but, in practice, the optimum capacity of any station or unit cannot be divorced from the system to which it is to be added. As I say in the third part of the paper, the optimum addition to a system is that which permits the system load as a whole to be supplied most economically, with, of course, the traditional high standards of security. In the same way, I do not think there is such a thing as an optimum capacity of heavy water moderated reactors as a class, and, especially with pressure tube designs, there would seem to be little limit on size apart again from prudence.

The cost of heavy water has stood at £10 per pound for some time now and, as the A.E.C. have reduced production at their Savannah River plant to one-third capacity because of lack of demand, it does not seem that any appreciable reduction in price from that, the world's largest source, is likely. A method of production as an ancillary to the production of synthetic ammonia has been proposed, but it has not yet been commercially demonstrated and what reduction in cost, if any, it will produce is not known. I do not forsee any appreciable reduction of cost in the near future.

Helium may have chemical and heat transfer advantages over carbon dioxide but its cost is very high and it is not naturally available except in the United States. Carbon dioxide now costs only £20 per ton in the United Kingdom where it is readily available and can be delivered in large quantities at very short notice, and the steps that would be necessary to reduce coolant leakage from the present British reactors

to below the order of a ton per day would not be economically justifiable. In later reactor concepts, such as the high-temperature gas-cooled reactor, carbon dioxide will not be permissible because of its interaction with other reactor materials and then either the high cost of helium must be paid or nitrogen must be used at the cost of additional fuel enrichment. In Britain helium is exotic and expensive and one does not use such materials unless they are accompanied by economic advantages sufficient to tip the scales.

The potential hazards associated with nuclear power are tremendous as Mr. Nobbs says but they are well appreciated and much effort is, and always will be, expended in seeking to ensure that they do not arise in fact. For that reason it would be more rewarding to notice how easily and cheaply the accident to which Mr. Nobbs refers might have been prevented by better design, rather than to take comfort in medical science's ability, laudable as it certainly is, to save five of the six men injured.

Mr. Nobbs suggests the construction of an experimental reactor in South Africa largely for instruction purposes. There is difficulty in the U.K. in finding adequately trained staff both to operate and to maintain power reactors and training of personnel is an essential preparation to the nuclear programme that will come to South Africa when economics insist. I agree entirely with Mr. Nobbs' remarks.

As was said in the paper, for every kWm of energy used by the pump storage scheme at off peak times, about 0.67 kWh is required at time of peak. A strictly comparable figure cannot be produced for the air storage scheme because energy stored in this scheme is augmented by energy added in the form of fuel oil, but, with air storage at a depth of about 500', for every kWh used at off-peak time about 1.33 kWh is available at time of peak. Looking at the relative efficiency of generation in pumped storage and air storage cases, then if the off-peak electrical energy is generated at 28% efficiency in either case, the overall efficiency of units generated by pumped storage will be about 19% compared with about 23% for those generated by air storage.

THE PRESIDENT: Thank you Mr. Powell.

I don't propose to close this discussion this afternoon; there will be further time tomorrow morning.

Has anybody else come prepared to say something?

Mr. J. E. MITCHELL (Salisbury): I intend to be brief, Mr. President. As it is the first time during this Convention that I have been on my feet, I would like, first of all, to give you my congratulations on being elected President of this Association, and I am sure we shall have a wonderful President, and possibly a hard task master.

Next I would like to say that I only really got on my feet, not because I know anything about nuclear power, or the paper itself, but Mr. Powell and I have been associated on thermal power stations for something like nine or ten years now, and Alderman Morton Jaffray and myself have been trying to get Mr. Powell out to Southern Africa ever since, and it appears to have taken an atomic explosion, possibly graphite moderated, to get him out here at all.

I have paid the usual visits to Calder and Dounrae and I came to the same conclusion that one of the greatest difficulties which we should have if we ever went in for nuclear power in this country is the one that Mr. Nobbs and Mr. Powell have referred to, and that is the dearth of technicians.

We have a greater difficulty, in my opinion, in this country even than in the U.K., because we have an African population, and when you take the actual proportion of technicians to the whole of the population, and the whole of the population must be taken into account, then our difficulty is even greater than his.

I know how long it took me to train operators into just the operating of a pulverised fuel boiler instead of an ordinary boiler, and believe me that was a big enough battle in itself.

I want to congratulate Mr. Powell on giving us a wonderful paper. I think really he was very clever, because the paper that he gave — well, I coudn't find anything in

my paper that bore any relation (or very little relation), to what he was talking about. Consequently, unless you could write it down as you were going along, he had a great advantage over us.

I was very interested in his pump storage and had thoughts of the mines round here being flooded or pumped up with air. These things may sound in the realm of phantasy at the moment, but they could happen.

I have really only two questions for Mr. Powell. He mentioned Hinckley Point was £120. a KW and .7d. per unit sent out, which I presume is on a fairly high load factor.

In the White Paper that was presented in order to persuade the British Government to find enough money for all the nuclear power stations they are now going to build, it said that the price of power was going to be ¿6d. No engineer, of course, believed it, because you sold the ashes for a great deal more than the cost of the original fuel, and I would like to ask Mr. Powell whether that .7d. takes into account any sale of the ashes which is a very vital point in nuclear power economics.

The other point I would like to ask Mr. Powell is one I came up against as far back as 1952, and peculiarly enough, one of the engineers concerned on this is in this hall today. That is in regard to the glands for the blowers. I understood it was a difficult enough proposition to make a gas type gland for the blowers when the pressure was 50 lbs. as in the case of Calder Hall. I understand now that that has been stepped up at Chapel Cross to 185 lbs. and I would like to know from Mr. Powell whether there have been any great difficulties, or whether they have got a brand new type of gland which has taken care of that.

As I said before, I am not producing any fresh paper on nuclear power stations, but I did want to get on my feet and thank Mr. Powell for giving us such a wonderful paper, and, if I may say so, for his wonderful method of presenting it.

Mr. A. E. POWELL: Mr. President; I think that everyone in Britain, whether in public or not, now admits that the estimates made in the White Paper were optimistic. The figure of 0.6d/kWh s.o. quoted there was the pessimistic limit of a range of unit costs quoted by Jukes in his 1955 Geneva Conference paper. In 1955 the U.K.A.E.A. gave irradiated fuel a value of from 50% and upwards of its unirradiated value, but not more than 100% (so things are not quite as bad as Mr. Mitchell fears). There is still a plutonium credit in the fuel replacement cost part of the 0.7d/kWh but it is lower than the 1955 figure and the estimated price of production is thus far less dependent upon that credit. The most important thing to notice, however, is that 0.7d. is still only an estimate and nothing conclusively better than an estimate can be available until a representative proportion of the first fuel elements put into the civil power reactors have had time to reach their irradiation target of 3,000 MWD/ton. About three years after commissioning would be required for this.

The coolant pressure at Chapelcross is nominally 100 lb.sq.in.g., the same as at Calder. There is minor gas leakage both at Calder and Chapelcross but the blower glands seemed very satisfactory and they are not the culprits. The seal design follows generally the lines of seals on hydrogen-cooled generators and, although there has been trouble at Calder due to oil getting into the coolant stream, this has been due to mal-operation of the sealing oil system and is no reflection on the efficiency of the gland.

THE PRESIDENT: Thank you Mr. Powell.

I think in view of the programme this evening it is time that we stopped today. We will give you further opportunity tomorrow morning.

Before we go, though, I would like you to show your appreciation for Mr. Powell's abilities in the usual way.

CONVENTION ADJOURNED.

SECOND DAY

On Resuming at 9.30 a.m.:

(Convention announcements were given at the opening of the proceedings.)

THE PRESIDENT: Now, gentlemen, Mr. Powell is with us this morning. I would like to give you an opportunity to continue the discussions on Mr. Powell's paper. I would like you to understand, too, that we still have Thursday and Friday morning, together with the other papers.

Mr. A. E. POWELL: Mr. President, gentlemen: judging by one or two remarks which were passed to me after yesterday's discussion, I feel that I might perhaps spend a few minutes talking about the question of effluence from a nuclear station, just to try and put the thing in the right perspective.

It should be assumed that fuel for a nuclear station would normally be supplied by the U.K., the U.S.A. or an equivalent source of such material and that the irradiated fuel would be returned to the supplier for chemical processing. The effluents arising from nuclear stations in South Africa, or in any other country using nuclear power, would be much the same as those arising from stations in the United Kingdom, and Chapelcross might be taken as typical. There fuel is received fully canned and, prior to its use in the reactor, it produces no effluent problem and the operators' major concern is to see that it is kept clean. During irradiation and after effectively all the highly radio-active fission products are retained in the fuel element by its can and the irradiated fuel elements represent the really obnoxious material to be disposed of from the site.

Irradiated fuel elements are extracted from the reactor and transported in heavily-shielded coffins to the fuel-element decay pond, a special construction containing water about 17 feet in depth. In the pond and under water the fuel elements are remotely transferred to skips in which they were stored at the bottom of the pond for a period of two to three months. After such a period their radio-activity decayed to a level permitting their transport to the U.K.A.E.A. chemical separation plant at Windscale in fair bulk without the use of uneconomically excessive shielding. The fuel elements leave by road in coffins designed to ensure that they offer no radia-

tion hazard to anyone on the journey, and which are carefully washed clean before despatch to ensure that there would be no dripping of contamination from their exteriors.

Water has the great advantage for a shielding material of being transparent, but, in order that advantage can be taken of this property, the water has to be kept clear. It also has to be maintained sufficiently alkaline to minimize corosion of the irradiated fuel elements under water, and these requirements are met at Chapelcross by a daily system of purge and make up. The purged water is pumped through a filter designed to remove active particulate suspensions in the water and when it is ultimately discharged to the Solway is of potable quality. The filters are periodically washed back and the active particulate matter obtained is separated out from the washings in a high speed centrifuge and collected in a plastic container. Such containers are ultimately shiped in a shielded box to Windscale for storage or disposal, and the quantities involved are too small to make a significant addition to the shipment of irradiated fuel.

The coolant gas is regularly blown down at Chapelcross for reactor charge and discharge purposes, although this would not be necessary at the civil stations. The effluent gas presents no hazard at all because such radioactive content as it carries after passing the exhaust filters is diluted to insignificant level by mixing with the atmosphere long before the gas reaches ground level. Actually the requirements of the Factories Act designed to prevent asphixia from carbon dioxide necessitated more stringent precautions than the radio-activity acquired by the gas in the reactor, but they too are an insignificant matter.

Those were the only effluents from Chapelcross, apart from such normal effluents as cooling tower purge and other such normal arisings from power stations, and it can thus be seen that they are innocuous. The problem of dealing with the enormous amount of fission products which arose in a nuclear reactor was transferred to the chemical separation plant and does not arise on the nuclear power station site.

I hope that makes the situation clear, because I feel that there was some misconception on that from remarks that I made yesterday.

THE PRESIDENT: Thank you very much, Mr. Powell. Now, further discussion, please, gentlemen.

Mr. J. L. VAN DER WALT (Krugersdorp): Mr. President, I would like to know from Mr. Powell, in view of the success of Zeta, will the method by fusion probably replace the method by fission as a method of steam raising?

Mr. A. E. POWELL: I think the question is perhaps based on a misconception.

Zeta is certainly not a success at the moment as far as power production is concerned and Sir John Cockroft has described it as only the first glimmerings of a breakthrough on the use of nuclear fusion for power production. The most optimistic period before power is produced from fusion was given at Geneva in September 1958 as twenty-five years and even after that there would be an enormous amount of engineering work to be done before fusion becomes a real proposition. I consider fission type reactors to be the only practical type for many years to come.

Mr. P. A. GILES (East London): I would like to congratulate the author on the excellence of his paper, which sets out very clearly to me as a student, the physical method by which the fission of the uranium nuclei is accomplished and the means whereby the heat released by such fission is absorbed by the reactor and passed through the heat exchanger to the boilers and there used for the generation of electricity by conventional methods.

I was going to ask a question on fusion, but Mr. van der Walt anticipated me.

The use of uranium as a nuclear fuel results in more complicated furnace arrangements so far as I can see, far more complicated than that required for oil or coal, and it is clear, as mentioned by Mr. de Villiers, that the complexity of the operation and the serving of a uranium pile, necessi-

tates extremely special and particular training for the operatives and the mechanics, and that this feature may prove a difficulty in a country which does not operate atomic piles or engage in nuclear research.

It is noted that no particular type of reactor can be considered as being superior to the others, and gas, water and liquid metal types of coolants are described in great detail by Mr. Powell.

The type of reactor to be used in any application therefore appears to be an open question requiring considerably study before a decision is made.

The author has set out the contribution which nuclear power can make to the national economy, and has indicated the technical and economic factors to be taken into account when integrating nuclear power with existing thermal power stations. Actually the problem appears to be mainly one of capital finance. Substantial expenditure will be required to provide a base load nuclear power system together with processed uranium for the initial reactor fuel charge. In addition facilities for handling peak loads are necessary and such items as separately fired super heaters, pumped water or compressed air, alternatively thermal storage stations are required to be provided for the system.

Finally, the author thinks it prudent to have available on the system spare plant capacity to take into account the unavoidable failure of the largest nuclear unit. Thus a vast capital sum would be required to finance the purchase of all the items enumerated and it would appear that the expenditure could only be warranted provided the difficulties of obtaining coal at a justifiable price were insurmountable. In this unlikely event, at least in the foreseeable future, the coal fired stations on which the Union's electric power system is built would be unable to deal with the big expanded load.

When this happens the introduction of nuclear power stations to augment the power supply systems would be a necessity. However, at the moment it appears to me the Union has an abundant supply of coal and taking into account the very speculative nature of the estimated costs associated with nuclear power it would appear that coal will be the main source of basic energy in this country for some time to come.

THE PRESIDENT: Thank you Mr. Giles.

Mr. A. E. POWELL: There is very little to add, really, to what Mr. Giles has said. I may have misunderstood his remarks, but of course I did not mean, necessarily, that the stand-by plant should be nuclear.

With regard to the speculative nature of estimates of nuclear costs Mr. Roddis remarked in the World Power Conference of 1957 that the most significant aspect in estimating nuclear costs is the man making the estimate.

Mr. G. J. MULLER (Bloemfontein): Mr. President, I would like to add my quota of thanks to the author for his really excellent paper. The merit of it, I think, insofar as this South African audience is concerned, lies chiefly in this: that he has put the matter of nuclear generation in a proper perspective as far as the development and potential in our country is concerned.

As you can appreciate, in Bloemfontein we are not immediately interested in nuclear power, but there is a question I would like to ask Mr. Powell, just as a matter of curiosity. Could he indicate to us the relative cost per unit, of the safety measures associated with a nuclear station? i.e. the station itself, as far as staff is concerned, and the disposal of the, shall we say, rejected fuel? I appreciate that the fuel is not really rejected in the vicinity of the station but goes back to the country of origin, but the cost of handling and so on, even the filtering the tanks, associated capital, and so on — What would you estimate would be the relative cost of the safety precautions associated?

Mr. A. E. POWELL: That, Mr. President, and gentlemen, is really a tough one!

There are few items in a nuclear station that can be separated out as investments in safety only. Radiation shields and so on are essential to permit the plant to be operated and the biological shield forms the major part of the reactor housing, and so their cost

of about £3/kK/ (or 2½% of the total cost of the station) must be charged under other headings.

Provision of coolant blow-down filters and handling facilities for irradiated fuel elements in a nuclear station, items specifically mentioned by Mr. Muller, might cost about £0.5/kW. The health physics organisation, that is the branch which monitors operators and plant for radioactivity, will possess a variety of equipment but not of significant value when compared with the cost of the whole station. Their service could cost of the order 0.001 d/kWh. s.o.

Those figures apply to the present British design of reactors where containment, that is provision about the reactor of a sealed container designed to prevent the escape of radioactive substances in the event of an accident, is not practised. For reactor types where containment is considered necessary then this alone might cost up to £5/kW for a large plant.

Very roughtly, safety provisions might add between o.01 and 0.03 d/kWh s.o. for a large plant, according to the type of reactor.

THE PRESIDENT: Thank you Mr. Powell.

Mr. C. G. DOWNIE (Cape Town): Mr. President, although I have already had my say in connection with this paper, there is a question I would like to ask Mr. Powell. It may not be up his street, but nevertheless, he may know something about it.

This arose out of something that Sir Joshia Eccles said at a recent conference of the Association of Supervising Electrical Engineers in England quite recently when he referred to the possibility of producing electricity direct from the atom. He referred to the intriguing possibility of being able to exploit the conversion of a gas into a conductor moving at a terrific speed across a magnetic field, thus providing the elements for an electro-motive force. From what I can remember, he referred to the possibility of thus being able to produce electricity as direct current without the need for a mechanical prime mover.

Does Mr. Powell know anything about such development?

Mr. A. E. POWELL: Mr. President, gentlemen: the questions seem to be increasing in toughness as we go along.

I assume Sir Josiah Eccles referred to an ingeneous reactor concept which, although it would use U235 plasma, was a fission device and not a fusion one. I can do no better than to refer Mr. Downie to the description which appeared in "Nucleonics" for August, 1957, pages 50 to 55.

THE PRESIDENT: Thank you Mr. Powell.

I propose to give you a break. We have not yet finished with you. I am sure there will be one or two tougher questions, but I would like to get on with the balance of the Agenda, and thank you very much for coming here this morning. I trust you will have tea with us, too.

Mr. A. E. POWELL: Thank you very much.

THE PRESIDENT: Gentlemen, I would like to go on to the Reports of Representatives and Committees. I flatter myself by taking the first one, the Electrical Wiremen's and Registration Board.

You have a copy of my report on the printed document, and I take this opportunity of asking Mr. Malan to perhaps say a few words — unless there are any questions.

REPORT ON ELECTRICAL WIREMEN'S REGISTRATION BOARD, 1958 MEETINGS

The Board met on nine occasions during 1958 and the Examinations Sub-Committee met on the same number of occasions.

EXAMINATIONS

Four written examinations were held during the year covering Part A of the full examination on the Wiring Regulations and Electrical Theory. The number of notifications issued were 1,422, whilst only 699 wrote and 29.6% were successful.

There were 10 practical examinations with 477 entrants and 75.2% passes.

During the year the Board granted oral examinations to 6 candidates who, for various reasons, were unable to pass the written examination.

427 applications for registration were considered, 405 accepted for examination or exempted whilst 22 were refused or deferred for further particulars. 364 certificates were issued making 7,207 the total number of certificates issued to date.

During the year 87 provisional registration certificates were issued and 50 were renewed for a further period.

DETERMINATION OF AREAS

No new areas were determined in terms of Section 18 during 1958 but provisional notices were issued in respect of the municipal areas of Winburg and Bothaville.

At the end of 1958, 64 magisterial districts and 8 municipal areas had been determined in terms of the Act with 40 further areas awaiting the Minister's decision (mainly those areas reported on for 1957).

GENERAL

I am indebted to the Board for the information provided in this report and for permission to submit it to Convention.

R. W. KANE,
Representative

Mr. G. J. MALAN (Department of Labour): Mr. President, before dwelling on the Annual Report, may I as Chairman of the Wiremen's Registration Board congratulate you on behalf of the Board on your election to this high office.

I feel that the Board has been greatly honoured, and I have no doubt that you will make a wonderful success of the ensuing year.

Gentlemen, as the President has mentioned, it is assumed that his report has been perused, and I feel there are no comments necessary. There is, however, one very important aspect that I am sure will be of interest, and that concerns the determination of areas.

It was reported during 1957, and again 1958, that a number of areas were under consideration for determination. The latest position is that on the 20th February, 1959, Government Notice No. 264 listed 41 Municipal Magisterial and Village Management Areas that the Minister intended to determine. A copy of this Government Notice has been laid on the table and I have to inform you that the areas mentioned were finally determined with effect from 1st May.

In the majority of cases ample notice of intention has been given, but nevertheless there may be some cases of possible or suspected hardship. Whilst the Board would naturally prefer that registration is effected in the normal manner, there is the possibility of limited registration for special cases, and in this connection, more than likely the advice of the Town Electrical Engineer will be required.

THE PRESIDENT: Thank you Mr. Malan.

Is there any discussion?

(There was none).

THE PRESIDENT: We will move on to the Coal Allocation Committee.

Mr. D. J. HUGO (Pretoria): Mr. President I have pleasure in formally submitting the report of the Coal Allocation Committee. As you have already mentioned these reports have been widely circulated, and I don't propose reading it out. In amplication of the report I can just announce that the levy on Transvaal and Free State coal was reduced by 5d. a ton as from the 7th May.

REPORT OF THE COAL ALLOCATION COMMITTEE

Mr. President, Gentlemen,

Your Association has been represented at all meetings of the Coal Allocation

Committee which have taken place since the last Convention.

As far as your representatives are aware no Municipal Electricity Undertaking experienced any difficulty in regard to the supply of coal for power station requirements during the past twelve months.

Members will have read the announcement by the Minister of Transport that road haulage on the Reef will be reduced by half during this year. This will result in a deduction of the levy on coal, produced by the Transvaal and Orange Free State Collieries, from 10d. to 5d. per ton. The position will be reviewed after this winter with a view to a further reduction or perhaps complete removal of the levy.

Your representatives take the opportunity of placing on record their appreciation of the assistance received from the Chairman of the Coal Allocation Committee, Mr. W. J. Lamb, and from the representatives of the Railways, of the Transvaal Coal Owners Association and of the Natal Associated Collieries.

D. J. HUGO,
Representative.

THE PRESIDENT: Thank you. They seem to time these adjustments round about Convention time!

Mr. Fraser, Safety Precautions Committee.

Mr. J. C. FRASER (Johannesburg): Mr. President, it does appear that it is taken for granted that everybody has read my report which has been supplied by you in the booklet given to us, so following the example of the two previous speakers, I don't intend to read the report, but I would like to amplify it by saying that this is probably the last report which will be read as the Safety Precautions Committee.

I have explained in my report that this Committee is now being taken over by the Institute of Electrical Engineers, who have, I understand, named it the Wiring Regulations Committee. I understand that it is quite possible that the President, Mr. Kane, will be the Chairman of that Committee and, indeed I think it has been arranged, that he should take over this Committee.

I would emphasise again that I consider that this Association should place on record the work that the Insiitute of Certificated Engineers of South Africa has put into this Committee, without a doubt, they started this committee 23 years ago, and they have been the secretariat for this committee during the whole period. I don't think there is anything further to add to the report, and I formally submit my report as printed.

REPORT OF THE SAFETY PRECAUTIONS COMMITTEE

Mr. President and Gentlemen,

I have pleasure in presenting a report on the activities of the Safety Precautions Committee. A great deal of correspondence on the interpretation of the Wiring Regulations has been dealt with by the Committee and further amendments to the Regulations are in draft form, the urgent need for additional secretarial service and other important matters affecting the working of the Committee has also been dealt with. You will recall at the last convention I made reference to the increasing volume of work coming before the Safety Precautions Committee. In addition to the routine correspondence there is the drafting of a new edition of the Standard Regulations for the wiring of premises. It became apparent to the members of the Committee that they would have to meet more frequently, and as members are so completely occupied with their official duties it has been extremely difficult to create further spare time for the considerations and development of draft amendments. The Committee has a number of proposed amendments on hand and to complete this work it is essential that the services of a full time drafting Engineer with additional secretarial assistance be obtained if the Committee is to make the progress desired.

A memorandum setting out the Committee's difficulties and offering certain suggestions, was prepared by the Committee and forwarded to the Secretariat of the Institution of Certificated Engineers and the S.A. Institution of Electrical Engineers, as the interested parties in the Committee's

activities. A number of meetings were held between the office bearers and delegates of the Institution, and the Institute. Arrangements have now been made for the S.A. Institute of Electrical Engineers to take over the Secretaryship, drafting work and Sponsorship of the Safety Precautions Committee.

The new Committee which will be formed shortly, will be known as the Wiring Regulations Committee, and will have similar representations to that of the old Committee with power to have additional representation from other interested bodies.

As this will be the last report presented to the Association under the heading of the Safety Precautions Committee, I would like the Association to place on record its appreciation of the services rendered by the Institution of Certificated Engineers of South Africa, who have carried out the secretarial work of this Committee since its formation some 28 years ago.

J. C. FRASER,

Chairman.

THE PRESIDENT: Thank you Mr. Fraser, and thank you for representing us on the Safety Precautions Committee for many years.

Is there any discussion from members?

I think we will take the Secretaries' Annual Report now.

I would suggest that possibly Alderman Morton Jaffray may want to say a few words.

ALDERMAN MORTON JAFFRAY (Salisbury): Mr. President, I would like to pay tribute to our Secretaries for the able manner in which they have set before us their Annual Report for the past year.

Our Secretaries (particularly our friend Dick Ewing), have a very tough job in handling the affairs of this Association. I think we all know what temperamental people electrical engineers are, and having been in the picture for quite a number of years now, it simply astounds me how any secretary can keep track of what our engineers sometimes want to put across. I say that, of course, with great respect to them.

It gives me great pleasure, Mr. President, to move the adoption of the Secretaries' Report and of the Accounts for the year ended 28th February, 1959.

Mr. J. L. VAN DER WALT (Krugersdorp): Mr. President, it gives me great pleasure to second the motion for the adoption of this report.

Our finances seem to improve from year to year, and I think a lot of it is due to the hard work and meticulous accuracy of our Secretaries. You can see from the Balance Sheet, and the Income and Expenditure Account that the amount of money this Association is dealing with is increasing year by year, and I wish to congratulate the Secretaries for keeping our financial house in order.

I second the motion for the adoption of the report.

(There were no questions).

THE PRESIDENT: I would like to take the opportunity at this stage to thank Dick Ewing for many things this last year. It does not always occur that the host town has the secretary in it, and, as Dick said last night, he is quite surprised that we are still friends. There were many occasions when we were all very busy, very actively doing the same thing simultaneously, but we have a lot of common, decent, sensible support from our Secretaries, and we have a lot to be thankful for — and I thank you, Dick.

THE SECRETARY: Mr. President, gentlemen: it is not customary, or rather I have not made it customary during the last couple of years, to say thank you for all the nice things that you have said about us when our Report has been dealt with. I don't think they are really deserved, but I would like to thank you, Mr. President, on this occasion for your co-operation, especially as Chairman, or convenor, of the Finance Sub-Committee over the last few years. Indeed, I think since the time we took over the job of Secretaryship of your Association, you have been of the greatest assistance to us at all times, and I do say this most sincerely, "Thank you, Bob."

ANNUAL REPORT OF THE SECRETARIES

To the President and Members of the Association.

Mr. President, Gentlemen,

It gives me great pleasure to submit to you the Annual Report of your Association together with the Revenue and Expenditure Account and Balance Sheet for the financial year ended 28th February, 1959.

Obituary :

I deeply regret having to record the passing of Mr. J. A. West an Associate Member, formerly of St. Michaels on Sea; Mr. J. Iverach, City Electrical Engineer, Grahamstown; Mr. P. Bechler, Town Electrical Engineer of Newcastle whose death was reported at the last Convention and Mr. J. Mordy-Lamb, a former Town Electrical Engineer of East London, and President of the Association in the years 1927/29.

Thirty-second Convention :

The 32nd Convention of the Association was held in Cape Town from Tuesday, 15th April, to Friday, 18th April, 1958. Delegates were welcomed to the Convention by His Worship the Mayor of Cape Town, Clr. Col. Billingham.

The Convention was formally opened by Mr. W. B. J. Slater, Acting Administrator of the Cape Province, and a total of 444 members, delegates, representatives, officials, visitors and ladies attended.

On behalf of the President, Members of the Association and all others who attended the Cape Town Convention held in the delightful venue of the Civic Centre, Camps Bay, I wish to record sincere appreciation to His Worship the Mayor and City Councillors of Cape Town, for the hospitality extended to all and the assistance rendered in connection with the Convention.

To the President, it is my pleasant duty to place on record, appreciation for the sincere and efficient discharge of his duties at the Convention and for his untiring work which made it the success it was. To Mrs. Downie and Mrs. J. Cottier, who deputised for her, grateful thanks are also extended. Last, but not least, the thanks of all concerned are extended to the officials of the City of Cape Town for their untiring work in connection with the Convention.

The papers presented at the Convention were Gas Pressure and Oil Filled Cables by P. W. Cave, B.Sc., M.I.E.E., M. Amer., I.E.E.; Synthetic Rubber and Thermoplastic Cables by B. B. Evans, B.Sc., F.R.I.C., F.I.R.I.; and Design and Economics of Township Reticulation by Low Voltage Overhead Mains by H. Wood, A.M.I.E.E. The first two papers were presented on behalf of the Cable Makers' Association and were unanimously accepted as being of the greatest value to members of the Association. The paper by Mr. Wood of the Electricity Department, Cape Town, proved of great practical interest and aroused much fruitful discussion.

The discussion in Members Forum, held on the occasion of the Cape Town Convention for the first time at night, was in general, of the usual high standard. In particular, a lively discussion took place on the subject of level price tendering which in turn has lead, during the year, to further serious consideration of this vexed question which it is hoped, will ultimately be of benefit to all concerned.

The amended Constitution of the Association which I mentioned in my previous report was submitted to, and finally adopted by the Cape Town Convention.

The Convention unanimously accepted the recommendation of the Executive Council, that Messrs. C. R. Hallé, A. Foden and G. G. Ewer be elected Honorary Members of the Association.

Membership :

The following new members were elected during the year ended 28th February, 1958 :—

Councillor Members :

Burgersdorp, Municipality.
Rouxville, Municipality.

Tzaneen, Municipality.
Empangeni, Municipality.

Engineer Members:

T. D. Zeerderburg (Ladybrand), Subsequently transferred to Associate Membership.
H. Fohren, (Eshowe).
H. C. Joslin, (Heidelburg Tvl.)
J. K. Von Ahlften, (Sasolburg).
C. F. Rautenbach, (Burgersdorp).
W. Beesley, (Livingstone).
H. C. Dreyer, (George).
W. J. B. van Heerden, (Middleburg C.P.)
R. S. Dunstan, (Port Elizabeth).
T. D. Millen, (Tzaneen).
L. Booysen, (Vrede O.F.S.)
P. C. Asselbergs, (Empangeni).

The comparative figures for the Membership for the years 1957/58 and 1958/59, are as follows:—

	1957/58	1958/59
Council	111	112
Engineer Members	103	109
Honorary Members	10	13
Associate Members	33	31
Associates	1	1
Technical Associates	1	1
Affiliates	79	87

Finance:

A few comments on the Income and Expenditure Account for the year under review, as well as the Balance Sheet as at 28th February, 1959, as submitted to you.

The excess of Income over Expenditure of £477 14s. 8d. reflected in the accounts may be regarded as indicating that after the re-organisation which has taken place over recent years, and dealt with fully in previous Annual Reports, the Association is now operating on a satisfactory break-square basis, with a reasonable excess of Revenue over Expenditure in years such as that just passed when little unusual expenditure was called for, and possibly a corresponding deficit in years when the venue of a Convention or other extraneous factors result in greater expenditure.

Once again I must convey to the Members of the Finance Committee sincere appreciation for their assistance during the year and to Mr. Kane in particular for his willing co-operation and support. To the advertisers, the thanks of the Association are again extended.

General:

The Regional Branches of the Association in the Eastern Cape and Natal now appear to be firmly established and playing their essential part in the organisation of the Association.

Once again the hope is expressed that the Branch structure in other centres will develop in the near future.

The Mid-year Executive Meeting was held this year in Springs and this opportunity is taken of recording the thanks of all concerned for the hospitality extended to the Executive Council by His Worship the Mayor and Councillors of Springs.

I again wish to record on behalf of the Association the sincere thanks to the Members of the Sub-Committees and representatives on other Committees, for their continued and untiring work in the interest of the Association and its Members.

Lastly it is my pleasure to thank you, Mr. President and all other Members of the Executive Council for the courtesy and assistance afforded us during the past year. The accessibility of Members of the Executive Council and their willingness to be of assistance at all times is of the greatest assistance to us.

To the Association and all Members we extend our best wishes for the year 1959/60.

R. G. EWING,
for DAVIDSON & EWING (PTY.) LTD.
Secretaries.

5th March, 1959.

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA
BALANCE SHEET – 28th FEBRUARY, 1959

1958							1958			
4,114	ACCUMULATED FUNDS:						1	PRESIDENTIAL BADGE		1 0 0
								Nominal Valuation		
3,105	Balance at 28th February, 1958	4,114	3	5			51	FURNITURE AND FITTINGS		46 4 0
								At cost less depreciation		
1,009	*Add*: Excess of Income over Expenditure for the year ended 28th February, 1959	477	14	8	4,591	18 1	2,605	INVESTMENTS		3,772 14 9
								Fixed Deposits and Savings Account at Building Societies including interest accrued.		
125	PROVISION FOR AGENTS' COMMISSION				123	7 10	707	DEBTORS		447 16 1
61	INCOME RECEIVED IN ADVANCE					—	18	PAYMENTS IN ADVANCE		20 0 0
							10	DEPOSIT—Davidson & Ewing (Pty.) Ltd.		10 0 0
							908	CASH AT BANK		417 11 1
	NOTE: 1. There is a Contingent Liability in respect of unclaimed expenses amounting to approximately £60.									
	NOTE: 2. Stocks of Medals for Past Presidents and Honorary Members to the value of £35 were on hand at the financial year end.									
£4,300					£4,715	5 11	£4,300			£4,715 5 11

Davidson & Ewing (Pty.) Ltd.,

C. G. DOWNIE, *President.*

Per R. G. EWING, *Secretaries.*

Report of the Auditors to the Members of the Association of Municipal Electricity Undertakings of Southern Africa:

We report that we have examined the Books, Accounts and Vouchers of the Association for the year ended 28th February, 1959 and have satisfied ourselves of the existence of the securities. The above Balance Sheet is properly drawn up so as to exhibit a true and fair view of the state of affairs of the Association as at 28th February, 1959 according to the best of our information and the explanations given to us and as shown by the books of the Association.

SAVORY & BRINK,
Chartered Accountants (S.A.)
Auditors.

Johannesburg, 11th March, 1959.

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 28th FEBRUARY, 1959.

1958				1958		
13	Audit Fees 1958		18 18 0	1,706	Subscriptions—council and other	1,714 17 0
14	Bank Charges		11 11 4	109	Interest on Fixed Deposits and Savings Account	167 12 4
13	Bad Debts—Sales of Proceedings		—	1,176	Subscriptions—Affiliates	1,290 11 0
1,159	Convention Expenses		1,412 13 3	309	Proceedings—Schedule 1	242 8 4
72	Medals—Past Presidents and Honorary Members		—	6	Sundry Revenue	4 0 0
6	Insurance		8 5 6			
(	Depreciation Furniture and Fittings		5 0 0			
127	Printing and Stationery (general)		176 8 1			
67	Postages and Telegrams (general)		43 10 7			
600	Secretaries Fees		900 0 0			
28	Telephone		23 10 0			
170	Executive Council Expenses		324 5 3			
	Attendance at half-yearly meetings	190 14 4				
	Attendance at other meetings	133 10 9				
15	Subscriptions		15 0 0			
7	Sundry Expenses		2 12 0			
1,009	Excess of Income over Expenditure transferred to Accumulated Funds		477 14 8			
£3,306			£3,419 8 8	£3,306		£3,419 8 8

ASSOCIATION OF MUNICIPAL ELECTRICITY UNDERTAKINGS OF SOUTHERN AFRICA

SCHEDULE 1.

PROCEEDINGS:					
Advertising—Gross				1,152	10 0
Less: Provision for Agents Commission 1959	123	7	10		
Less: Overprovision for Agents Commission 1958	11	2	2	112	5 8
				1,040	4 4
Add: Sales				217	0 0
				1,257	4 4
Less: Cost of Printing	898	1	0		
Sales Commission	116	15	0	1,014	16 0
				£242	8 4

REPORT ON STANDARDISATION OF ELECTRICITY TARIFFS

Mr. President, Gentlemen,

The standardisation of electricity tariffs has demanded the attention of electricity undertakings since 1925. In 1925, 1929 and 1935 the then Electricity Commissions of Great Britain established committees to report on the matter. To date no practical solution has been found and your Sub-Committee is of the opinion that an impossible task was set, particularly as far as domestic tariffs are concerned.

The Sub-Committee agrees with the McGowan Committee of Britain (1929) when it reported as follows :—

"We do not think there is at present any one satisfactory uniform basis of two-part tariff for domestic supplies which could reasonably be imposed compulsory on all undertakings."

To-day, 30 years later, the same conditon still holds.

If any attempt were to be made to build a tariff structure for municipalities on costs alone, it is bound to fail. Similarly if based upon "use value" alone, it will fail. Tariff structures should take both these factors into account and they must also be flexible enough to meet the requirements of a dynamic industry which electricity supply happens to be.

It is impossible to devise a tariff structure which is free from criticism and also one which could replace the tariff rates of any particular electricity undertaking.

The basic requirements of a sound tariff structure are :—

(a) The revenue should cover costs plus a reasonable profit.

(b) Tariffs should be such that it attracts business and that it will promote or encourage the greater use of electricity.

(c) The simplest and minimum amount of metering equipment should be required.

(d) The tariffs should be simple and understandable by all concerned, particularly consumers. It should not require frequent inspections of consumers' installations.

(e) The prices charged should be competitive with the cost of substitute fuels.

(f) The primary question is: What can the consumer afford to pay and yet cover supply costs plus a reasonable profit.

The Sub-Committee, however, strongly recommends that as few classes of tariffs as is possible should be adopted. Due to the dynamic nature of the electricity demand special tariffs appear to be losing ground in modern tariff structures. Basically there are three classes of consumers to consider, viz :—

(1) Domestic
(2) Commercial
(3) Industrial

(1) *Domestic Tariff.*

It now appears common practice to have either

(a) a variable block tariff based on :—

(i) property valuation, or

(ii) number of rooms, or

(iii) floor area (for the demand related portion of the load) plus a flat charge (for the corresponding lower rate unit consumption), or

(b) the fixed block tariff in which the units consumed are divided into fixed blocks with a high initial rate for the first block and lower rates in the subsequent blocks.

In total revenue there appears to be no great variation to warrant any definite recommendation regarding the adoption of either the one or the other. Both have their advantages and disadvantages and local conditions should be the deciding factor.

(2) *Commercial or Business Tariffs*

It appears to be common practise for the commercial or business tariff to be of the "block" type. Here again there are various schools of thought and the controversy over "fixed" or "variable" block continues.

The survey carried out shows that the block tariff is by far the most popular, i.e. 44% fixed block tariff, 36% variable block tariff and 20% others.

It is recommended that the number of blocks be kept to a minimum, two or three blocks being sufficient.

Some undertakings provide a special heating and cooking tariff, but here again the need for the number of forms of tariff to be kept to a minimum must be stressed.

(3) *Industrial Tariff*

It has been found necessary to divide this class of consumer into two classes :—

(a) Small consumers, and

(b) Large consumers.

For the small industrial consumer, the fixed block, variable block and maximum demand tariff is being applied with the fixed and variable block tariff being more favoured because with a tariff based on recorded maximum demand it is possible for the small low load factor consumer to be overcharged.

For the large consumer, the familiar two-part maximum demand tariff, based on either kW or kVA, is recommended.

The dividing line between the two classes of industrial consumers should overlap and the figures 25/50 kVA are recommended.

(4) *General*

As few forms of tariff as possible should be adopted, the three forms referred to above being considered essential.

A tariff for intinerant consumers such as merry-go-rounds, festivals, commercial shows and temporary consumers may also be introduced. It is also customary to levy a surcharge on rural consumers.

In conclusion, the Sub-Committee feels that because of the dynamic nature of the supply industry, it is not practical to recommend hard and fast tariffs. Local conditions and also the fact that some Councils have certain prejudices in the matter and are at liberty to alter tariffs for relief of municipal rates militate against attempts to foster the standardisation of forms of tariffs for all electricity undertakings.

Due to the diversity of consumers, it appears to be unpractical to design a tariff structure on the basis of cost alone.

It is hoped that the above remarks and indication of tendencies will assist members in their attempts to design tariff structures.

J. L. van der WALT,
Convener.

Mr. J. L. VAN DER WALT (Krugersdorp): Mr. President, I am fully armed!

The report is before you and you will remember it is fitting that, since this report started in Johannesburg, through a paper read by your Mr. Pulik, who recommended that such a committee should be formed; it should be finalised some six years later. Such a committee was formed, but I warned the Association at that time, they should consider themselves fortunate if a report was received within 20 years! I think we have beaten the 20 years' time limit, Mr. President The report is before members for discussion.

Mr. A. R. SIBSON (Bulawayo): Mr. President, I was one of the sub-committee that drafted this report, and I must therefore accept with Mr. van der Walt the full blame for what lies before you.

There is one thing I would like to add to what the report contains, and that is a personal view that engineers should not omit to take account of that good old principle, which I believe the S.A. Railways have practised for many years, of charging the consumer what the traffic will bear.

I refer to the custom which I think you will find fairly common throughout this country of charging an excess over cost for certain classes of consumption, in particular lighting when it is used commercially, to enable one to accumulate a sufficient excess of revenue over expenditure, thereby enabling other classes of supply to be sold at less than cost.

I feel that this is a very important principle which has gone a long way towards building up the success of our electricity undertakings, and it is not a principle which should lightly be cast aside. The point is not made very clear in the report which lies before you, and I thought I would emphasise it now so that it is not overlooked.

Mr. A. JACKSON (Provincial Administration, Cape Town): Mr. President, tomorrow evening in Cape Town the Cape Western Centre of the S.A. Institute of Electrical Engineers will be hearing a paper by two of Mr. Downie's engineers on tariffs, and the opportunity of that paper gave me the chance to crystallise some thoughts on tariffs. I would like to put these before you, because I think they are relevant to this report.

In the Cape Province the control of the conditions of supply by all local authorities other than Cape Town is vested in the Administrator, and the guiding principles used by the Administration in considering tariffs may therefore be of interest.

Some of these are similar to those in the report; others differ.

These principles are, firstly, that a tariff should be financially sound, i.e. total annual revenue should balance total annual expenditure.

Secondly, the tariff should be equitable, i.e. there should be no undue discrimination between consumers, or between consumer or classes. The tariff should thus reflect, as closely as reasonably practicable, the costs of supply. (It follows that the principle of charging what the traffic will bear is not acceptable except insofar as it is justified by the higher cost of high "use-value" supply.)

Thirdly, the tariff should be as simple as practicable, i.e. easily understood and easily administered.

Fourthly, the staff should promote the economic development of the undertaking.

These requirements should be satisfied insofar as is reasonably practicable, and it is considered that two-part or three-part tariff forms are the most suitable for this purpose.

COUNCILLOR KAUFMANN (Vrede): Mr. President, I am a newcomer to this Convention, and you will forgive me if I ask a question which might seem foolish, but this question does not cover the tariffs charged in Native townships. Is that left out particularly or is there a special reason for it?

THE PRESIDENT: I don't know if you would like to answer Mr. van der Walt? Have you Native tariffs?

Mr. J. L. VAN DER WALT (Krugersdorp): The supply to Native townships of course, is covered by legislation. You should supply your Native townships at cost. Now that term "at cost" was very widely put. It does not say at what point the cost should be determined, but I think it is customary, and you comply with legislation, if you supply your locations at the municipal cost, after taking all your distribution costs, overheads, and so forth into consideration.

Some local authorities supply their locations with bulk supply, from which the Native Administration takes over, but Native Administration then trades in the locations. According to the legislation the Electricity Department is not supposed to do the trading inside the location; all profits made from electricity sold to the Natives in the locations should go to the Native Revenue Account. That is the principle that should be followed. I hope I have covered the point raised.

THE PRESIDENT: Any further discussion?

Mr. F. STEVENS (Ladysmith): Mr. President, as I understand the position, one is not supposed to supply locations at an abnormal profit, which is to say, one can supply them at ordinary tariff rates.

THE PRESIDENT: Thank you Mr. van der Walt, do you want to say any more? Does anyone else wish to speak?

I don't propose to take any more reports at this stage. I have one or two messages.

(Convention messages followed.)

TEA ADJOURNMENT.

On Resuming at 11.00 *a.m.*:

THE PRESIDENT: Mr. G. Masson, here on my right, is about to give his paper on "The Supply of Electricity to Native Townships," and he has deliberately cut down the presentation of the paper, as you all had a copy of it, and he will speak mainly to slides, so that there will be a fair amount of time, even this morning, for discussion.

Mr. G. MASSON (Johannesburg): Mnr. die President, dames en here: Aangesien die tyd wat vanoggend beskikbaar is, beperk is, en die referaat „Die voorsiening van elektrisiteit aan Bantoe-dorpe" al aan die lede gestuur is, is ek met u toestemming van plan om net uitreksels aan te haal en 'n bietjie uit te brei oor items wat miskien van spesiale belang is.

Die Regering het tereg besluit dat die voorsiening van goeie behuising en noodsaaklike dienste die hoogste voorrang moet geniet en dat fondse en arbeid nie vir ander doeleindes, wat die aanbou van Bantoe huise mag vertraag, gebruik mag word nie. Gedurende die afgelope drie jaar het die owerhede wat te doen het met die aanbou van huise, verbasende voruitgang gemaak en terwyl daar moontlik nog nie ten volle in die behuisingsbehoeftes van die Bantoe voorsien is nie, lyk dit tog of die dringende behuisings probleme nou opgelos is.

Die voorsiening van elektrisiteit in die huise in die Bantoedorp is dringend nodig om die ongesonde uitwerking van rookmis te bestry en die gesinslewe van die inwoners te verbeter. Dit wil voorkom asof die tyd aangebreek het om 'n begin te maak met die voorsiening van die nodige dienste, en die beplanning vir die groot taak wat voorlê.

Since the time available this morning is limited and the paper entitled "The Supply of Electricity to Native Townships" has been circulated amongst members, I propose, subject to your permission, to quote extracts from the paper and to enlarge on items of especial interest.

The Government has rightly laid down that the provision of good housing and essential services is priority number one and funds and labour must not be diverted to other purposes which would impede the progress of housing. During the past three years the Authorities concerned with the building of houses have made remarkable progress with their tasks and whilst the Bantu housing requirements have possibly not yet been fully catered for, the urgent housing problems appear to have been solved or nearing solution.

The provision of electricity supply to the houses in Bantu townships is urgently required to combat smog and to improve family life in the homes. It would seem that the time is now ripe to commence with the provision of these services and complete planning for the vast project that lies ahead.

Work Planned in Johannesburg.

Within the European areas of Johannesburg there are the Native townships known as Eastern and Western which have been in existence for some 40 years. Street lighting has been provided since the establishment of the townships and in 1948 the 600 houses in Eastern Native Township were wired by the Council. At Western Native Township the tenants have been permitted to wire, at their own expense, the premises they occupy and many have done so. The Council has not however carried out any wiring programme in this Township.

In the South Western Areas known as the Orlando complex we have 19 townships bearing such familiar names as Orlando, Moroka, Jabavu, Dube, etc. These townships embrace approximately 60,000 stands and fall under the jurisdiction of the Johannesburg City Council.

In addition to the aforementioned townships, the Natives Resettlement Board has established and administers the townships of Meadowlands and Diepkloof where there are to total of approximately 14,000 stands. These townships were established for the clearance of the slum areas of Sophiatown and Martindale and will be extended to provide decent housing for the surplus population of Alexandra Township which lies outside the Municipal area.

The City Council has agreed in principle to provide house wiring installations in all Council owned houses in these areas within the next 9 to 10 years. A start has been made at Orlando East and 1,800 houses have been wired and are now ready for service.

Financing of Electrical Schemes.

We have been fortunate that rudimentary street lighting has been considered an essential service by the Authorities and that permission has been given for the financing of bulk supply to the townships out of the Native Services Levy. These concessions have made the provision of electricity supply

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for domestic purposes very much simpler than it was a few years ago.

Planning of Reticulation and House Wiring Schemes.

In the planning of these schemes it would seem advisable to steer a middle course between the policies of those who contend that the native can neither afford nor has he any wish to have electricity supply and the others who suggest that native township schemes should be to a higher standard than we can afford in European townships.

The minimum standards of construction should be such that they comply with statutory requirements and provide a scheme that is reasonably maintenance free. Furthermore it must be borne in mind that such schemes will have to be maintained and operated by native artisans in the foreseeable future.

The question of the training of Bantu electricians and wiremen is one that must be given a lot of consideration. There are few trained Bantu electrical wiremen available and until adequate apprenticeship and technical training facilities are available, Bantu electricians can not be trained to completely take over the work in these areas. It is however essential that training should be given on the types of selected work that could be done without the necessity for a complete apprenticeship. The only danger at this stage is the possibility that we may finish up with a class of electrical handymen who could be a menace to themselves and others. It would therefore seem desirable to train natives as wiremen, a trade in which they can qualify and thereafter trainees with special aptitude could be given training in other aspects of electrical distribution work until such time as they could be regarded as trained electricians capable of training apprentices.

Unit Consumption and Metering.

The figures given for the unit consumption FIG. 1. will no doubt vary in other townships depending upon the economic status of the inhabitants and the tariff charged. As a matter of interest a recent survey of the Eastern Native Township installations showed that the small domestic appliances are fairly extensively used as shown by the following figures:—

75% use electric irons.
10% use hotplates or plug-in stoves.
17% use radiators.
50% use wireless sets.

Two householders have washing machines and five have electric refrigerators.

The popularity of radiators seems surprising in view of the fact that the houses all have coal stoves. Judging from the consumption of one consumer who used 1,000 units per month, during winter months, he must have had his radiator in service approximately 10 hours per day.

Alternative Methods of Reticulation.

Photographs A and B have been taken in a Native township in the Transvaal. Photograph A shows the unsightliness of the overhead services due to the low height of the apex of the roofs on the opposite side of the street to the overhead mains. In Photograph B the man is standing on the sidewalk holding a golf club.

Photographs C and D show the overhead armoured cable type of service conection adopted for Nancefield Hostel. This method is very satisfactory where the buildings are in line. There are however townships where the fronts of houses in a street are not all in line and difficulties may be encountered from the staggered formation. For this hostel scheme the street lights were erected on the buildings and a satisfactory installation has been effected because there is little vehicular traffic through the grounds. I do feel however that pole mounting of street lights is essential in a residential township where the streets carry very fast moving traffic and the growth of trees is not controlled.

Photograph E shows a typical meter box of the type installed at Orlando East. The box is galvanised with a sprayed baked enamel finish. The door of the box is shown in the open position but it is designed to be self closing. No locks have been provided but provision has been made for fitting a padlock in any case where this may be required.

Photograph F shows the split neutral designed to form a cradle. This construction may be criticised as expensive but I feel that some protection should be provided to

cater for the contingency of broken conductors. It has been claimed in recent newspaper reports that all insulated conductors provide this protection. We did however have a case some years ago where an insulated street lighting conductor broke and fell to the ground where it lay for some time without anyone being aware of the danger. Unfortunately however a young child put the broken end of the wire into his mouth with fatal results.

Conclusion.

It is generally agreed that the use of electricity is an amenity that forms part of the way of life in an urbanised community and its provision in the native home will strengthen family ties by creating the opportunity for leisure time activity. The provision of electrical service may not be an economic proposition in the initial stages of a scheme but as the native salary structure improves I believe the native areas will prove to be a fruitful field for the sale of electricity.

In the circumstances careful planning and if necessary experiment is necessary to provide electrical schemes at an economic cost. It is folly to establish schemes which are electrically hazardous or present continual maintenance problems because insufficient capital was available when the scheme was embarked upon. On the other hand it is a pity that certain authorities have embarked upon luxury schemes which at best can be described as building for posterity. The capital charges on uneconomically planned schemes will continue to be a burden on the Native Revenue Account and can possibly act as a brake to future development in these townships.

In presenting this paper I would stress that the opinions expressed therein are my personal thoughts in the matter.

Acknowledgement:

I would like to express my thanks to the Association for the privilege of presenting the paper to this Convention, and to Mr. Kane, General Manager and Chief Engineer of the Johannesburg Electricity Department for his permission to use the information given in the paper.

THE SUPPLY OF ELECTRICITY TO NATIVE TOWNSHIPS

by G. MASSON

INTRODUCTION

There seems to be no doubt that the native in the Urban Areas requires electricity supply to his house both for economic reasons as well as convenience. From the Local Authorities' point of view widespread use of electricity will eliminate the smog that is becoming a serious factor in large native townships and thereby result in an improvement in the health of the inhabitants.

Electrical Engineers throughout the country have given much thought to the problems to be faced in providing the required services and an interchange of ideas and experience will benefit both the consumer and the supply authority which generally will be called upon to carry out the work with limited funds. These notes are therefore submitted in the hope that others will let us have the benefit of their experience.

WORK PLANNED IN JOHANNESBURG

Within the European areas of Johannesburg there are the native townships known as Eastern and Western which have been in existence for some 40 years. Street lighting has been provided since the establishment of the townships and in 1948 the 600 houses in Eastern Native Township were wired by the Council. At Western Native Township the tenants have been permitted to wire, at their own expense, the premises they occupy and many have done so. The Council has not however carried out any wiring programme in this Township.

In the South Western Areas known as the Orlando complex we have 19 townships bearing such familiar names as Orlando, Moroka, Jabavu, Dube, etc. These townships embrace approximately 60,000 stands and fall under the jurisdiction of the Johannesburg City Council.

In addition to the aforementioned townships, the Natives Resettlement Board has established and administers the townships of Meadowlands and Diepkloof where there are a total of approximately 14,000 stands. These townships were established for the clearance of the slum areas of Sophiatown and Martindale and will be extended to provide decent housing for the surplus population of Alexandra Township which lies outside the Municipal area.

The City Council has agreed in principle to provide house wiring installations in all Council owned houses in these areas within the next 9 to 10 years. A start has been made at Orlando East and 1,800 houses have been wired and are now ready for service.

FINANCING OF ELECTRICAL SCHEMES IN THE NATIVE AREAS

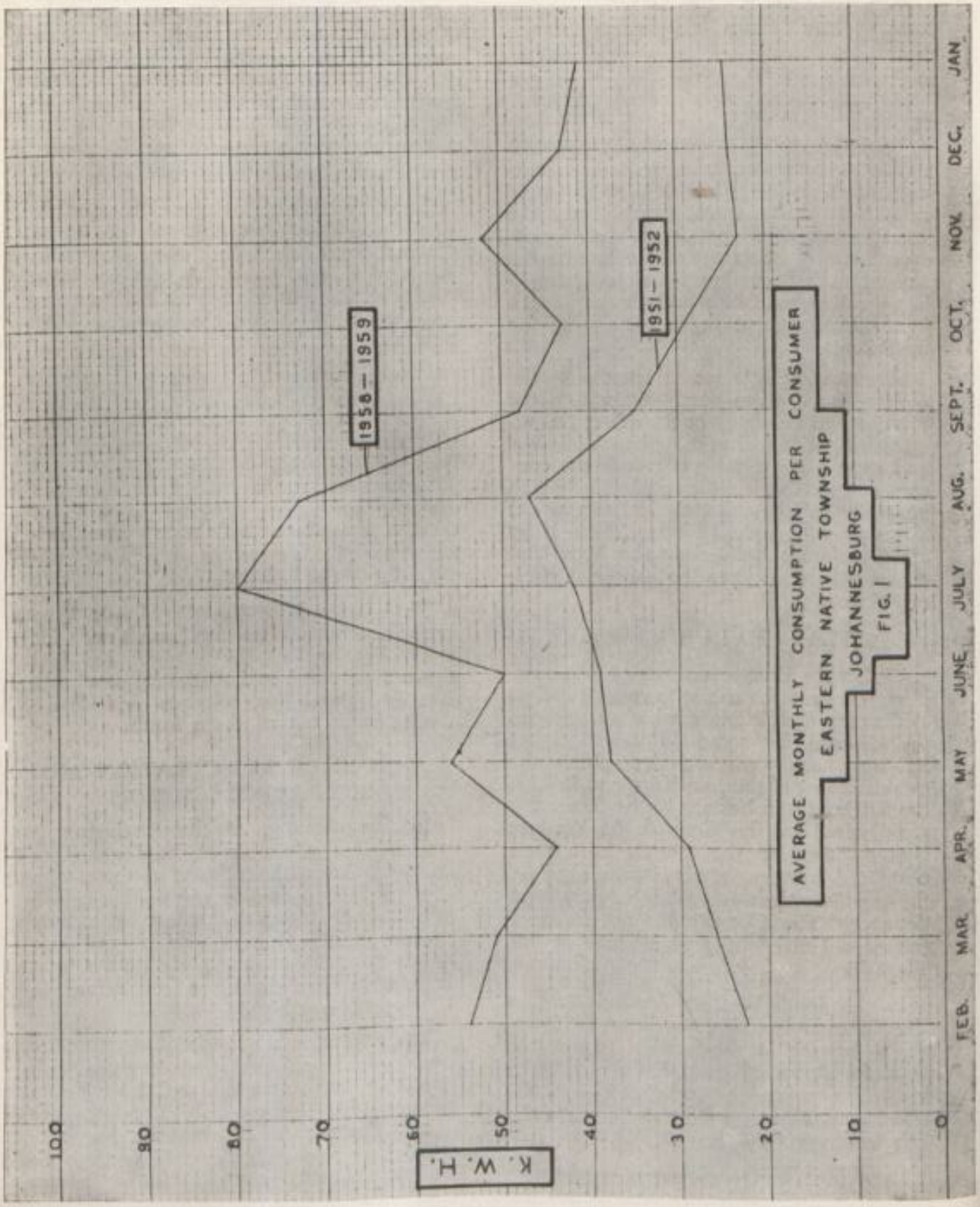
After approval by the Honourable the Minister for Bantu Administration and Development, funds have been allocated out of the Natives Services Levy Fund for the provision of bulk supply of electricity to Native Townships as well as rudimentary street lighting.

To a very limited extent funds have been used out of Housing Loan Funds for street lighting but the Minister has laid down that the Local Authority must not finance reticulation schemes and house wiring work out of these funds.

PLANNING OF RETICULATION AND HOUSE WIRING SCHEMES

In the planning of these schemes it would seem advisable to steer a middle course between the policies of those who contend that the native can neither afford nor has he any wish to have electricity supply and the others who suggest that native township schemes should be to a higher standard than we can afford in European townships.

The minimum standards of construction should be such that they comply with statutory requirements and provide a scheme that is reasonably maintenance free. Furthermore it must be borne in mind that such schemes will have to be maintained and operated by native artisans in the foreseeable future.


AVERAGE MONTHLY CONSUMPTION PER CONSUMER
EASTERN NATIVE TOWNSHIP
JOHANNESBURG
FIG. I
1950—1959
1951—1952
K. W. H.
100
90
80
70
60
50
40
30
20
10
0
FEB.
MAR.
APR.
MAY
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.
JAN.

LOADING REQUIREMENTS

(i) General

The requirements of the native consumer is governed by many factors, the chief of which are no doubt his economic status and the tariff charged. Taking the minimum requirements of the householder to be lighting and assuming that he requires the use of one lighting point four hours per day then his consumption will be 5 units per month for a 40 watt lamp and 8 units for a 60 watt lamp.

The light flux from a 40 watt tungsten lamp is approximately equivalent to that of 30 candles and experiment has shown that an average candle costing 3d. burns for 9 hours under good conditions. This gives and operating cost of 6/10d. per month for the use of 2 candles each burning for 4 hours per day. To give a fair comparison a figure of say 2/- per month must be set aside to cover the capital costs of a wiring installation costing say £20. It would therefore still be to the native's advantage to use electricity if the cost per unit is less than 1/- per unit. In this connection it would seem to be good policy to provide a special tariff for consumers whose consumption is small. The present domestic tariff in Johannesburg is a block tariff and it is proposed to convert this to one embodying a minimum "availability" charge assessed on a room basis and thereafter a flat rate for units consumed. Since this tariff will be a hardship to small consumers having a large number of rooms on their premises an optional tariff is to be provided on the basis of 4d. per unit for the first 20 units per room in any month and thereafter 0.6d. per unit for the balance of units consumed in any month.

(ii) Unit Consumption and Metering

Consideration has been given to the question of the installation of meters which are expensive and present administrative problems as far as the reading of meters, the rendering and collection of accounts is concerned. Before the houses in the Eastern Township were wired the Local Advisory Board was consulted and they were very opposed to the adoption of a flat rate of charges without metering. An analysis of the consumption of electricity shows that the requirements of the tenants vary considerably and there is no doubt that some measurement of the power consumed is essential.

The consumers at Eastern Native Township probably present a fair cross section of the native community in Johannesburg and drawing FIG. 1 shows the average consumption per consumer in this township over the 12 month period February to January for the years 1951 and 1958. This graph gives an indication of the growth of load. It is however, appreciated that "average consumption" figures can be misleading and to give a clearer picture of the consumption of the 600 consumers in this township, the March 1958 figures have been analysed and these can be taken as a guide for any month :—

(a) 5% used between 5 and 10 units per month.
(b) 13% used between 11 and 20 units per month.
(c) 18% used between 21 and 30 units per month.
(d) 19% used between 31 and 40 units per month.
(e) 11% used between 41 and 50 units per month.
(f) 34% used more than 51 units per month.

The houses in this township are mainly of a two roomed type and for tariff assessment purposes are regarded as one room. During 1951 the tariff was 6 units at 4d. and the balance at ½d. per unit for the consumption in any month. The tariff in 1958 was 8 units at 5d. and the balance at ½d. per unit plus a monthly service charge of 2/-. The average revenue from the consumers under the aforementioned tariffs is worked out below :—

	1951 Tariff	1958 Tariff
(a)	From 1/8d. to 2/2d.	4/1d. to 5/5d.
(b)	From 2/3d. to 2/7d.	5/6d. to 5/10d.
(c)	From 2/8d. to 3/-d.	5/11d. to 6/3d.
(d)	From 3/1d. to 3/5d.	6/4d. to 6/9d.
(e)	From 3/6d. to 3/10d.	6/10d. to 7/1d.
(f)	From 3/10d. to 45/-.	7/2d. to 47/-.

(iii) Maximum demand

It is difficult to assess the maximum demand of the average native consumer since the demand will be dependent upon the consumer's ability to purchase domestic appliances. Native Administrators seem to be of the opinion that a 15 amp. plug is insufficient provision for cooking but with the high capital cost of the larger stoves I consider a 15 amp. outlet adequate except for isolated consumers.

At Eastern Native Township the after diversity demand in the year 1948 was

PHOTOGRAPH A.
Overhead House Service Connections

240 watt per consumer and this rose to a maximum value of 400 watt in 1958. A system planned to meet an after diversity demand of 0.5 kW per consumer should be adequate if the design of the scheme lends itself to strengthening at a later date.

A demand of 0.5 kW per consumer gives a demand of 3.5 kW per acre as against a figure of 10 kW per acre for European townships.

DESIGN OF RETICULATION SCHEMES

(i) General

It would seem that initially the supply of electricity to Native Townships is not an economic proposition but the indications are that such schemes can rapidly become payable if the reticulation and wiring work is not done on too lavish a scale.

In Johannesburg we are faced with the problem of wiring 60,000 houses and providing the necessary reticulation during the next decade. Small savings in the cost per stand can result in considerable savings in capital cost whilst errors in design will provide problems in the future. Since street lighting has been urgently required we have pushed ahead with the provision of this service. Had funds been available for the complete reticulation work savings could no doubt have been made in the execution of the work. Furthermore it may have been decided to carry out the work on a different basis to the conventional methods adopted. Since however, the street lighting work is rudimentary (i.e. in every second street) it may be possible to have a combination of new methods as well as the old. It is therefore proposed to set out thoughts on the subject and to discuss alternatives.

(ii) Overhead versus Underground Reticulation

Whilst the majority of us would prefer the underground reticulation its higher cost generally precludes the adoption of a complete underground scheme.

The bulk supply mains within Orlando East Township are overhead at 6.6 kV and have been in service for 22 years. There have been many outages due to lightning, vehicular damage and baling wires thrown

PHOTOGRAPH B.

Overhead House Service Connections Showing Difficulty of Maintaining Clearance over Roadway and Pavements due to low Height of the Apex of House Roofs

over the lines. Since these outages generally affect a large area and frequently occur at night time in stormy weather, our operating staff are very opposed to the overhead system. It is felt that from the police security point of view and bearing in mind the aforementioned disadvantages it is preferable that an underground high tension system should be adopted where funds are available to make this possible.

(iii) Alternative Methods of Low Tension Reticulation

Bearing in mind the small stand frontages in the native township and the low load factor of the consumers, I feel that the conventional methods in common use in the European townships in South Africa are not necessarily the correct methods for the Native Areas.

In the investigation into alternative methods it seems that the type of service connection adopted must strongly influence the type of reticulation selected.

If it be decided to instal underground services the individual service to each house is out of the question because of its high cost. The loop service from house to house is however, worthy of consideration especially where the service cable forms the street distributor.

I am opposed to the old method of overhead service connection comprising two or more horizontally spaced conductors, since even with approved conductors it is difficult to ensure that the insulation does not deteriorate after a few years of service and thereby create a hazard to children and workmen working on house roofs.

The duplex or triplex type of overhead service cable sheathed with P.V.C. or other insulation that has been used during recent years does not appear to constitute the same hazard if we can rely on the quality of the insulation which may not stand up to our climate or the heat of the African sun.

The apex of the house roofs is between 12 and 14 feet above ground level making the installation of overhead services difficult if the poles are planted on pavements and the photographs A and B, which were not taken in Johannesburg show how unsatisfactory such a system is.

PHOTOGRAPH C.

Overhead P.V.C. Armoured Service Cable Showing Method of Attachment to Building. Nancefield Hostel.

In the following paragraphs the various alternatives considered are discussed:—

(a) High Tension Block Distribution

A method similar to that proposed for Montgomery Park can be considered. The unit transformers required to supply a block of houses would require to be of 10 to 15 kVA capacity to cater for an after diversity demand of 0.5 kVA per house. The use of underground high tension cable would make the cost of this method prohibitive but competitive costs can be obtained by the use of bare overhead high tension feeds or or alternatively one could use a polythene/P.V.C. aerial power cable with aluminiun conductors and incorporating a galvanised steel carrier wire.

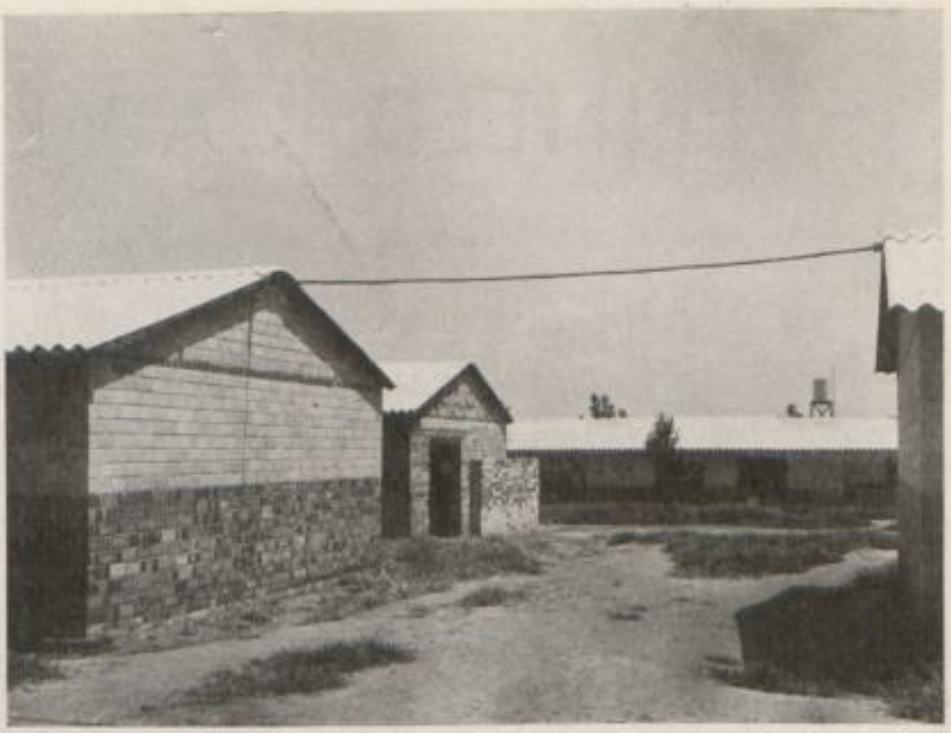
A network of bare high tension overhead lines in residential townships would be definitely undesirable and the ultimate life of a polythene/P.V.C. cable is also an unknown factor. For these reasons I do not favour this method for the Native Townships.

(b) Rear Boundary Reticulation

If overhead dropper services are to be installed then the system described by Mr. H. Wood in his paper presented to the 1958 Conference of the Association has advantages. This method permits the installation of short service droppers and obviates crossing roadways with service wires.

(c) Overhead Low Tension Service Cable from Roof Top to Roof Top

At the Nancefield Mens Hostel a P.V.C. armoured cable comprising conductors for power distribution and a street lighting control wire has been carried from building to building roof apex using a steel messenger wire to support it. This system has proved very satisfactory where the digging was rocky and resulted in savings over an underground system. If however, it be applied to a residential



PHOTOGRAPH D

Overhead P.V.C. Armoured Service Cable.

Nancefield Hostel.

suburb where there is no control over the growth of trees beneath such cables it could be a source of trouble. Photographs C and D show the construction.

(d) Looped Service Connections Fed from Overhead Mains

The first township to be reticulated under the 10 year plan is Orlando East. This township was provided with a street lighting reticulation scheme more than 20 years ago and the scheme was laid out without much thought of possibility of adding mains for domestic supply at a later date. Many of the poles are unsuitable for carrying additional mains.

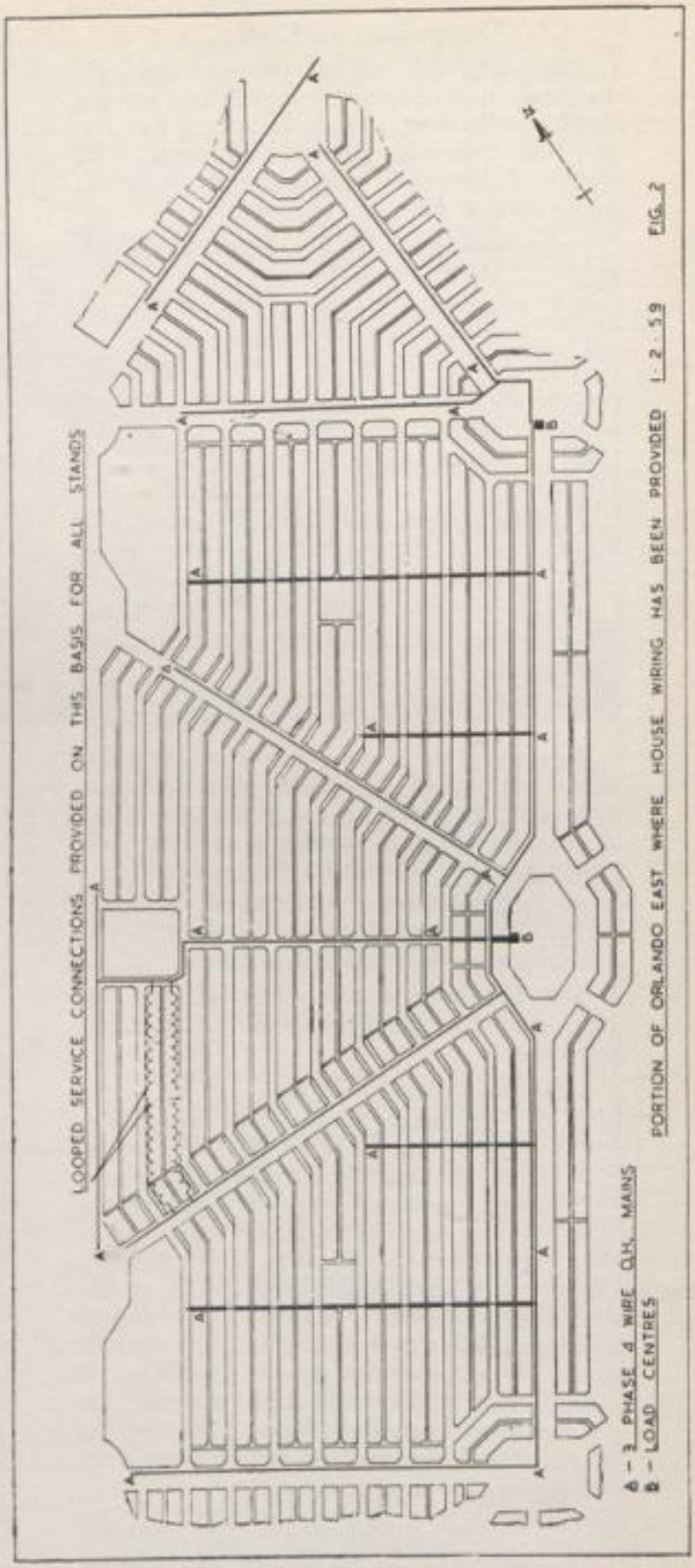
For the initial pilot scheme of approximately 2,000 houses it was decided to recondition the street lighting system wherever necessary but to run new power mains as shown on drawing FIG. 2. It will be seen that the minimum amount of new mains have been provided and the mains are basically at the end of blocks of houses and in some cases at mid block positions. The mains feed underground service cables which have been looped from house to house so that from six to ten houses are fed from each pole connection. This has resulted in a partial underground system and savings have been effected due to the short length of service cable which amounts to approximately 50 feet per house.

This system can be adapted to townships where rudimentary street lighting has been installed. The proposal would be that in streets where no street lights have been provided an additional core will be provided in the service cable for street light switching and poles will only be planted where street lights are required.

Photograph E shows a meter box fed by a P.V.C. armoured 0.0225 square inch x 2 core cable.

PHOTOGRAPH E.

Typical Underground Service Connection at Orlando East.



(iv) Comparison of Costs

Since methods (c) and (d) are the only methods which have been put into service in Johannesburg the costs given for the methods (a) and (b) are estimated. In each case the costs given are on the basis of European labour :—

Method (a)—(High Tension Block Distribution)

Polythene E.H.T. cable and overhead service connections.

£35 per stand.

Method (b)—(Rear Boundary Reticulation with Overhead Service Connections)

£30 per stand.

Method (c)—(Standard Reticulation with P.V.C. Cable Services from Roof Top to Roof Top)

£31 per stand.

Method (d)—(Looped Underground Services Fed from Overhead Mains)

£32 per stand.

As a basis for comparison it is estimated that a complete underground reticulation will cost from £42 to £45 per stand depending upon whether hard or soft digging is encountered.

(v) Construction Methods Adopted for Schemes Completed or in the Course of Construction

The following notes are submitted setting out the standards of construction used :—

(i) Tranformer Kiosks

A brick transformer kiosk designed to house a 400 kVA transformer and its associated high and low tension equipment cost something less than £300 when built by native labour. For security reasons it is felt desirable that the transformer should be housed indoors and at the present time it is not possible to get buildings of steel or other durable material for less than this figure bearing in mind the cost of foundations, etc.

(ii) Low Tension Network

The grants from the Natives Services Levy for street lighting were based on the cheapest form of construction and a wooden pole overhead system using aluminium conductors in vertical configuration has been adopted in alternate streets which form the basis of the so called "rudimentary" street lighting system.

Details of the street lighting mains constructed to date are set out below :—

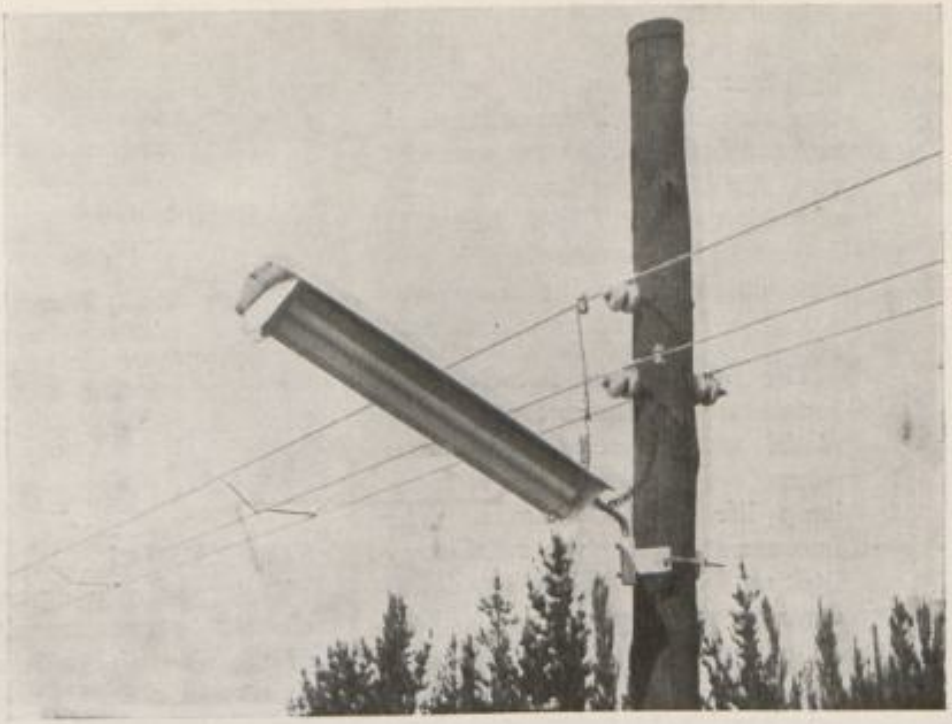
(a) Poles

The 30 feet impregnated wooden pole is used and five holes have been drilled at 9" spacing to carry reel type porcelain insulators. Experience has shown this length to be ideal in that it permits a reasonable mounting height for street lights and linesmen's ladders for this length of pole are not unwieldy. In terms of the Factories Act, the Postmaster General has for approved schemes, asked for a minimum clearance of 21' 6" and using vertical configuration of conductors this is extremely difficult to maintain even with the 30 foot pole.

A considerable number of wooden poles have had to be replaced due to vehicular damage and along narrow roads poles are planted close to the building line. A pleasing feature of the vertical configuration and aluminium conductor has been that although poles struck by motor vehicle break off near to the ground, the aluminium binders on the insulators have sufficient give to permit the broken pole to fall without breaking or unduly stretching the conductors.

(b) Conductors

Bare aluminium conductors are used with a pole span of 40 yards. Radial feeders from the load centre are 3 phase 4 wire with single phase distributors. Vertical configuration has been used throughout and after 3 years service the all aluminium has given every satisfaction. Due no doubt to the



PHOTOGRAPH F.

Split Neutral Constructed to Form a Cradle.

dry climate no signs of corrosion have been experienced and no elaborate measure has been taken to obviate corrosion.

(c) Earthing and Protection

The low tension mains are earthed at the transformer neutral and multiple earthing of the neutral has been adopted. Difficulty has been experienced in the Orlando Area in obtaining satisfactory earthing and earth spikes buried up to six feet below the surface have given readings up to 3,000 ohms per earth point. These values could no doubt be improved by the installation of trench earths but bearing in mind the Factories Act requirement that precautions be taken to earth broken conductors at road crossings, it was decided to adopt a split neutral system. Two neutral wires, each half of the cross section of the phase wires are mounted in horizontal formation in the lowest conductor position on the pole and four cross lacings are provided per span between the two neutral wires which then form a cradle as shown in photograph F. Stays are provided with 18 inch square steel base plates and the neutral is earthed to every stay as well as intermediate earth spikes where these are considered necessary.

(d) Street Lighting

Whilst street lighting is considered essential by most people it is still the Cinderella of services whether it be for European or Native township and sufficient funds are seldom provided for what the Illumination Engineer regards as adequate street lighting.

In one native township scheme with which the author has been associated, the Authorities decided that from the funds available for essential services, a maximum amount of 3d. per house per month could be provided for current consumed and maintenance. On the basis of 80 yards spacing between

street lights, one light serves 10 to 12 houses. A 200 watt tungsten light burning from dust to dawn consumes 800 kWh per annum and at a tariff of say 5/8d. per unit will cost £2-1-8d. per annum. The allocation of £1-16-0 from 12 houses is inadequate for the current consumed and nothing was available for lamp replacements.

The solution was found in the installation of fluorescent fittings of 60 watt capacity using tubes guaranteed by the suppliers for a lamp life of 3,500 hours. The fluorescent light gives satisfactory lighting but the following disadvantages are apparent :—

(i) the capacitors used in the power factor corrected fittings are very vulnerable to lightning and result in extra maintenance.

(ii) The tubes are an easy target for stone throwers and many tubes are broken during festive seasons. This also applies to tungsten lamps which are also broken but are cheaper to replace.

(iii) The type of fitting available for approximately £7 is not very robust and will probably require replacement at the end of 20 years' life.

RECOMMENDATIONS

Of the reticulation methods considered I consider methods (iii) (b), (c) and (d) to be most worthy of consideration. The following advantages are offered by these methods :—

(iii) (b) Rear Boundary Reticulation

This method appears to be the cheapest and forms a reliable system and has the advantage that the construction work lends itself to the use of native labour for both construction and maintenance.

(iii) (c) Overhead Service Cable from Roof Top to Roof Top

The adoption of this method ensures a partly underground scheme and in this respect is superior to method (iii) (b).

(iii) (d) Underground Looped Service Cable

This scheme in superior to either methods (b) or (c) if capital is available for its extra cost. Such an installation can be planned so that the system can be readily strengthened if the load should increase beyond the figure initially catered for.

CONCLUSION

It is generally agreed that the use of electricity is an amenity that forms part of the way of life in an urbanised community and its provision in the native home will strengthen family ties by creating the opportunity for leisure time activity. The provision of electrical service may not be an economic proposition in the initial stages of a scheme but as the native salary structure improves I believe the native areas will prove to be a fruitful field for the sale of electricity.

In the circumstances careful planning and if necessary experiment is necessary to provide electrical schemes at an economic cost. It is folly to establish schemes which are electrically hazardous or present continual maintenance problems because insufficient capital was available when the scheme was embarked upon. On the other hand it is a pity that certain authorities have embarked upon luxury schemes which at best can be described as building for posterity. The capital charges on uneconomically planned schemes will continue to be a burden on the Native Revenue Account and can possibly act as a brake to future development in these townships.

In presenting this paper I would stress that the opinions expressed therein are my personal thoughts in the matter.

THE PRESIDENT: Thank you Mr. Masson.

We have with us here today Mr. Heckroodt, Chairman of the Native Resettlement Board, who has been good enough to propose a vote of thanks.

Mr. H. W. L. HECKROODT (Native Resettlement Board): Mnr. die President, dames en here, ek wil u graag baie hartlik bedank vir die geleentheid wat u vir my vanmôre hier bied om 'n kort woordjie van dank aan Mnr. Masson te rig vir die baie interressante lesing wat hy hier voor ons gelê het. Dit sal in lengte van dae onthou word, die wegspringplek vir die voorsiening van die Elektrisiteit in Naturelle Dorpe.

Mr. President and gentlemen: In the paper we have just listened to the writer has adopted an unusual form of presentation in that, whilst it must be regarded as a technical subject attention was also paid to the financial and social aspects thereof. This to my mind has enhanced the value of the contribution.

That the supply of electricity to Native townships has reached the stage of practical politics cannot be gainsaid and perhaps you will permit me to deal very briefly with certain aspects on the economic side of this question. Here I speak of experience gained over the past four years in the Native township of Meadowlands, consisting of some 13,000 houses.

In considering the desirability of providing electricity to individual householders regard must be had to the economic capacity of the proposed consumers. The occupiers of this township came, as you have heard, largely from the western areas of Johannesburg as a slum clearance measure.

During 1950 the City Council of Johannesburg had a socio-economic survey carried out embracing the inhabitants of the affected areas. The bulk of the people concerned resided in Sophiatown, Martindale, Newclare and to a lesser extent in Pageview. This survey revealed that by and large 40% of the inhabitants could be classified in the group of economic occupiers and the remaining 60% in the sub-economic category. The economic group comprises those earning more than £15 per month and the sub-economic group those earning £15 and less per month. The difference between the two groups only affects the rate of interest on Capital Loans from the Union Treasury. In the case of the economic group the full current rate of interest on all Capital loans is leviable whilst for the sub-economic group a special interest rate of ¾% is charged.

The townships of Sophiatown, Martindale and Newclare are old-established townships where electricity has been available for many years but surprisingly enough few houses have been wired and use made of the facility at hand. It may be that the slum conditions which had obtained for many years had darkened the hearts of the people and gave little hope for the future.

This is neither the time nor the place to inquire into the whys and wherefores for these unsatisfactory conditions but it does remind one of a passage in one of Lowell's essays "Our healing is not in the storm or the whirlwind, it is not in monarchies or aristocracies or democracies, but will be revealed in the still small voice that speaks to the conscience and the heart, prompting us to a wider and wiser humanity."

It may interest you to learn of the various components of which the monthly rentals are comprised. The rentals vary between £2.14.6 and £4.4.0 per month, according to the size of the house. Out of these rentals provision has to be made for interest and redemption on capital expenditure, for water consumption, sewerage, rubbish removals, medical services, street lighting, schools, maintenance of roads, maintenance of buildings, replacement of rubbish bins, insurance, irrecoverable rents and expenditure involved in the administration of the township. From the foregoing it will be obvious that careful consideration had to be given to capital expenditure in every possible direction in order not to load the rentals unduly. Whilst the Native Services Levy Fund stood in for the expenditure involved in the provision of bulk supply it was distinct injunction that capital funds were not to be used for general reticulation and house-wiring, but provision for street lighting was agreed to. In order, however, to keep rentals low only a

rudimentary street lighting system could be provided. The estimated expenditure for street lighting in Meadowlands East alone amounted to £81,138 a not inconsiderable item of expenditure. That this amenity is appreciated is borne out by expressions by inhabitants on different occasions.

It must be explained that the Natives Resettlement Board is in a somewhat different position to other Local Authorities in that its sources of income are limited to the house rentals and one or two other minor items. It is therefore incumbent on the Board to apply the strictest economy to keep within the compass of the published rentals to avoid a shortfall, for you will appreciate the undesirability of varying rentals from time to time. That the economic status of the native is improving is evidenced by the fact that whilst in 1950 those falling in the economic group represented roughly 40% of the inhabitants of the western areas the position today is that the sub-economic group of the same people (since removed to Meadowlands) represents roughly 40%.

A recent analysis of the income groups of the inhabitants of Meadowlands gave the following results:—

Up to —				
£10 per month income:			total in group	1239
£10 to £15	"	"	"	3581
£15 to £20	"	"	"	3387
£20 to £25	"	"	"	1015
£25 to £30	"	"	"	464
£30 to £35	"	"	"	192
Above £35	"	"	"	162

In addition to these there were several hundreds of day workers who were not anxious to reveal particulars of their earnings and for rental purposes they are regarded as falling within the economic group.

These figures do not require any further elucidation beyond the remark that this evidence supports the view that the economic position of the native is improving steadily.

In a new township at Diepkloof also within the municipal boundaries of Johannesburg provision is made for house ownership by the natives and of the 104 natives who have so far acquired houses under this scheme all have electricity provided in their homes. This leads one to the conclusion that the demand for electricity in native townships must grow. There is an undoubted desire among many of the natives to enjoy electricity in their homes, particularly those who have worked as domestic servants in European homes.

In conclusion, I am sure that I speak on behalf of all present in offering to Mr. Masson congratulations on the excellent paper presented here today and in expressing the conviction that in the future this will be regarded as the turning point in the reticulation of electricity in Native townships.

(APPLAUSE).

THE PRESIDENT: Thank you very much indeed, Mr. Heckroodt. Mr. Wilson will now second that vote of thanks.

Mr. J. WILSON (Pretoria): Mr. President, gentlemen: In his paper on the "Supply of Electricity to Native Townships," Mr. Masson has provided us with much useful information in relation to the problem as it affects Johannesburg and much of this should be of great value to others who are engaged in developing similar schemes.

One of Mr. Masson's objects in presenting this paper is to invite the representatives of other towns to contribute their experiences in this field and I do not, therefore, propose to enter into any discussion of his paper as such but rather to relate what we have done and are doing in Pretoria.

The Pretoria City Council controls the Native townships known as Atteridgeville, Saulsville, Vlakfontein West and Vlakfontein East as well as Lady Selbourne which, however, falling within a White area, is to be removed. Apart from this latter township, the only Native area in which dwelling units receive a supply of electricity at present is the older portion of Atteridgeville. The hostel scheme for single natives is located in Saulsville and this too is provided with a supply of electricity. In the newer portion of Atteridgeville and the remaining townships which are of comparatively recent

origin the present emphasis is essentially on street-lighting, the only other consumers being shops, administrative offices, etc.

Atteridgeville comprises 4437 completed dwelling units and 1400 vacant sites which will be developed to house families moved from Lady Selbourne. Only 1550 houses located in the older portion are at present wired and provided with electricity. These are of the two, three and four roomed type, some being built as separate houses and others as semi-detached units. High tension feeders radiate from the bulk supply point to a number of outdoor sub-stations and four of these with an installed capacity of 800 kVA supply the 1550 dewelling units, shops, offices and street lighting in this area. Three phase 19/14 overhead mains are erected in the main streets with three, two and single phase mains of No. 4 S.W.G. conductors in the side streets. Street lighting is provided in every street, there being some 600 units. In view of the comparatively large number of houses per unit length of street frontage and as an economy measure, groups of six to ten houses are supplied from one single-phase connection from the street mains. The connection is taken overhead to the roof of a central house in the group and extended on either side to the remaining houses in the group by means of overhead mains from house to house. The arrangement is neat and has been found quite satisfactory over the past 20 years. There have also been remarkably few instances of interference with the overhead mains.

Up until two or three years ago the only metered supplies were those to shops, offices, etc. There are some 100 consumers in this category. The balance of the supplies to the dwelling units were charged for at a fixed monthly charge which was included with the rent. This consisted of a charge of 2s. 6d. per month for lighting and an additional 2s. 6d. per month per 15 amp socket outlet. With residents making an ever increasing use of electrical appliances, the revenue derived by this means was being rapidly outstripped by costs and some alternative system became necessary. Since metering and the administrative costs associated with it could not be justified in the majority of cases it was decided to instal miniature circuit breakers and charge according to their capacities. At the present time 1495 of the 1550 houses are equipped with miniature circuit breakers of either 1, 3, 5 or 15 amp capacity, the respective charges being 3s. 6d., 9s. 6d. and 30s. per month, which again are added to the rent. The remaining 55 houses, in which electric cookers, etc. are installed, are metered.

The distribution of the miniature circuit breakers is as follows:—

1 amp rating in	180 dwellings i.e.	12%
3 amp rating in	665 dwellings i.e.	44.5%
5 amp rating in	510 dwellings i.e.	34.1%
15 amp rating in	140 dwellings i.e.	9.4%

Since consumers naturally endeavoured to make do with the smallest capacity of m.c.b., it was inevitable that at the outset numerous changes in capacity were called for but this position has now become relatively stable. Unfortunately I am not able to tell you whether the charges are adequate or not for the Non-European Affairs Department have not yet been able to assess the position.

In the absence of general metering of individual supplies it is not possible to give a breakdown of the consumption on the lines provided by Mr. Masson and only average consumption figures are thus available. For the year 1958, the average consumption per consumer varies from a low of 60 units per month in February to a high of 123 units per month in July, the average for the year being 83.5 units per month per consumer. Although somewhat higher, the general trend follows that shown in the graph published by Mr. Masson. As regards demand, the after diversity maximum demand per consumer was 360 watts which again compares favourably with that given for Johannesburg's Eastern Native Township.

The hostels for single Natives are, as indicated previously, located in Saulsville. The hostels, each comprising a dining-room with quarters on either side for a number of Natives, are in groups with a centrally located kitchen, ablution block and conveniences. Each such group is under the control of an Induna who can control the

lighting to all hostels in his group from his room. The light in his own room is supplied from the street lighting mains so that he can have light during the night although he has switched out the lighting in the hostels. The kitchens are provided with banks of hotplates on which all cooking is carried out.

There are at present 12,166 dwelling units in the various townships which are not wired and another 2000 units under construction but unlike Johannesburg the Council have not as yet adopted any definite programme for the wiring of these, although it is understood that individual consumers may arrange to have their houses wired. The present policy is therefore to provide these widely scattered supplies by individual overhead connections from the street mains, as the demand for wiring of premises has so far been negligible.

Street lighting, which at present is the urgent matter, is being provided in all streets, the funds other than those financed by the Native Services Levy being provided ex Native Beer profits. These mains as well as the transmission to the area are being planned on the basis of all dwelling units eventually receiving a supply of electricity since both the N.E.A.D. and the E.D. are against having to effect changes at a later date. The planning is on the basis of an after diversity maximum demand of 1 kWA per consumer.

As regards the method of reticulation, this is all overhead both in the case of the H.T. and L.T. mains for apart from the question of economics it is felt that from the security aspect one can hardly justify the increased costs of underground mains for a portion of the system if economics have dictated the use of overhead for some other portion. Also our past experience has been that no greater trouble arises in Non-European than in European areas with overhead mains.

In conclusion I should perhaps explain the position of the Electricity Department in relation to these supplies. In the case of all townships, the Department furnishes a H.V. bulk supply at the standard H.V. tariff and this is its only source of revenue. The planning, construction and maintenance of the distribution and reticulation systems within the townships as well as the wiring of premises when undertaken by the E.D. are performed by the E.D. in the capacity of a contractor to the N.E.A.D. The latter meet all costs from their own funds and votes and in return receive all revenue from the consumers in the townships.

In conclusion, Mr. President, I have much pleasure in seconding the vote of thanks to Mr. Masson for initiating what I am sure will prove a valuable contribution the proceedings of this Convention.

THE PRESIDENT: Thank you, Mr. Wilson.

We have with us this morning, Mr. Carr, the Manager of the Municipal Non-European Affairs Department, and we are very pleased to have him with us. I think he wants to speak, and we would be very pleased if he will.

Mr. W. J. P. CARR (Native Affairs Department, Johannesburg): Mr. President, Ladies and gentlemen: thank you for the opportunity of saying a few words to this distinguished gathering.

My thanks are due to Mr. Masson for focussing public attention on an aspect which I think of very considerable public interest.

When one considers that the non-European population, in practically every South African city, far outnumbers the White population, it is important to realise that, they, too, are potential consumers of electrical current, and therefore, are of particular interest to you gentlemen. You are in the business of producing electricity, and that correctly is your function. But it is equally your business, I suggest, to try and find as many consumers as you can for your product. Here is an aspect which has been neglected far too much in the past.

I would like to say a few words about the social effects of providing electricity in Native townships.

There has been a remarkable transformation in those areas where reticulation has been provided. I want to deal firstly with the aspect of street lighting and secondly with full reticulation including house wiring.

Insofar as the former is concerned, although it has been a tremendously powerful crime deterrent, in point of fact, Mr. President, there are certain streets in our Native townships which were colaterally known as "murder miles" — several such areas — and in these particular districts it was quite genuinely unsafe to walk to and from the bus termini and the places of residence after dark. Since the installation of electric street lighting in these areas the whole social life in that area has been transformed, and it is possible now for people to make use of these areas without the dangers which were previously in attendance.

There is, however, one unfortunate aspect to street lighting only when house wiring is not installed, and that is that the children are attracted out of the homes to street corners, and particularly to shop fronts and those few central points where lighting is provided. The reasons for that are so obvious that there is no need for elaboration at all.

It does, however, mean that the local authority can, even on this truncated basis, provide certain social amenities in halls, schools clinics, and so on, which they cannot do in the absence even of this limited supply. But the full idea I think, must always be complete reticulation for house wiring as well as street lighting, and in those areas where this has been done, life really is transformed. Not only does it give a tremendous impetus to family life, which Mr. Masson has correctly pointed out, but an indirect result has been the spectacular decline in juvenile delinquency. Also, an interesting side line has been the increase in the number of scholars taking part in extra-mural activities, night schools, and so on. So that from every point of view, full reticulation for all Native townships is the ideal I think we should all aim for.

May I say, please, that in considering this do bear in mind the economic status of your customers.

I want to endorse what Mr. Heckroodt has said, but to some extent he is dealing with a rather favoured little group, who are better off than the average.

One cannot generalise on these matters, but I want to give you just two figures. Treating Johannesburg as a whole, the average Native wage in the city as a whole has been computed as being ± £12.12.6. per month. In contra-distinction, Mr. President, the computed poverty datum line for an average family of five is £19.10.0. There are obvious exceptions either way but these are fair working figures to assess one's argument on.

It is clear from this that there is a deficit of ± £3. in the case of a very large number of Native families in the city, and such being the case it is obvious that in assessing a tariff for electricity supplied to the ordinary Native home in our locations this fact must be borne in mind, and on a tariff factor which is different, I suggest, from the ordinary European consumer must be adopted.

This aspect is important, and I do ask you to bear that in mind.

I would like to add my thanks, too, to the Convention for the very fine paper Mr. Masson has delivered, and again my thanks for being permitted to address you.

THE PRESIDENT: Thank you Mr. Carr — in particular for your very refreshing views, and I think you have touched on several things which we in our normal jobs don't give much thought to.

I don't entirely agree, of course, about the tariff aspect, but if Mr. Carr cares to come tomorrow morning, he will probably hear a lot of discussion on this paper.

Mr. Heckroodt will be coming tomorrow.

In that we have a peculiar programme today from the time angle, I am going to suggest that I ask Mr. Masson to thank the speakers now before we really open for discussion.

Mr. G. MASSON (Johannesburg): Mr. President, gentlemen: may I say thank you very much to Mr. Heckroodt, Mr. Wilson, and Mr. Carr for their contributions. I do feel that their contributions are probably more important than mine. There are aspects to this problem which are more than just plain engineering, and I do feel that their contributions are very valuable, and

I would like to express my thanks for what they have said.

THE PRESIDENT: I am also very grateful to the three good people because we have had some very interesting aspects. We still have time for discussion, and I think one or two are prepared.

Mr. J. DOWNEY (Springs): Mr. President, gentlemen: Firstly I should like to thank the author for the information and data he has furnished in his paper, which was most interesting as most of us today are finding ourselves involved in the reticulation, or preparation of plans for the reticulation of Native townships.

I know the author has been giving this matter serious consideration for a number of years, and therefore must have collected quite a lot of valuable data on the subject.

As one who has also had to give consideration to a Native township, I appreciate the difficulties he must have experienced in obtaining correct, and reliable, information on the subject.

The graphs on consumption are most interesting, but here we must differ, because probably the set of conditions obtaining in Springs is different from those in Johannesburg.

From a survey taken in the Payneville Township in Springs, it was found that the average unit consumption was much higher than even in an European section of the town at the time. The European area referred to has now increased in consumption, since the industry it served has increased its wage bill paid to its employees.

The unit consumption was averaging well above the 100 unit mark per month, and the demand over the whole township was .68 KVA per consumer; in addition the rate of rise annually in demand was equalling, if not higher than most of the other European townships.

From the foregoing it must be noted that in providing for the future of Native townships, adequate provision must be made for catering for the development of the Bantus standard of living.

In the early stages of the planning of the Kwa Thema, my council offered gas to the residents of the Native townships, as owing to the extremely rapid rate of demand for electricity of the European townships and industry, and the availability of gas, it would have been an advantage to my Council as a whole to furnish gas to the Native townships. The Natives in the townships repeated, bluntly and emphatically, that they were not prepared to accept gas, even if it meant they had to wait a number of years for electricity. This, then, is the condition of the Native's mind in regard to electricity and should not be ignored.

Bearing all the foregoing in mind, it was consired prudent to design the new township for a demand of 1 KW per consumer of per house.

Perhaps the author would be good enough to explain how he has derived a figure of .5 KW per consumer, bearing in mind the foreseeable increase in the standard of living of the Native. It may well be, however, that owing to the larger and more concentrated nature of the industrialisation of Springs, that the Natives' wages are higher on the average, than in Johannesburg, which may account for differences in the end results.

Perhaps the author will give his comments on this as he is familiar with the set up in Springs. (I believe he took the opportunity of visiting Springs during my absence on leave).

Apart from the paper, I have known the author personally for over 20 years and must say that I cannot find much that we differ upon in his remarks.

I would say that we are more in agreement than in difference, excepting in street lighting. In some respects, experience has shown that for most Native townships street lighting is a misnomer. In many cases it should be called "an occasional light in a street" rather than "street lighting."

In the native township of Kwa Thema the reticulation for street lighting has been done by means of specially insulated PVC copper conductors, using concrete poles. A light is placed at every pole, using a diacon plastic

refractor/lantern, with tungsten lamp, protected by a suitable wire cage to protect the whole from the skills of the local youth with his David and Goliath acts and catapults.

In addition the mounting height is above average. The native youths have been greatly disappointed by this system, as the skill of spinning a wire loop up the stay on over to the top of the lines at the top of the poles has produced no Guy Fawkes displays, and the height and wire guards of the lanters have not provided him much reward for his extended efforts.

The author also seems to find the Native an excellent means of knocking over poles. To this problem perhaps the author will tell us how he proposes to overcome this difficulty.

Coming to the spacing of individual lanterns, I should like to make a few comments.

What sort of street lighting is a street without lighting?

Lighting up every second street does not provide the protection for the township which it is intended to do. And the economics of a light at every second pole, (although the photograph shows every third pole), only increases the maintenance and supervision of the system.

Where a light is provided at every pole it is not necessary to scout and replace the lamps so frequently as would be necessary when the lanters are at every other pole. This reduces the cost of labour considerably.

In making discreet enquiries from the residents of Kwa Thema on their reactions to street lighting, after the first section of street lighting was switched on, I was informed that it was the first time that they were able to sleep at night, as stone throwing, shouting, burglaries, and assaults were previously carried on all night, but now they were able to sleep.

The same report was obtained from all other areas, and the Natives interviewed were quite frank in saying that the street lighting made it safe, to walk the streets at night. Gentlemen, you have heard what Mr. Carr said this morning about it, and I am only confirming what he has told you.

They can sleep now, and the assault cases dropped very considerably indeed.

How can this be accomplished with a system of street lighting at every alternate pole and every alternate roadway illuminated.

Perhaps the author would explain the reasons for this inadequate system.

I could have much to say about lamp sources and wattages, but one must remember that economics of the light source are not the only considerations to be given to a lighting installation.

Tee formations give a lead in this matter, and the most important of all, the speed of perception which gives the designer a pointer in the size of light source to use and the requirements for his lighting installation, bearing in mind the traffic, both pedestrian and vehicular.

I agree with the author's remarks regarding the low voltage reticulation. There is only one way to reticulate a Native township for a safe supply, and that is by the underground system. Overhead services are not only unsightly but dangerous, and the cost of bringing the supply down each pole to every house is not only unnecessary but costly, and if one includes the cost of services with the distribution mains, I am sure it will be found that the overhead system of supply it not worth considering.

In conclusion, may I congratulate the author in presenting a paper of such interest to all local authorities at the present time.

Thank you Mr. President.

THE PRESIDENT: Thank you, Mr. Downey. I don't know if I followed your remark about Mr. Masson slinking out there when you weren't present, but don't forget that you slunk out there from Johannesburg some years ago.

We are five minutes past our time, so I will have to close the discussion now.

I want to thank Mr. Heckroodt, and Mr. Carr, for coming along today, and I do hope they will manage to come tomorrow morning, because I think there will be lots of trouble!

CONVENTION ADJOURNED FOR LUNCHEON AND VISITS TO FACTORIES.

On Resuming at 8.00 p.m.:

THE PRESIDENT: I don't think Mr. Mitchell needs any introduction to you, gentlemen, so I'll hand over to him.

Mr. J. E. MITCHELL (Salisbury): Mr. President, we have quite a series of questions tonight. The first one of course is whether I am going to be paid a salary for this permanent job of Quizmaster.

Oh, the answer is "No". That was quick, wasn't it? No other comments?

The first question I am going to pose to you, to get right into the business, is Question No. 9.

"To what extent should a low voltage consumer contribute directly towards the cost of his service conection:

(a) In general.

(b) If supply is taken from overhead mains;

(c) If supply is taken from underground mains via street distribution pillar boxes?"

Over to the Forum.

Mr. R. W. KANE (Johannesburg): Mr. Quizmaster, should I say 100%?

QUIZMASTER: The answer so far, gentlemen, is 100%. Any advance on 100%?.

Mr. C. R. HALLÉ (Port Elizabeth): I put it to you Electrical Engineers seriously, that if you don't make more money the City Treasurer won't have enough for our Transport Managers to lose, so I say 200%.

Mr. R. M. O. SIMPSON (Durban): I am just wondering about our President's suggestion, if we go back to Power Stations, I presume he will share the whole distribution with everybody?

Seriously, this is a very good question, because it is one that comes up very regularly in giving supply to various consumers.

Generally I suppose one could say that it is a matter of policy. You can make quite a fair argument that the consumer should be given quite large concessions in regard to the cost of a service, because you can make quite a case with regard to the distance that should be the responsibility of the consumer, so it does become, I think, one of a matter of individual policy in respect of that particular consumer.

I will just quote: in Durban the policy has been that we do aim to allow the consumer to pay for approximately 50% of the actual service from the street to the house, so that, from a general point of view, that is a general policy.

If the supply is taken from overhead mains, then of course your supply is very much cheaper, but the policy still applies that we aim to let him pay a connection fee which is approximately 50% of the cost of giving that service from the pole to the house, and similarly by underground mains, it would be done in a similar manner.

It is definitely one of policy that is going to be followed by that particular town. There are so many arguments that can be used against the policy of giving any concession to a consumer. It could be said, and I have heard it said in the Forum, I think on a previous occasion, that if you can pass these capital charges of connecting consumers over to the consumer, that it means you have that amount of money less to borrow.

Well, that is quite a good point, but then again the responsibility of the supply authority comes in; how far are you going to let that responsibility go? Are you going to define the responsibility as being up to the nearest transformation point, from the high voltage to the low voltage at a substation?

I think here it does eventually evolve to a question of policy, and I have just stated that the policy in Durban, generally, is that 50% of the cost of the service from the street to the house for a domestic consumer is the normal method of charging.

THE QUIZMASTER: Thank you Mr. Simpson.

Could we possibly tie this up, not just to cost of service? Some members here may have some system for charging for estates, i.e. the reticulation within the estate, as well as the service connection. I think this question could go as far as that, if anybody has methods of charging capital costs of the reticulation within an estate as distinct from the actual service connection, and if you wish there is no reason why you shouldn't tie up that type of connection to the service connection.

Mr. R. W. KANE (Johannesburg): Mr. Quizmaster, are we allowed to discuss the replies?

QUIZMASTER: I see no reason at all.

Mr. R. W. KANE (Johannesburg): Oh, how disappointing!

Mr. W. H. MILTON (Escom): Dealing first of all with the service connection side, I think we must bear in mind when framing our policies we should deal with costs which are shared by the community we serve, as well as the costs which are not so shared.

The service connection is one of those costs which is not shared, it is personal to the consumer, and can be reflected as a direct charge against the consumer.

Against that one must bear in mind that as a community, the cost is reduced owing to the number of people who are served, and from that point of view it is desirable, in my opinion, to average the cost of the service on the basis of the average in the community itself, and a special fee should then be charged to cover that average cost.

It means that in certain cases a consumer will be paying less than the cost of his service, but in others admittedly more. On the average, as a member of that community, I think it is a fair basis for framing the policy.

As regards the question of reticulation in estate areas, this matter was dealt with two or three conventions ago, at very great length, but there I think the best plan to adopt is to call upon the owners of the estate to finance the entire reticulation network, less the cost of the service conections which the supply authority recovers direct from the consumers, and to leave the refund to the owners of the estate on the basis of an adequate return of revenue on capital provided by the supply authority.

In our own case, Escom works on the basis of refunding to the owners of the estate five times the revenue. That means that we are looking for a 20% return as a useful yardstick for arranging the capitalisation ourselves. By adopting that policy it leaves a township owner free to invest as much as he desires in the development of this township, and it also serves as a very useful restricted measure in connection with the free sale of plots within the township area.

If there is no such restriction, and if the supply authority is compelled to supply all consumers in the area whenever they come on, you get a free sale, and very scattered development of the township, with the result that the actual cost of reticulating to individual consumers is very seriously increased, with detriment to the consumers who do ultimately take supply in that area, and I think that restrictive measure is very evident when township owners realise that by selling plots indiscriminately, they are landing themselves in very heavy capitalisation, and they then tend to restrict their development to useful zones.

We have found that approximately 40% development of a township will normally result in the supply authority being able to bear the full cost of reticulation of the area concerned.

Thank you Mr. Quizmaster.

Mr. C. LOMBARD (Germiston): Mr. Quizmaster, I feel that the charge for a service connection should be based on the cost of the service connection from the boundary to the consumer's meter board, otherwise it would mean that the man who has to take a very long service connection from the line across the street would be penalised.

To this cost based on the length of service connections from the boundary to his consumer's meter, should be added a charge based on the average length of service connections from the consumer's boundary to the mains.

Thank you Mr. Quizmaster.

Mr. A. R. SIBSON (Bulawayo): Mr. Quizmaster, the question really divides itself into two, I think. The question of a connection fee for the service connection as such, by which I mean the last lap of the supply mains, and the rest of the system that may be required to feed the particular consumer.

Now in the built up areas, it is only the former part that really is peculiar to the particular consumer, and in Bulawayo we have a nominal fixed fee of £5 per consumer. It bears no relation to the cost. It is not intended to. It is merely a nominal figure largely to get a little extra revenue, and it roughly amounts to about a fifth or a sixth of the actual cost of connection. It is purely a matter of policy as to whether you make a connection fee at all. It is merely another way of getting revenue. If you don't get it that way, you get it through the tariffs.

Where you have individual consumers who, by virtue of their geographical position impose an abnormal cost on the supply authority, particularly in rural areas, it then becomes justifiable to recoup the authority's cost in some way or other.

I have, on several occasions in the past, indicated to this Association the method we employ in Bulawayo, which is to relate the connection fee to the area of the property being served, on the principle that it is the area of the property and not the distance run by a particular distribution main which imposes the cost on the supply authority, because the area of one property makes it necessary to go all the further to a neighbouring property. It may be that the supply mains to the first property owner are merely 100 yards long, but by virtue of his possession of 10, 15 or 20 or 30, acres he makes it necessary to go perhaps a quarter of a mile to his neighbour. Now the additional cost has been imposed by the man who owns a large piece of land. Therefore, we adopt a formula which I have given before, but I will give again, which is $C = bM + d$ into the Root of A, where C is the connection fee in £'s; b is a constant; M is the distance from the centre of gravity of the load; d is another constant; and A under the Root sign is the Area in acres of the property — and I leave it to you to work it out.

QUIZMASTER: Thank you Mr. Sibson. It sounds like the professor of mathematics who dreamed that he was a negative quantity under a square root sign, and he couldn't extract himself.

Any more contributions to this most interesting discussion on service charges?

(NO FURTHER DISCUSSION)

This question as you will notice was put in as Item 20 as well, so two people were definitely vitally interested in this. I think you have had a certain number of answers to it, and I think generally the position can be summed up this way, that you need a certain amount of money to run an undertaking, and like the Government, you can obtain it by income tax, indirect tax, customs duty, and any other method you like to make it the easiest to extract the necessary amount out of the consumer, whether you make it 100% connection fee, or 50% it seems to be a matter of policy.

While I am on policy I can't resist telling you the story of the owl and the centipede which you can tell to your councillors. The centipede had rheumatism in all its ankles, so he went to see the wise old owl. The wise old own said, "Well, it's quite simple, just turn yourself into a dormouse, then you'll only have four ankles to worry about."

So off went the centipede, but he hadn't got very far, when he thought "Well, that's very good advice, but how do I turn myself into a dormouse?" So the centipede went back to the owl and he said, "I am sure that was very good advice, but tell me, how do I turn myself into a dormouse?" And the own said, "I only deal in policy; the details I leave to you!"

Question No. 8:

"When introducing ripple or some other form of domestic water heater load control for the purpose of reducing system peak loads, is it advisable to supply those consumers whose water heaters are controlled at a lower tariff than consumers whose water heaters are not controlled, and thus compen-

sate them for the lower cost of supplying them and the inconvenience (if any) caused by their water heaters being controlled?"

A lovely question for Ladysmith, Bloemfontein, Cape Town, Port Elizabeth and East London!

Mr. F. STEVENS (Ladysmith): Mr. Quizmaster, all I can say in answer to that one is that we do make allowance to consumers who agree to go to—we'll call it controlled or a restricted supply at peak periods. We do, however, make it a condition that they have to have a house wired for electric cooking, have an electric water heater installed, and further be prepared to have the supply interrupted at times to suit the department. If they agree to this, we supply them at, instead of 7/8th of a penny at 5/8th of a penny, and I can assure you it has made a tremendous difference to the undertaking insofar as our load factor goes. Consumers very rarely complain about the interruption that takes place, as they are getting value for money.

In short, I consider that they shou'd be considered, and made some allowance.

Mr. D. MURRAY NOBBS (Port Elizabeth): In reply to this question, if we consider an Undertaking receiving a bulk supply on a maximum demand tariff then obviously, if it can be established that interruption of electricity supply to heaters over peak periods, results in a reduction in the total maximum demand of the Undertaking and a corresponding reduction in the tariff amount payable to the bulk supply authority, and further, provided that interruption of supply is of a short duration and consumers are not inconvenienced in this regard then there is a case, based on economics, for granting a tariff concession to consumers whose water heaters are subjected to intermittent operation.

In the case of the Generating Undertaking, if it can be shown that the control of hot water load results in a reduction in maximum demand and postponement of the installation of additional capital plant and, incidentally, a saving in capital charges, then again there is sound reason for passing on to consumers who have co-operated, a proportion of the savings effected. In other words, the supply to hot water heaters could then be said to fall within the category of an off-peak supply.

To compensate consumers for inconvenience that may be caused to them, is a different proposition. In my opinion, avoidable inconvenience should never be caused to any consumer, but should it be desired to introduce a system of control which may result in inconvenience, then the consumers approval should be canvassed in the first instance and his co-operation sought. I cannot see, however, that the Undertaking can possibly grant tariff concessions on this score alone. This would be tantamount to subsidising a group of consumers who had agreed to accept control of their water heaters at the expense of other consumers.

The questioner, however, does not ask, "Is it correct to supply at a lower tariff those consumers whose water heaters are controlled?", but instead he asks, "Is it advisable?". This of course depends on the characteristic of the system load curve. Should this incorporate peaks of short duration then geyser load shedding could be carried out without being noticed by the average consumer and no inconvenience could be said to result, but should the base of the peak extend over a fairly long period of time and the geysers be interrupted for that period, then tariff concessions will not help very much if no hot water is available when required.

To sum up, therefore, I would say, that where a financial saving to the Undertaking has resulted from the co-operation of a particular class of consumer that consumer does not bear any relation to the economics of an Electricity Undertaking and no tariff relief should be granted on this account. In fact, any electrical control system that will inconvenience consumers should not be considered as part of any Electricity Supply Undertaking.

Mr. K. W. J. HALLIDAY (Port Shepstone): Mr. Quizmaster, we work in possibly a different way down at Port Shepstone, where we are rather socialistic in outlook. We don't feel that everybody should have to pay for the luxury of some particular per-

sons. The way we work it down our way, is he who wants to bath while other people wash or eat, is made to pay a little bit more. In that way, we make him pay an additional charge per kW of geyser load, and the rest, the unit consumption, stays as it is.

QUIZMASTER: Thank you, Port Shepstone. I am not certain whether that is socialism or fascism!

Mr. G. F. BELLINGAN (South West Africa): Mr. Quizmaster, as I see this question we have consumers who have their hot water cylinders controlled, and those who do not.

I feel that if we control the hot water cylinder of customer A, and not the hot water cylinder of customer B, we must reduce the fixed charges on customer A.

Mr. C. LOMBARD (Germiston): Mr. Quizmaster, I think the problem here is that all consumers contribute towards the capital charges involved in providing a controlled system like this, and I think that those who have their water heaters controlled, or who are lucky enough to have them controlled, should be on a lower tariff than other consumers who are not so controlled, and are nevertheless contributing towards the capital expenditure involved?

Councillor L. R. F. OBERHOLZER (Brakpan): Mr. Quizmaster, just speaking as a layman, I feel that consumers are already being compensated in this respect, that these water heaters are being controlled to offset peak demand periods, and so to overcome possible power failures, and because of that they are being compensated in being saved the embarrassment of the possibility of a power failure.

Now, arising out of the discussion, I would like to raise this further question in connection herewith: If a special tariff should be charged to these particular consumers, would it not entail additional administrative costs to the suppliers concerned?

QUIZMASTER: Are there any further contributions?

Mr. A. JACKSON (Cape Town): Mr. Quizmaster, perhaps I am a little obtuse this evening, but reading this question I am a bit puzzled. It refers to consumers whose water heaters are controlled, and consumers whose water heaters are not controlled. As I understand it, apart from the development stage, where it pays an undertaking to install control of water heaters, all water heaters would be controlled. Perhaps I could have an explanation of that one?

QUIZMASTER: The position is, Mr. Jackson, that what we are talking about is those who have the full use of their water heaters during 24 hours of the day, as against those who have the use of their water heaters only when the supply authority says they can have the use of their water heaters, which is rather different.

I think the position summed up is this: That we have been talking about a reduction in tariff for those who have their water heaters controlled, but if we look into the replies we have had, I think the major point is that you increase the tariff of those who refuse to have them controlled. In other words you base your tariff on the fact that you are going to have a reduction in the overall costs because you don't have the same peak load, you don't have the same generating plant, you don't have the same maximum charges, and anybody who contributes some load which is going to make you pay extra costs should pay the difference. I think that possibly is the summary of the position.

Mr. Lombard, of course, I feel should get back to our tariff report, because he is suggesting there is some justice in electricity tariffs. I have never found any yet.

Question 23:

"What is the most satisfactory way of protecting a low voltage consumer from lightning surges when he is at the end of a line?"

Mr. W. H. MILTON (Escom): Mr. Quizmaster, I suggest that it would be advisable to extend the line!

QUIZMASTER: Thank you Mr. Milton. I thought that a better way would be to remove the last span!

Mr. J. F. LATEGAN (Stellenbosch): Mr. Quizmaster, I am no longer in the lightning

area. I am safe, far away in the south, but having had 27 years of it, I feel I can voice an opinion on this.

This is a matter of the theory of lightning. Lightning no more comes from the cloud—it comes out of earth, according to B.P.I. so I think it is needless to try and attempt to earth. I have tried in this way. I have connected a No. 16 gauge across the shunt coil in the meter and brought that current back across the gap provided into the neutral, and by the lightning jumping over there, it got back into the neutral instead of into the premises of the consumer.

Mr. A. R. SIBSON (Bulawayo): Just one quick word, Mr. Quizmaster. There is of course, no sure way of protecting anybody against lightning, that is to say protecting a surge or preventing it from entering the premises; but what one can do is to short-circuit it to earth, enabling the circuit to be isolated by some protective device, unless that device is something of the order of a miniature circuit breaker, it can be easily closed again. The system we use in Bulawayo is to use spark gaps, on the meter boards, and these initially installed to protect the meters, and they have been extraordinarily successful in this way, they will also protect the installation. Of course, their operation results in the operation of the M.C.B. That can easily be re-closed, and in most cases the spark cap has not damaged itself although in some cases it has, but at least nothing else has been damaged.

QUIZMASTER: Thank you Mr. Sibson, Actually our President gave me an answer to this; I think he should give it to you.

Mr. R. W. KANE (Johannesburg): Merely on your request, Mr. Quizmaster, I asked the staff to produce questions. I think some of them produced an answer, but for the life of me I can't remember what it is, but it is something to do with Mr. Milton's, or your suggestion of cutting out the last span.

QUIZMASTER: The actual answer I got from you, Mr. Kane, was that you should run a span underneath the existing line, back to the second last pole and treat that as the end of the line!

Mr. A. A. MIDDELCOTE (Bureau of Standards): Well, I think we all must agree that the valve type of arrestor would be the best.

A word of warning, many still do have quite a high remnant voltage left, and while they will protect most of your wiring, certain parts are still vulnerable and will be hit; notably it appears that hot water cylinder elements are still fairly vulnerable. The first bit of advice is to make sure that the lightning arrestor does perform properly. We have tested and found many of them still to leave about 8KV on a domestic installation; others reduce it to about 2½ to 3, which is more reasonable.

But a final word of advice: possibly if you fit a ripple delay you might cut out the hot water cylinder and prevent it being hit during a storm.

QUIZMASTER: Does Mr. Middelcote mean that the ripple relay is a very fine lightning arrestor?

Well, ladies and gentlemen, do you think you have the answers? I think you have had a series of answers.

Seriously, the only answer is to put in a reasonable reputable lightning arrestor, and hope for the best. You cannot possibly give full protection, especially against a direct stroke.

Question 17:

"Does the responsibility of a Supply Authority and its Electrical Engineer cease at a socket outlet? By way of an example, if the Engineer or his representative knows of consumers who persistently overload plugs or connect unearthed appliances that are not portable, is the Engineer legally required to take action?"

Mr. G. A. DALTON (South West Africa): It has been held, Mr. Quizmaster, that the Supply Authority's responsibility finishes at his meter, so I cannot see how any engineer, Supply Authority, or their representative could be held responsible for the actions of the consumer on the consumer's own premises, as the installation of the house is deemed to belong to the consumer, or the

occupier of the premises, and not the Supply Authority.

Mr. A. A. MIDDELCOTE (Bureau of Standards): Mr. Quizmaster, I think we have argued this out many times before, and I think everyone realises that the only way you can combat this is to try and get some set of regulations which forbid the sale of equipment which could be inserted in a plug and which is unsafe.

We have argued this out at previous A.M.E.U. conventions, where we pressed for the safety specifications to be made compulsory.

Mr. K. W. J. HALLIDAY (Port Shepstone): Mr. Quizmaster, I think that is not quite the way the question is formed. I rather fancy that what the questioner here is wanting to know about say, the use of electricity which doesn't conform to the wiring regulations. By that I mean the possibility of flex running out of the windows to the garage outside, and all that type of business; and I rather fancy that when a consumer takes supply he undertakes to abide by the Electricity By-Laws which include the Wiring Regulations in most cases and I, in my case, when I find that, I just disconnect them.

I do feel we could not be really classed as being responsible for inspecting what everybody does all the time, but if we knowlingly allow it then I think we are responsible.

Mr. J. C. DOWNEY (Springs): It sounds to me, Mr. Quizmaster, it is more like the interfering mother-in-law.

QUIZMASTER: That is very likely, but we have not actually had the answer to this question yet.

Mr. J. L. VAN DER WALT (Krugersdorp): Mr. Quizmaster, I think we are morally responsible for the safety of those consumers, though not legally, and I would suggest the best action to take is to warn that consumer in writing that he is participating in a dangerous practice, and if he does not heed the warning, I think you have done your duty.

QUIZMASTER: Seeing we have Mr. Milton with us, and he has not been with us until tonight, I think I am going to give you all a real good chance.

"(a) Is it considered that a 7½% regulation would be satisfactory from a bulk supplier to a town supplier having 20,000 inhabitants?

Question No. 1:

(b) Should not the bulk supplier regulate his supply to closer limits than this in view of the fact that the generally accepted regulation to a low voltage consumer should not be more than ± 5%".

Don't be frightened, you Reef members!

Mr. W. H. MILTON (Escom): Mr. Quizmaster, sooner than have to make a statement which would appear to be an answer to attacks, I think a statement in the first place is called for.

The question, as it applies to Escom (from your point of view Mr. Quizmaster), is not quite correctly put.

The regulation of 7½% to which reference is made in this particular question is the maximum regulation, permissible at any time, under any circumstances, except of course those of a fault.

If a supply authority supplying urban consumers in bulk is called upon to regulate the supply to plus or minus 5% in all circumstances, the consumer complains about the cost of electricity, because, of course the regulation up to that particular point of supply must be taken into account in exceptional circumstances, which then involves the expenditure of relatively large sums of money.

The regulation of 7½%, to which reference is made in this question, only arises under extreme conditions. Under all normal conditions the regulation is closer to 2½ to 3%.

The actual voltage regulation is therefore well within the margin of tolerance for any bulk supply authority.

It is rather the duty of the consumer to provide voltage regulation equipment in order to maintain constant voltage if he wants voltage at a constant potential at the

bulk supply point than that of the supply authority. One or other must provide the equipment needed and from the point of view of the towns taking a supply, if they desire very close regulation, we feel that it is preferable that they should be given the chance of spending the money themselves instead of having, Escom, for example do so as a standard condition. That money would be spent, and paid for by the consumer, in order to supply within very close regulation limits those consumers who are quite prepared to take a cheaper supply under wider limits of regulation.

Mr. R. W. KANE (Johannesburg): Do I understand Mr. Milton to say "No" to the first question and "Yes" to the second?

Mr. W. D. HUTTY (Dowson & Dobson, Johannesburg): I have found, living in the township of Hurlingham, that our voltage regulation is far in excess of 7½%. We pay Escom, Escom are our bosses. What are they prepared to do about it?

QUIZMASTER: I am surprised that has not brought forth more than it has. All scared? All right. You have had your "Yes" and your "No" from . . .

I beg your pardon.

Mr. J. L. VAN DER WALT (Krugersdorp): Mr. Quizmaster, perhaps we are scared because we are all guilty. I don't think we should press ESC too much; our consumers may start pressing us!

QUIZMASTER: Question 25: "Does the forum consider that electrical installations in government owned buildings are exempt from the inspection and control by supply authorities, as is the case, as far as building regulations are concerned?"

Mr. G. J. MALAN (Dept. of Labour): Mr. Quizmaster, this is a very innocent question, but it has a very interesting implication.

An Act of Parliament only binds the Crown, when this is specifically provided for in that Act. Hence the Factories, Machineries and Building Work Act bind the Crown because Section 56 of the Act says so. The Electrical Wiremen and Contractors Act is silent on this point, and hence the Act it not applicable to the Crown.

The question now arises whether Legislation by bodies inferior to the Crown can be made binding on the Crown. The answer is, I think, an emphatic "No." Therefore local authorities and provincial administrations cannot make regulations for the Crown to abide by.

But Section 19 of the Wiremen's Act has in my opinion a very interesting dodge, and in a roundabout way it almost binds the Crown.

It is common knowledge that the Crown cannot prosecute the Crown, but the Crown can prosecute an officer of the Crown. Now if you read Section 19 carefully, you will see that the supply authority is not obliged to inspect installation before energising that installation, but it is put rather negatively and any person is precluded from making that connection until such time as the supply authority has given permission.

The implication is that no person may connect the wiring of any government owned building to the source of supply without the suppliers' consent. This virtually, in my opinion, gives the supply authority the same rights, with respect to government buildings as they enjoy in the case of other buildings.

If this is not so, then there is at least a condition of stalemate between the government and the supply authority, by virtue of a very clever play with words.

Mr. Quizmaster, this whole question does not really surprise me, because, unless I am very seriously mistaken, the Wiremens' Act was drafted between the years '32 and '39 by members of your very Association.

Mr. G. J. MULLER (Bloemfontein): Mr. Quizmaster, the working arrangement, in our part of the world is this: where the Crown or the Government has engineers in charge, we normally do not expect our municipal inspectors to inspect their work, but we do expect them to comply with the other regulations such as the handing in of forms for wiring, if for nothing else but record purposes.

As far as the work on wiring is concerned, in other words, the use of registered wiremen —there we have come to a gentlemen's agreement. The P.W.D. and the Railways, where they wire outside government premises, Railway premises particularly, there they invariably use registered wiremen. Thank you.

Mr. R. W. KANE (Johannesburg): I have heard rumblings of this throughout the years, and I think that a few years ago Kroonstad was in trouble. Our Reef Association had quite a fair amount of correspondence with the Wiremen's Board, before Mr. Malan took over, and one or two other people; in the long run, we were told, legally, that the connector was responsible.

Johannesburg, about October last year, struck the same trouble, and on this occasion we wrote to the P.W.D. and asked them what they wanted done about it, and we got a letter back telling us all about the co-operation that had existed in the past, they were surprised at our attitude, and things like that, and in the long run, offering us an indemnity. This indemnity amused me, because I wondered why if their powers were so great why they should offer us an indemnity.

It more or less implied that we had no right in their building whatsoever.

We sent it to the Town Clerk's Department. They said, "Take the indemnity," we said, "Why?" and we were told, "If anybody offers you anything, it is good policy to accept it."

The Town Clerk offered to draw up the indemnity. We had a chat with the P.W.D., they accepted the suggestion, we produced the indemnity, and until last week have been waiting for this indemnity. We have got a copy (unstamped; we also told them they had to produce a half-crown stamp on it, which, apparently did not amuse them). To cut a long story short, generally I think the State Departments are first-class craftsmen, and I think we are worrying ourselves a little too much about this thing. If they want to take the responsibility, let them take it.

It does seem ridiculous, but when they adopt that attitude, and when they are ready, hand them the fuses, let them put them in, you seal the fuses. In other words, they connect.

Mr. J. L. VAN DER WALT (Krugersdorp): Mr. Quizmaster, Mr. Malan has said that the Crown is not bound by any of the Acts or By-Laws of a local authority, but your Association has had legal opinion from its own adviser, who agrees with that view but also points out that the local authority is bound by its by-laws, so it is safer, although we have reached stalemate, for the local authority to inspect before it connects any building belonging to the government or provincial authorities.

Mr. C. R. HALLÉ (Pietermaritzburg): In Pietermaritzburg, as the main government institutions there are mental hospitals, we just treat them like the rest of the suppliers, and they go through the loop like everybody else. It is sheer ignorance. We didn't know that they weren't exempt!

QUIZMASTER: Anybody else qualify?

I think we have debated that one long enough. I would like now to turn to Question 4. This was on the forum last year, but we got a bit diverted last year. I wanted to warn anybody here that if he talked on level price tendering for as much as one second he would get hammered!

Question 4 was put on because we expected a certain number of ladies to be present, and we thought they might like to actually ask questions, and it was put on for that purpose.

"Housewives have heard sundry arguments and discussions on socket outlets, and would like to know whether the actual siting of these is under the supply authority, why some installations include controlling switches and others do not, why there are such a variety of sizes and types, and finally why a satisfactory design cannot be produced that would eliminate the far too frequent necessity of repairs to the flexible wiring adjacent to the plug?"

Mr. A. A. MIDDELCOTE (Bureau of Standards): Mr. Quizmaster, I think probably one would be misled about the "large variety of plugs available." There is one

variety that is widely used, which we try to standardise on in this country, the 15 amp, but unfortunately the difficulty experienced in England, where they did have a wide variety of plugs, which led them to produce a rather unusual design caused a non-standard plug to be produced on the South African market, a South African market that was becoming quite stable. This plug, apparently, had quite an attraction, as regards the shape of the prongs I expect, but it is doing a lot of harm. It is stopping the standardisation of 15 amp plugs. It is, I believe very popular in the Federation, and I believe is making 13/15ths engineers of us all.

I suggest that we have a standard plug in this country; we can make things quite easy by observing that standard. Finally, we can prevent the all too frequent necessity for repairs to the flexible wiring adjacent to the plug, mainly by using flexible cord of suitable design. I think most of the problems are caused by using inferior flexible cables to the plug sockets—those bought in the bazaars, particularly and certainly well below the requirements of the safety specifications.

If people are educated to buy good cord, and 15 amp plugs, to a sound specification, there should be no trouble, but if we persist in trying to change our standard in this country to the 13 amp we are going to aggravate the position.

QUIZMASTER: Thank you Mr. Middelcote; you dealt with two specifications. What is a specification for height from floor?

Would the ladies like to comment?

You know, it's amazing; this is one place to keep them quiet, isn't it?

Mr. J. L. VAN DER WALT (Krugersdorp): Mr. Quizmaster, the other night one of my lady friends (and I have a few!) phoned me to ask me how to connect those silly wires in a plug. So I carefully explained to her how she had to do it, but I told her, I would rather she did not attempt it. She insisted that she wanted to know, so I told her. When I had finished telling her about the red wire to the line terminal and the black wire to the neutral terminal, and the green one to the earth terminal, she said, "Oh, my, when I connected the two to the plug, I found this third wire so I divided it in half and gave each terminal half!"

Mr. R. W. KANE (Johannesburg): I think Van should also tell us the story about his wife, Mr. Quizmaster.

QUIZMASTER: Certainly, let's have it Van.

Mr. J. L. VAN DER WALT (Krugersdorp): I don't know which one Mr. Kane means, Mr. Quizmaster. Not the wife, the story!

But I think he means the one where we had a visitor staying with us, and the electric iron went out of order—I told this one at Salisbury I think. The iron went out of order, and my wife's friend said, "Well, you'd better get an electrician," but my wife said, "No, I'll wait until my husband comes home. He can fix it." So this lady very surprised said, "But can he?"

QUIZMASTER: I want to deal with questions 10 to 14 all together. Really it should have been one question although it does deal with various aspects of the same subject.

"What is generally the policy adopted in installing electricity meters in blocks of flats and offices? Are all consumers metered individually, or is a bulk supply given?

"If electricity is supplied in bulk, what tariff is applied, i.e. domestic room rate, or say a maximum demand tariff?

"If electricity is metered at one point only, how is the owner of the building prevented from making a profit out of the electricity supplied to his tenants?

"If tenants are metered individually, is the full connection fee charged for each installed meter, and is a common meter room required in every case?

"What connection fee is charged where a consumer is given a high tension supply?"

Mr. R. M. O. SIMPSON (Durban): Mr. Quizmaster, here again I suppose it does become a question of policy. I can only

state what policy is followed in Durban. It has been the policy for many years to regard individual domestic consumers as going right down to the flat owner or flat occupier, so that in blocks of flats where the supply is given we have generally given supply to each flat, so that the policy in Durban has been that domestic residences whether they are in blocks of flats or individuals are individually metered. That is not the case in commercial buildings, offices, etc., which are generally metered at one common tariff, either a bulk rate, and the consumer pays electricity in the form of rent.

In question 11, as far as we are concerned, as I say, it does not apply, because each domestic consumer is given an individual supply at the domestic tariff. We have no blocks of flats in Durban at all that are metered in bulk.

It is a point though. It is a question of policy. We feel that each individual flat occupier does look to the supply authority to maintain his supply and we do not like the idea of passing that responsibility over to the owner of the block of flats. We would sooner deal with the individual.

Question 12. We have a bye-law in our tariffs that covers this particular point, that if anybody does sub-meter in the event . . . (because it is not disallowed. If a consumer particularly wanted that, say in a commercial building, and wanted to sub-meter, it can be or could be agreed to). In which case, if he did re-sell he must sell at the average cost, in other words, no profit is allowed out of it.

If tenants are metered individually, we in Durban allow for the first 20 meters of a block to be charged for at the normal rate, which we will say is £4 and all over that would be £1 cheaper. They would get them at a lower rate.

Connection fee if a consumer is given high tension supply—here again, dealing with the domestic consumer, that does not apply, because generally we give the supply direct to the consumer at low tension.

If this were referred to an industrial consumer, then we certainly do take account of the voltage of the supply, and it is normally given at a slightly lower tariff, depending on the actual voltage, and how many steps of transformation until we step the actual tariff.

I think that covers it in general.

QUIZMASTER: Not quite Mr. Simpson. Would you just cover connection fee for high tension?

Mr. R. M. O. SIMPSON (Durban): Connection for high tension supply—we have in Durban no . . . we make no difference for the actual connection fee to a high tension consumer. He gets it at the same fee as the normal low tension consumer does. It is just the standard fee that is paid.

QUIZMASTER: In connection with the high tension supply, do you finish at the high tension switch?

Mr. R. M. O. SIMPSON (Durban): Yes, we finish at the meter. The consumer has to supply the controlling switch, and the metering position, and our supply finishes at that point. That is high voltage.

QUIZMASTER: Thank you, Mr. Simpson. There you have the conditions as laid down by Durban. I think that was the general idea of this question, to find out what is happening in South Africa, generally, and the person who asked the question can take his choice, and decide on his own policy, so if any others have different methods will they please let us know them.

Mr. D. MURRAY NOBBS (Port Elizabeth): The questioner asks what is the general practice, and I suppose that practice varies all over the country. In Port Elizabeth, owners of blocks of flats are required to provide a meter room in which is contained a domestic service meter for each flat; in other words, each flat dweller is treated as a separate consumer and is supplied in terms of the Council's domestic tariff. A connection fee of £26, the same as for a normal residential property is charged for the first flat, and a connection fee of £5 is charged per flat for the first flat, and a connection fee of £5 is charged per flat for the remainder.

It was suggested recently that a bulk supply be given to the owner of each block of flats, the advantages claimed being:—

(1) Fewer meter readings, fuse calls, disconnections, irrecoverable debts and accounts to be maintained.

(2) Less correspondence and queries.

(3) Prompt payment of accounts by flat owners.

(There being provision in the Tariff for 5% discount if accounts are paid within fourteen days of rendition.)

(4) Less billing and machine work.

(5) Less work for the Deposit Sub-section.

On the other hand, there were several disadvantages such as:—

(1) Reluctance of owners to provide sub-metering, and therefore inability to control the use of electricity.

(2) Objection on the part of tenants to being sub-metered by the owner of the building.

These disadvantages were considered sufficient justification for retaining the present system of individual consumers. As a point of interest, consideration was also given recently to installing prepayment or slot meters for each flat-dweller, the advantages claimed being:—

(1) No accounts to be rendered.

(2) No disconnections.

(3) No bad debts.

(4) No machine accounts.

(5) No special readings.

(6) Less correspondence and queries.

The disadvantages of this form of metering are, however, as follows:—

(1) Pilfering, particularly in the case of metered flats.

(2) Deposits against pilfering.

(3) Slot meters would have to be installed in the flats and not in the central meter rooms as at present.

(4) More work would be involved for the meter reader controller as he would have to visit each flat.

(5) As many flat-dwellers are in business all day, arrangements would have to be made to collect when convenient to the consumer.

(6) A decision would have to be made whether the Council would take responsibility for the installation and maintenance of the rising main wiring, or hold the owner responsible.

In the case of office blocks, the owner can take a bulk supply and sub-meter his tenants if he so desires. Alternatively, provision can be made by the Department to meter each floor separately. Where shops occupy the ground floor these are supplied through individual meters.

Where a bulk supply is taken at high tension, a connection fee of £26 is charged up to 25 KVA and £45 is charged above 25 KVA.

Mr. F. STEVENS (Ladysmith): Mr. Quizmaster, I intend to be brief.

In answer to question No. 10, at Ladysmith we do have a central point in blocks of flats, all meters. We do not supply blocks of flats in bulk, any other consumers supplied in bulk are supplied on a maximum demand plus energy charge tariff.

As far as making profit out of re-sale of current is concerned, I cannot see how much can be done about it if it is done on the quiet.

In answer to question No. 13 for each connection there is a full connection fee charged, and in the case of high tension bulk consumers—they are charged a fixed fee of £15 covering the first 15 feet of cable involved, and for all extension cables.

Mr. E. DALTON (South West Africa): I don't represent an undertaking Mr. Quizmaster, so I cannot answer the questions, but would rather pose a question. If a large block of flats supplied with bulk supply, and the owner is permitted to sub-meter, would he not then, in fact, be a supplier of electricity? There may be difficulty in terms of the Factories, Machinery and Building Work Act or Ordinance in the case of South West Africa.

Mr. R. W. KANE (Johannesburg): I think, to answer Mr. Dalton, that a govern-

ment or provincial building would claim to be a separate Supply Authority!

Coming back to the other questions, in Johannesburg. Question 10, we do give a bulk supply to any building, whether it is entirely flats, or a mixture of flats and offices. Question 11—we charge the normal room tariff, or, where mixed, a demand tariff. Then we come to the question of profit. Some years ago we had a by-law, which more or less stated that nobody should re-sell at a profit. The legal people seemed to think that once you had sold the electricity you had no right to control what happened to it subsequently.

There have been one or two incidents in Johannesburg recently, only a few, but, like everything else, they seemed to assume major proportions, and a recent alteration to the tariff has merely laid down that where anybody is metering or re-metering they can only charge the applicable municipal tariff. It still means that they would show what one would call a slight profit in some cases.

Question 13 falls away as far as Johannesburg is concerned.

When we come to high voltage supply, once again it is a question of average. The high voltage cable to a building, under certain circumstances may only be measured from the nearest street corner and they pay for that. The switch itself is supplied by us, the installation of a transformer, and all the cabling up to the low voltage switch is done by us—at their expense.

QUIZMASTER: Thank you, Mr. Kane.

I did want to take Mr. Kane up on a paradox which he mentioned this afternoon, and that was that they charged their Native areas at cost, and within the Native areas they were allowed to charge the normal tariffs and thereby made a profit—and yet he is increasing his tariffs very shortly. I couldn't quite make that one out!

Mr. R. W. KANE: Do you want an explanation, Mr. Quizmaster?

QUIZMASTER: No, thank you. Kane is Able!

Mr. J. DOWNEY (Springs): In regard to these questions, Mr. Quizmaster, I find that the system adopted in Springs is very similar to that of many other Reef towns.

The cost of the service connection, including the meters is paid for by the consumer, plus 10%, actual cost, all consumers are metered individually if they so desire. We adopt the policy that the consumer is always right, and if he wishes to be metered individually and is prepared to pay for it, he can be metered individually. In one case a bulk supply is given to a block of rooms where the owner wishes that he become the bulk supplier. He pays the total cost of the installation, he also pays the total consumption deposit; each one is added up as individual consumer, but the owner is responsible for the total payment to the council.

In many cases of blocks of flats, and it is desirable (we have laid it down as a policy wherever possible) to use the consumer's sub-station as a mutual service sub-station. Where the council, to its own advantage, can supply other LT consumers from the same sub-station. This has worked out exceedingly well, as it eliminates the problem of finding a sub-station site. By interconnecting the various sub-stations, both through the high-tension ring, and through LT, we find ourselves with a fairly flexible means of distributing the LT supplies.

In regard to meters in a block of flats, we consider that it is unnecessary and undesirable that every meter should be placed in one room of a block of flats of 10 or 20 storeys, to put all the meters in the basement would be asking quite a lot. What we allow is a rising main and a cupboard on the landing of each floor, and each flat is metered in that cupboard. It saves the meter reader running round, he has easy access, he does not have to worry about whether the consumer is home or out, and so it is a simple means of taking a meter reading, and provides a very efficient means for the department to control the supply.

In every case, as I said previously, if additional meters are required for offices, or for any other purpose, that meter is supplied by the department at cost—installation cost—and therefore it eliminates the requirement

of the owner having to employ a contractor to put an additional meter in. We do not permit sub-metering. If you want to sub-meter we put it in for you, and you pay for it. And that eliminates all those problems.

In regard to bulk supply, if a consumer wants a bulk supply on his own, which can be of no mutual benefit to the council, he will pay for the total cost of the installation. If he requires a transformer we will hire it to him, and he will pay the rental for it, but he pays the total cost.

Mr. R. M. O. SIMPSON (Durban): There is just one little point I would like to make: I may have conveyed in my remarks earlier that we allowed meters in every individual flat.

Whilst we individually meter each flat, we do centralise meter position in blocks of flats, either in one common meter room, on the ground floor, or, in very large blocks, in meter rooms on each alternate floor.

Mr. C. LOMBARD (Germiston): Mr. Quizmaster, I feel that the charge for a service connection should be based on the cost of the service connection from the boundary to the consumer's meter board, otherwise it would mean that the man who has to take a very long service connection from the line across the street would be penalised.

To this cost based on the length of service connections from the boundary to his consumer's meter, should be added a charge based on the average length of service connections from the consumer's boundary to the mains.

Thank you Mr. Quizmaster.

Mr. A. R. SIBSON (Bulawayo): Mr. Quizmaster, the question really divides itself into two, I think. The question of a connection fee for the service connection as such, by which I mean the last lap of the supply mains, and the rest of the system that may be required to feed the particular consumer.

Now in the built up areas, it is only the former part that really is peculiar to the particular consumer, and in Bulawayo we have a nominal fixed fee of £5 per consumer. It bears no relation to the cost. It is not intended to. It is merely a nominal figure largely to get a little extra revenue, and it roughly amounts to about a fifth or a sixth of the actual cost of connection. It is purely a matter of policy as to whether you make a connection fee at all. It is merely another way of getting revenue. If you don't get it that way, you get it through the tariffs.

Where you have individual consumers who, by virtue of their geographical position impose an abnormal cost on the supply authority, particularly in rural areas, it then becomes justifiable to recoup the authority's cost in some way or other.

I have, on several occasions in the past, indicated to this Association the method we employ in Bulawayo, which is to relate the connection fee to the area of the property being served, on the principle that it is the area of the property and not the distance run by a particular distribution main which imposes the cost on the supply authority, because the area of one property makes it necessary to go all the further to a neighbouring property. It may be that the supply mains to the first property owner are merely 100 yards long, but by virtue of his possession of 10, 15 or 20 or 30, acres he makes it necessary to go perhaps a quarter of a mile to his neighbour. Now the additional cost has been imposed by the man who owns a large piece of land. Therefore, we adopt a formula which I have given before, but I will give again, which is $C = bM + d$ into the Root of A, where C is the connection fee in £'s; b is a constant; M is the distance from the centre of gravity of the load; d is another constant; and A under the Root sign is the Area in acres of property — and I leave it to you to work it out.

QUIZMASTER: I am going to close the discussion on that now. I think the poser of that question has had various answers from which he can make his choice.

I am now going on to Question 15, because, although this question was dealt with last Convention, it was only dealt with in a very superficial way, and it has been asked again and that is:

"What are the main factors which influence the supply engineer in his choice between copper or aluminium for his overhead conductors in any electrical reticulation scheme?"

Mr. C. LOMBARD (Germiston): Mr. Quizmaster, I am going to be very brief. The factors influencing the choice of copper over aluminium for conductors are technical considerations, economic considerations and price stability considerations. The latter are quite important, because, as we know, schemes are more often than not planned months in advance of the time that they will be carried out, and price fluctuations in basic metal prices rather inconvenience supply undertakings.

Mr. A. A. MIDDELCOTE (Bureau of Standards): Mr. Quizmaster, I believe in most countries it is just an economic question, except in the Federation where I believe they once constructed a line of copper, despite the fact that it was cheaper to make it from aluminium; but they considered it was cheaper to make it from copper because copper bought in the Federation was cheaper than copper bought anywhere else.

QUIZMASTER: I may as well tell you the answer to that one. The whole point is that the line is only temporary, the copper will be regained, refined and then sold.

Mr. C. R. HALLÉ (Pietermaritzburg): One of the main reasons that decided us was of course that people don't steal aluminium; but strictly speaking we went into this very early, because of course we couldn't get copper. You people were closer to the controllers, and I suppose you managed to get the copper. Then the other very big point was that we have an aluminium factory in Pietermaritzburg, and we boast a double 88 KV line, and everything, bus bars, the lot are aluminium, as we have an aluminium factory in Pietermaritzburg — we hope you will all follow suit and use aluminium.

Mr. R. M. O. SIMPSON (Durban): I must just support the other speakers. It is, I suppose, to a large extent, an economic problem on normal low tension reticulation systems, but you cannot always deal with the question of price. It may be cheaper originally to put up aluminium, but you have to take into account the district in which it is constructed, and particular care has to be taken very often which, sometimes, reacts against the economic advantages.

With regard to higher voltage lines, transmission lines, of course, other problems come into the picture, and the economic problem may not be the only one that matters, dealing with the very long, and high voltage transmission lines.

QUIZMASTER: We have with us this evening somebody whom I think ought to sing for his supper, and that is Mr. Lane, who is one of the world authorities on transmission, and who was until recently Chief Transmission Engineer to the British Electricity Authority. I wonder if Mr. Lane would like to contribute to this?

Mr. F. J. LANE (London): This is perhaps more of a distribution problem than a transmission problem, but I am well aware that this problem has been very extensively examined in Britain; there have been, at times, economic advantages in favour of aluminium, but that situation does not exist today. I think the general practice is to use copper conductors, the techniques in respect of which are well understood for copper, whereas certain new techniques have to be introduced for the use of aluminium. You are often faced with the bi-metal problem, where the aluminium terminates and there is a change to a copper conductor, so that there are a number of technical problems, as well as the economic problem. I think the general preference, as far as British practice is concerned, is to stick to copper unless there is a very significant change in the prices of the two metals.

QUIZMASTER: Thank you, Mr. Lane. I thought you would have gone on to high voltage problems as well.

Any further contributions?

Before I go on to any further questions, are there any of the numbers which anybody would like specifically to have discussed, which we have not dealt with as yet?

Question No. 6:

"Lightning has been very active in the Free State during the past summer, and undertakings with an extensive overhead system have come in for more than their fair share of trouble, ranging from broken insulators and H.T. lines to smashed domestic services and damage to consumers' property. A feature is that certain places and premises seem to be picked out for repeated damage, while other sections of line and adjoining consumers are apparently immune.

(a) Is there any truth in the belief that lightning always strikes in the same vicinity?

(b) If there is, would it be possible to invite it to take a more innocuous path such as, for example, via a well earthed aerial pole?

(c) What is considered optimum spacing for arrestors on L.T. reticulation systems?

(d) Can anyone give details of the French "Deionising" idea for the protection of overhead lines, presumably earthed plates on the poles near the lines?"

Mr. L. L. LANGTON (B.I.C.C., Salisbury): On receiving this rather comprehensive question in Salisbury, we referred it to Mr. R. B. Anderson of the E.S.C. up there—many of you may remember he offered a paper to the S.A.I.E.E. on the subject some time ago, and was awarded a gold medal on it.

He has very kindly written up a reply, which I shall ask Mr. Molyneaux of the Rhodesian Railways to read out to you.

Mr. G. C. MOLYNEAUX (Rhodesia Railways): Mr. Quizmaster, Mr. Anderson deals with the question as follows:—

(a) The existence of well defined storm paths has been proved on several occasions, but generally speaking they would be related to peculiar topographical features and dependent also upon the type of climate prevailing. In the absence of such storm paths it is usual to assume, and there is statistical evidence to support this, that lightning strikes will be distributed at random over any given area. The actual point struck, however, will depend upon the relative heights of tall structures of trees, or in open ground it may be affected by localised areas of high conductivity in the soil. Generally speaking, overhead distribution lines in built up areas are well protected by the surrounding buildings and trees from the more severe discharges which are more likely to sideflash to nearby tall structures.

By far the most frequent lightning discharges, however, are those of low current up to say 10,000 amps peak. These strokes can proceed to ground within 40 feet or so of tall earthed structures, and could therefore terminate frequently on distribution lines in the vicinity. The amount of damage done would depend largely upon the type of construction used and the insulation level of the line; for example, lines with well earthed overhead earth wires would not be prone to damage as compared to open wire systems on steel poles, and also if the lines are erected on wood poles, the terminal points would be most affected.

(b) It is certainly possible to invite the more severe lightning discharges to take a more innocuous path via an earthed aerial pole which is high enough above the surrounds, but the radius of protection is dependent upon the lightning current in the stroke. To be effective however, these poles would have to be erected at too close an interval and this would be quite uneconomical excepting for special insulations which would merit such protection, such as an explosive magazine.

(c) Low tension lightning arresters would only be effective protection for equipment installed in very close proximity i.e. up to a few circuit feet away, and consequently it is better to locate lightning arresters on the terminals of the apparatus to be protected. It is fairly common practice, for instance, to mount arresters directly on Consumers' metering panels.

(d) French "deion'sing" idea for lightning protection has also been tried out in Canada and what would appear to be extravagant claims are made for its success. The device consists, so far as I am aware, of parallel plates one of which is earthed, fitted in tension insulator strings and apparently this

would introduce additional capacitance to earth on the Transmission System.

This would, of course, reduce the surge impedance of the transmission line and thereby the lightning currents to cause flash-over would have to be higher and are, of course, less frequent. However, in my opinion it would require a statistical comparison of the performances with a conventional transmission line to be carried out over some years before the effectiveness of the device would emerge. There would appear to be some doubt as to the "deionising" theory which purports to explain the phenomenon, but these days we are almost trained to believe that anything is possible!

Having said the foregoing, I am not sure if I have been helpful to the questioner, but in my opinion the amount of lightning protection which should be applied under any circumstance, is closely determined by the economics of the situation in which is included the value placed by a supply of authority upon the goodwill of his Consumers or his projected Consumers. It would appear that a very nearly complete answer to this problem lies in the application of auto-reclosing switchgear. The majority of faults which occur on any system are transient and do no permanent damage and consequently, if the circuit could be interrupted, especially on the affected phase only, and reclosed immediately the disturbance has passed, there virtually is no interruption to the supply in the majority of cases.

Thank you for the opportunity of making a few remarks in this interesting forum.

Mr. C. LOMBARD (Germiston): With regard to (a) — from my own observations, I would say that some areas in the same districts are more lightning-prone than others.

Referring to (b) I don't think it would help much as the area or zone that would be protected by such a pole, even though it might be of a considerable height, is fairly small. The protected zone would be that of a cone with the pole top as the apex and with the slanted side at an angle of between 15 and 22½ degrees from the perpendicular.

With regard to (c) in view of the fact, that most low tension lines are of limited length, lightning arresters at both ends should suffice. I think we should adopt the attitude that lightning protection is provided by the supply authority for its own equipment, and that consumers should install their own lightning arresters to protect their equipment. In fact, in new installations, in many towns, it is compulsory for consumers to provide suitable valve type lightning arrestors for their installations.

With regard to (d), I assume that this question refers to the Cougnard deionisers, invented by the late Jerome Cougnard as protection for overhead lines against lightning A paper describing an experimental installation of this type of lightning protection, and reporting amazing results on a 16 mile 33 KV solidly earth neutral overhead wood pole line, which had previously been a consistent poor performer was presented by H. N. Ecknal, Senior Engineer of the Research and Development Department of the Philadelphia Electrical Company, before the Transmission and Distribution Committee of the Pennsylvania Electric Association, and published in the American Journal "Electrical World" of 16 March 1957. An abstract of this paper, entitled "Mysterious Protection Against Lightning" appeared in the Electrical Times of April 4th, 1959. The Philadelphia Electrical Company's interest was first aroused by claims that lines and equipment in France, Africa and Canada were operating trouble-free at various voltages after the installation of some 10,000 of these deionisers.

It is still somewhat of a mystery how these Cougnard de-ionisers function. His theoretical explanation is difficult to comprehend in the light of conventional thinking, and still remains to be proved or dis-proved.

He theorised that lightning is created when sufficiently high voltage is induced in clouds by the galactic magnetic field cutting across them at 2,000 miles per second. The lightning stroke ionises the atmosphere and some of the ionised air is blown free of the stroke by the wind. These clouds of ironised air are called "vertical lightning," or, more com-

monly "ball lightning," and on coming into contact with the power line, the cloud of ionised gas attaches itself to the conductors and is propelled along them by the wind. He recognised that moving gas has inertia, therefore when the cloud of ionised gas travelling along the conductor comes to a sharp turn it tends to keep moving in a straight line. If for example this occurs at a dead end string of insulators, the ionised gas passing across them may cause power flash-over, and subsequent line tripping. He reasoned firstly that the cloud of ionised gas might be prevented from passing over the insulator string by the use of a barrier placed in its path, or secondly, it might be guided around a bend in the line by use of round-out jumpers. Both these methods are employed on the Philadelphia Electric's experimental line.

I think that the previous speaker gave us a description of these ionisers Mr. Quizmaster, but a few features of these deionisers have impressed me.

One is that they are very simple and inexpensive to make. As a matter of fact it is more of a plumber's job than anything else. In using them there would be quite a considerable saving in cost. Another feature is that no special attempts have to be made to obtain low earth resistances.

Thank you.

QUIZMASTER: Thank you, Mr. Lombard, for your very considerable research into this matter for us.

Time is pressing on, so I am going now to Question 29.

"The Question has been raised as to whether or not Municipal Electricity Undertakings should employ pupil engineers. One particular undertaking does not do so, as experience in the past has shown that at the end of the two-year pupilage it was not able to provide permanent posts for all such pupil engineers. The opinion of other Undertakings in regard to pupil engineers will be interesting, particularly in regard to whether the training received in a municipal undertaking would be beneficial to the pupil, whether some guarantee of future employment should be given, or whether the cost involved in the training of the engineers would be worthwhile for the future of municipal undertakings in general."

I think it might be taken in two parts. Whether the questioner means that a pupil engineer is a graduate engineer and having a two year college apprenticeship with the municipal undertaking after graduation . . . that is the only thing I can think it means, because it talks about two year pupilage; but I think we might extend the question to ordinary pupil engineers who train throughout and take their examinations while engaged as pupil engineers.

Mr. A. R. SIBSON (Bulawayo): Mr. Quizmaster, I had not really intended to speak on this, because I haven't a great deal to say, but I think somebody ought to start the ball rolling. The question obviously does refer to graduates, and I am rather intrigued to know where the questioner gets graduates from that he is unable subsequently to employ. We have had the greatest difficulty in recruiting graduate pupil engineers, and and as a rule it is not a question of wondering what to do with them after they have been with you some time, but wondering how to keep them!

Certainly as far as we are concerned, if we could get graduate engineers we would be only too glad to employ them and only too happy to continue their employment if they proved satisfactory.

The other class of pupil is a rather different problem, and, of course, the situation varies between the Union and the Federation. In the Federation we require a graduate engineer to be ultimately a chartered engineer, in the sense that he is a member of one of the London Institutions, and the requirements, particularly of the Electrical Institution, are such that it is very difficult indeed for men to qualify in the Federation, and this makes the employment of student electrical engineers very difficult indeed.

But certain steps are being taken, of which you, Mr. Quizmaster, will be well aware, to incorporate in the local training, a period of training overseas, and enable certain sections of their examinations to be carried out there, where better facilities exist.

In the Union I think the emphasis is not so much upon a chartered status, in the sense of membership of British Institutions, but rather upon university education alone, and to some extent, perhaps, membership of your own South African Institution. Insofar as the latter is concerned, I think the position is a little easier than it is in the Federation, so presumably there is no great difficulty in the training of pupil engineers in either category in this country.

However, I think it is important to say that only in the larger undertakings will the proper facilities exist for either type of training, and we should be very wary about attempting to produce engineers from a background which is inadequate as regards the technical equipment, and the quality of the staff with whom the engineer will be likely to mix.

Mr. A. A. MIDDELCOTE (Bureau of Standards): Mr. Quizmaster, just restricting this question to the training of graduates: I think we all should aim at a higher standard of graduate. The university training should be based on producing an engineer who is capable of thinking, and subsequent training to build him up to an engineer of great stature should encourage this art of thinking.

From what I hear of the various engineers in municipalities, I think that they would soon be taught not to think if they went there straight after university!

But seriously, I think that no municipality has a moral right to undertake training of pupil engineers in this country. Some of the bigger ones might do it, but probably one might, if one is to insist on training them in this country and not sending them overseas, for pupilage, take a leaf out of another small country situated to the north of England. This country was rather worried about losing all its engineers to a far more industrious, shall we say, neighbour in England, and it undertook a system of training whereby the power companies, various switchgear manufacturers, and certain machine manufacturers came together and offered a comprehensive pupilage whereby the schemed out the pupils' training and they went first to an undertaking, then to a switchgear factory, then to a, shall we say, cable factory, and finally probably ended up at the municipality which, during the training period, kept its eye on this man.

I belief this is the practice which they are trying to encourage in Scotland, to stop the English pinching their good engineers.

QUIZMASTER: Any further comment on this one? I can perhaps give you the scheme which is in use in Salisbury, but it is not for graduate engineers of course, because we haven't a university, and like Mr. Sibson we find it difficult to get graduates, and we have to use other methods.

The scheme in Salisbury is confined to persons of adequate educational standards to secure exemption from the Common Prelim. Examination of the Institution of Electrical Engineers to enable them to study Part I, and such pupils are indentured for a minimum period of 5 years.

Training facilities furnished by large municipal electricity undertakings, coupled with the theoretical study available locally are adequate, eventually, to secure professional qualification, where the end product is obviously limited in scope and experience. So in Salisbury provision has been made for selected pupils, after passing Part I of their examinations to be paid to go overseas to the United Kingdom, to complete their training under a sandwich course scheme.

There alternate periods are spent at the works of large electrical manufacturers, and under full-time courses of study. Undoubtedly engineers qualified in this manner will normally be more valuable to an undertaking.

We feel that with the growth of the electricity supply industry these pupils can be re-absorbed when they come back — in fact we actually tie them to come back to us for at least a year, so that they are not attracted away, as a lot of them are.

Actually the point in the question is the fact that we might lose them. When all is said and done, we have a duty in this matter. If everybody in the larger municipalities adopts a scheme of this nature, it seems to me that we are carrying out our duty in providing more engineers, which is what it is our job to do.

It is now after 10 o'clock, and it is up to you whether you want to carry on. I am quite willing to carry on. The President says it is up to the meeting.

(IT WAS DECIDED TO CARRY ON UNTIL 10.15 p.m.)

Has anybody any special question which he would like to hear?

"In any electricity undertaking many important senior official started their careers as artisans with the undertaking. The method of selection of artisans for promotion to a chargehand's rank therefore, has a pronounced influence on the quality of the applicants who will, at a later stage, be available for promotion to more senior positions.

(a) Is it possible and desirable in Municipal service that staff regulations should permit the appointment of the most suitable applicant to a chargehand's position, or must the vacancy be filled by the almost random selection of the individual who can claim to be the senior suitable applicant?

(b) If the most suitable applicant is to be appointed can the Forum suggest an equitable system for the unbiased assessment of the merit of individual artisans who apply for chargehands positions?

Mr. K. ADAMS (Johannesburg): Mr. Quizmaster, I have worked out an answer to this question.

While one might like to believe that ability should always be the first consideration in filling a promotion post, one must also take into account the effects of a promotion on the remainder of the group who were not as fortunate. If these persons become significantly dissatisfied or start looking for and finding other employers, then the performance of the group as a whole is likely to be impaired, notwithstanding the possible excellent qualities of the promoted person. A promotion must therefore be arranged in accordance with what may be termed the "stability" of the group. If the stability is poor, then seniority should be the basis on which promotion is made, since this will have the least disturbing effect on the group. When stability is good, then ability can be the predominant factor.

I have spent the past year in an investigation of the stability and performance of groups in terms of the financial prospects offered to employers. A very clear theory has emerged and from this I will provide this answer.

The stability of an artisan-chargehand group will depend largely on the size of the group and the ratio between the remuneration of the chargehand to that of the artisan. The following statements are based on obscure but sound logic.

Consider a group of artisans headed by a chargehand. If the sixth root of the number of persons in the group is greater than the ratio between the chargehand and artisan incomes, then the stability will be poor, and seniority should be the deciding factor in a promotion.

On the other hand, if the income ratio exceeds the cube root of the number of persons in the group, then the stability will be good and ability can be the deciding factor. For the intermediate cases, the relative influences of seniority and ability must be proportioned.

Under present circumstances, in most cases it will be found that seniority should be the deciding factor, and this is one reason for the relatively poor performance of these groups. I hope that what I have termed the "salary gradient" will be steepened in the near future, thereby contributing to improved group stability and performance, and allowing ability to play an increased role in the useful activities.

The merit assessment referred to in Part (b) of the question, is a method whereby, in theory, at any rate, some measure of ability can be taken into account in a promotion without upsetting an inherently unstable group. I dislike this idea completely. Merit assessments can only really measure wide variations in ability in but a few facets of a man's work, and the accuracy achieved will never measure up to the opinions of a good supervisor who knows his men. If the supervisor is insufficient, then merit assessment will not help the situation in any case.

Remember that the person who decides the promotion is the person in charge of the organisation. If the right to promote is delegated to a merit assessment, then "Big Brother" will take over. Eventually, a Town Psychologist will have to take his place and will be superior to the engineer.

If the salary gradient is steepened, however, this apparent need will fall away.

QUIZMASTER: Thank you Mr. Adams. You have obviously made a very great study of this, and it will be interesting to read his contribution more carefully when we get it in the proceedings.

Are there any more contributions to this question?

Well, gentlemen, as it is almost a quarter past ten, I think we will close down for tonight on the Forum. I would like to thank all the contributors for contributing to our Forum this evening. I think the President will tell you that if there is further time before the Convention closes, we will possibly make an effort to finish the rest of the questions, but I do think that contributors this evening have worked very well in getting through such a large number of questions from a very comprehensive selection.

Thank you.

THE PRESIDENT: Thank you, Jimmy Mitchell.

Ladies and gentlemen, we once again have had the pleasure of observing our Quizmaster operating, and I think you will agree with me, that his ability constitutes a major success in this item on the Agenda. In this particular case, of course, he has been helped considerably by a renowned (reputedly) Transport Manager.

We thank you, Jimmy, very much for a very pleasant evening.

CONVENTION ADJOURNED at 10:15 p.m.

THIRD DAY

On Resuming at 9.30 a.m.:

THE PRESIDENT: Good morning, gentlemen.

(Convention announcements followed).

(The President sent regards to Mrs. Jones, Mafeking, who had stumbled and injured her leg).

Yesterday morning I greeted the new members, and I also mentioned Mr. Gouws of the Provincial Administration, and I think it would be fitting to have special greetings to a number of guests who are here for the first time. I refer to Mr. T. S. Bell of Federal Ministry of Power. Mr. Bolek, P.W.D. Swaziland, Mr. Lane of London, and Mr. Smuts of the Department of Bantu Administration of the Union Government.

We will either fill in this morning with reports of representatives, or, alternatively, put the reports on this afternoon, but there has been a model specification for the supply and delivery of underground power cables, prepared by a sub-committee which has been working on it for some time, and that will be sent to all members. It does not necessarily mean that you have to comply with it, but all the little points are there which we think you should consider in issuing specifications.

Concerning your sub-committee representative, and the various representations on other bodies; the complete group of last year's representatives have been re-elected; there has been no change with the exception of the Safety Precautions Committee, which is now defunct. No appointment has been made to the Wiring Regulations Committee for the time being. In addition, Mr. Muller, Bloemfontein, has been appointed a one-man committee to deal with the Rural Supplies.

Now I think we will continue with the discussions on Mr. Masson's paper.

Mr. P. A. GILES (East London): Mr. President, I wish to congratulate the author on his timely and valuable paper on this most important and pressing subject of

electricity supply to Native Townships. With the growth of the Bantu population and the need for housing of these people, the problem of providing essential municipal services to the houses is one that requires study from many angles, particularly from the financial aspect and the ability of the Native to pay for a proportion of such services as are provided.

East London has two Native townships in being, and one in the process of planning, and the necessity of providing the most economical electricity supply system for the new area is apparent to all engaged in this planning work.

A pilot survey of the living conditions of 312 families was conducted in the old established Native township of Duncan Village two years ago and revealed a fair indication of the low purchasing power of the Native in the East London area. The survey showed that less than half of the 312 families are self-supporting. The greater percentage lived below the poverty line, and about 15% had no regular income at all.

This information was available when an extension of 970 houses, and 22 business sites was commenced on an extension site adjacent to the old village. On the basis of this survey, only 350 to 400 families of the possible 970 can be considered as consumers of electricity, and their ability to pay their electricity accounts has to be assessed.

The new extension is being administered as a selling and letting scheme. The houses are priced at £250 and consist of 3 rooms and a kitchen. Each dwelling is set back 15 feet from the roadway on a plot 40 feet wide by 80 feet deep. The height to the apex of the asbestos roof is 11 feet and to the eaves 8 ft. 3 in. and services for electricity supply will of necessity require to be by the overhead cable loop system, standard overhead services being out of the question owing to the low height of the houses.

The purchasing terms for the houses are £12/10/- deposit, with repayment of the balance over thirty years, and amounts involved are £1/7/6d. per month for ground rental as the land is never sold, and this figure includes water, sewerage and roads, plus £1/6/9d. per month instalment on the purchase price of the house.

The total monthly cost is therefore £2/14/3d. for thirty years when the instalment of £1/6/9d. falls away. The electricity bill for four 60 watt lamps is expected to be 16/3 per month and in some quarters it is contended that this figure may be too high at the moment but will look more reasonable when economic conditions improve.

The electricity distribution scheme to the extension consists of two sub-stations on a length of underground electricity cable (which is favoured in East London on account of the high winds), plus 2g0 simple type street lamps about 150 feet apart. The occupiers of the business sites, the butchers, milk depots, fish fryers, and so on will pay normal standard tariffs as applied to trading concerns.

Referring to the paper, I would say that comparatively little damage is done to street lights and overhead wires in the village as a certain amount of control over Native youths is exercised by the elderly Natives who have elected a committee who meet the Council's Chairman of Native Affairs Committee and the municipal Bantu Administration Department monthly, and such matters are reported and acted upon.

In conclusion Mr. Chairman, I wish to thank Mr. Masson for some very fine hints on distribution given us in his paper.

Mr. D. LEES (Benoni): Mr. President, gentlemen: Mr. Masson is to be congratulated on the presentation of a paper on a most interesting subject, "The Electrification of Bantu Townships" and as requested in his introduction, I feel that it may be of interest to present a few facts and figures relating to Daveyton Bantu Township, Benoni, which I suspect falls within the Author's category of luxury townships.

Daveyton today is a township of some 8,600 sites, comprising at present 8,184 council houses, 32 privately owned houses, 26 churches, 31 business premises and a Municipal Brewery of 1,600 installed H.P. of electrical plant, together with a Civic Centre comprising Administration Offices, Police Station and Barracks, Clinic, Post

Office, two Banks, Beer Hall and a Social Centre which is under construction.

The decision as to the type of reticulation to be adopted was based on experience gained at the older Benoni Bantu Townships, which provide an underground E.H.T. system, overhead LT. Mains and looped service connections serving approximately 2,000 houses, all of which are wired.

The maintenance costs of this township, due to vandalism, lightning and other faults, directly attributable to the overhead lines, total £1,760 each year. The maintenance costs of the older townships, together with the higher factor of safety offered by underground cabling, led to the adoption of a completely underground cable installation.

For purpose of comparison, at this stage it may be stated that the sum total of cable faults suffered in Daveyton to date (since the switching on of the first area on October the 18th, 1956), consists of three damaged 5 core .0225 P.V.C. cables, one of which was attributed to a gramophone needle having been driven into the cable and two to the picking of the cables by enthusiastic gardeners. The cost of repairings these faults amounted to a total of £15/0/0. During the same period, vandalism was limited to the damaging of 20 street lighting relays at a cost of approximately £120/0/0 all of which were damaged on the same night.

L.T. Reticulation.

The low tension reticulation comprises O.C.B. protected underground cables feeding cast iron distribution pillar boxes, which in turn supply the P.V.C. service cables. The service cables are installed on the loop system as described by the Author. The service cables are of the 5 core type, comprising .0225 x 4 core and one 7/.036 earth wire. The neutral is earthed at each substation and in each pillar box.

Although the low tension reticulation is arranged to feed on a radial basis, 90% of the pillar boxes are inter-connected.

Street Lighting.

Daveyton street lighting installation is of particular interest and complies with the ruling determination of a minimum pole spacing of 400 ft. Incandescent lighting was therefore ruled out, and a 5 ft. 80 W. double tube anodised aluminium bodies fluorescent fitting was chosen, which when mounted at a height of 27 ft. on concrete poles gives an output of 0.02 ft. candles at the centre of the 400 ft. span.

630 Street lighting units are in service, providing lighting in all major and in all side streets. 37 double fitting units being provided in Eiselen Street which is a double carriageway.

For street lighting control, an audio-frequency remote control system was adopted. The adoption of remote control equipment eliminates the orthodox pole to pole cabling and all that was required was to install a short length of 7/.036 cable between the nearest consumer's meter box and the street light pole base.

The audio-frequency relays were housed in the base of each pole and actuated by the transmitting unit installed in the main substation.

Apart from the fact that an estimated £60,000 worth of cable was saved, the flexibility of the installation (which provide 22 double "on and off" channels enables considerable savings to be made regarding consumption. Experience has shown the average Bantu tends to retire to bed comparatively early, with the result that street lighting, other than for main thoroughfare and certain selected points, could be switched off after 10 p.m.

To illustrate this point, the average monthly consumption for street lighting is 24,000 units on the basis of 220 burning all night and the remaining 410 for three hours each night. This arrangement has been found quite satisfactory, and in addition, the channels have been arranged so as to provide selective control of lighting in each ethnic group, which is extremely useful in times of emergency. Of the 22 channels available, 8 are at present in use, whilst the remainder are available for future load control, two rate metering and numerous other purposes, as required.

This arrangement effects a saving of £2,000 per annum on the consumption of electricity.

At one stage, 20 control relays were damaged by vandals, who removed the pole cover plates and destroyed the relays. This difficulty was overcome by installing the relays inside the house from which the street lights were supplied.

The fluorescent fittings installed are fitted with a perspex cover for protection of the tubes, and the control gear, due to the underground reticulation system is virtually unaffected by lightning.

The tubes used have an estimated life of 5,000 hours, and it is estimated that a complete relamping will be necessary at 18 monthly intervals. This period may be extended to 24 months in the case of lamps burning nightly. Experience has shown that these figures are on the conservative side, since the number of lamps replaced to date amount to 75 out of a total of 1,260.

House Wiring.

Of the 8,184 council houses at Daveyton, 6,549 are of the three-roomed type (two bedrooms, living room, kitchen and bathroom) and 1,625 are of the two-roomed type (bedroom, living room, kitchen and bathroom).

In the former type, five lighting points and one plug point in the kitchen are provided, with similar facilities in the smaller houses. The lighting points are installed in the centre of each room, as experience in the older townships, demonstrated that side brackets, or the provision of one lighting point between two rooms, led to the installation by residents of numerous illegal extensions.

Each house is metered and protected by a miniature circuit breaker. Particular attention has been given to earthing. Earthing the neutral as previously described at each pillar box, the provision of an earth wire in the service cable, and also the earthing of the cable armouring to the meter box, which in turn is bonded to the housing conduit, provides in all three independent earthing conductors to each house.

It is of particular interest to note that to date only one child has suffered a minor electric shock due to an unearthed appliance, in spite of the fact that the majority of Daveyton residents had had no previous experience of electricity. This is considered to be to some extent, due to safety propaganda disseminated by means of schools and Council publications.

Staff.

The electrical staff allocated to Daveyton consists of an Electrical Engineer, Wiring Inspector, one electrician and two learner Native wiremen, employed under the provisions of the Native Building Workers Act, 1951, and the Electrical Wiremen's and Contractor's Act 1939 (both as amended). The staff carry out all maintenance of mains and services, housing, street lighting, brewery and public buildings and have in the past two years, carried out the electrical installations of the Brewery, Clinic, Post Office, Police Station and Barracks, together with the wiring of 400 houses.

It will be obvious that the time devoted to the actual maintenance of the reticulation is of a minimum nature, in fact the only maintenance found necessary, to date, is of a purely preventive type.

Economics.

Naturally, it is the wish of every Electrical Engineer to install an electricity scheme which will ensure, that future maintenance costs are within reason, that foreseeable future loading requirements are met and that the safety of the public is safeguarded as far as is practicable.

I venture to suggest that each of these requirements has been met insofar as Daveyton is concerned. There is no doubt that the Bantu, both culturally and economically, is on the upgrade and that his demands for electricity in the home will increase tremendously within the next decade. With this object in view, Daveyton is designed 1 KW per stand.

The comparison between the domestic loading at the Eastern Native Townships, Johannesburg; Wattville, Benoni; and Daveyton, Benoni; is interesting, considering that the majority of Daveyton residents are of the comparatively non-urbanised type.

	Eastern Native Townships	Wattville	Daveyton
February, 1958	54	—	16
March, 1958	51	—	19
April, 1958	44	33	20
May, 1958	56	44	23
June, 1958	50	48	26
July, 1958	80	53	29
August, 1958	73	49	28
September, 1958	48	49	23
October, 1958	43	47	23
November, 1958	52	43	23
December, 1958	43	46	24
January, 1959	41	—	19
	635	412	273

This comparison indicates that one must not expect the loading in a new township to build up overnight and that consideration must be given to the type of Bantu inhabiting the area.

The domestic tariff promulgated for Daveyton provides for a basic of 5/– for 20 units, thereafter 1d. per unit. On this basis it will be seen that the average monthly consumption during the period mentioned varied between the basic of 5/– to a maximum of 5/9d.

On the reticulation side the sum of £16,123 was paid out of the Services Levy to meet the partial cost of bringing the H.T. supply to the Daveyton boundary. The whole cost was not borne by the Services Levy as European townships were fed en route by the Daveyton supply cable.

Approval was received for the spending of £75,341 from Services Levy Fund, on the initial site and service portion of Daveyton. The remainder of the internal reticulation of the township was financed by means of external loans repayable over a period of tweny years.

The breakdown of costs on the basis of residential sites is now presented. It will be appreciated that this breakdown of costs provides for supplies to the Brewery, all Public Buildings in the Civic Centre, a supply to a 5,000 Native Hostel Building Scheme, a supply point for a 756 H.P. sewerage works nearing completion, a hospital and for 20 light industrial consumers.

(a) H.T. Reticulation	£9	12	6
(b) L.T. Reticulation	16	17	0
(c) House Wiring	11	9	8
(d) House service connection	12	16	0
(e) Street lighting	4	13	3
(f) Meters and M.C.B's	4	10	4
(g) Sundries	1	2	8
The total cost per site being	£61	1	5

It is unfortunate that during the development of this scheme the price of copper was at its peak, the average price paid being £381 per ton, whilst the price assumed during the planning stage was £240 per ton. This factor alone resulted in an overall additional expenditure of approximately £60,000 or £7/6/8 per site.

Thus, under normal conditions, the price per stand would have been in the region of £53/14/9.

For the purpose of comparison the Author's "D" proposal will be taken to arrive at a cost comparison with Daveyton.

As will be seen from the aforesaid breakdown of costs, the reticulation cost per site, which comprises H.T. reticulation, L.T. reticulation and house service connection which appear to be the only costs considered by the Author, the actual cost for Daveyton is £39/5/6 per site.

If the copper cost is now adjusted from £381 to £220 (i.e. the ruling price today), the above reticulation is thereby reduced by £6 per stand, which brings reticulation cost down to £33/5/6 per site, which is comparable to the Author's "D" proposal.

Should a scheme similar to Wattville (as proposed in the Author's "D" proposal), have been adopted for Daveyton the annual cost of maintenance, caused by vandalism, lightning, motor traffic, based on the Actual Wattville costs, would be in the region of £5,500 per annum.

By the assimilation of the aforesaid savings in running costs that have been effected at Daveyton (which cost £530,000) it is considered reasonable to assume that the saving to be realised from the elimination of vandalism, lightning, motor traffic, pole painting, replacement of street light lamps, etc. not to mention the numerous desirable safety aspects, can be placed as high as £160,000 at the end of the 20 year loan period, which is equivalent to approximately £20 per stand.

I therefore conclude that Daveyton, far from being a luxury township, is the most economic type of reticulation that could be considered for Benoni and would go so far as to say that the same economic considerations probably apply to many other municipal electrical undertakings.

THE PRESIDENT: Thank you Mr. Lees.

Mr. D. D. BROWN (Roodepoort): Mr. President, this question of the establishment and development of new townships for the housing of Bantu people, has necessitated the construction of houses on an unprecedented scale. An integral part of this improvement of the living standards of the people is, or should be, the provision of an adequate supply of electricity for the household purposes at a reasonable cost.

This mass transition of a class of people who are, in the main, totally unused to the facility of electricity supply, and who are generally very, very close to poverty, presents a challenge to the initiative, imagination and ingenuity of the town or city electrical engineer, who is called upon to provide them with electrical services.

In fact in considering this subject in conjunction with the changing face of the post-war world, and the urgent need to stabilise the urban Bantu people, and also to improve their standard of living, I think it may be said that any engineer who meets this challenge adequately is performing not only a local task but a national one.

The most difficult aspect of this problem initially was the funding of the various works, and the situation was rather confused, but in our area at least, it appears to have sorted itself out with experience and in this area now the pattern is generally that the provision of a primary high-tension supply and of the so-called rudimentary street-lighting is funded out of the Native Services Levy. We have no difficulty in obtaining funds from that source for that purpose.

My Council, however, decided to illuminate all streets from the outset, not only the alternate streets, and also to reticulate all the stands. This additional street lighting, and the additional sub-stations, and mains for reticulation are funded by means of an external loan. The capital charges resulting from this additional street lighting form a charge against the Native revenue street lighting vote, and those resulting from reticulation it is proposed to recover from the charges applied to the consumers. These latter charges are not unduly high because the basic primary transmission system and the low-tension distribution poles are as stated funded largely from the services levy, or from the street lighting vote.

Mr. Masson has disappointed me somewhat in that his information and statistics stop short at the meter terminals; although

of course his paper is titled "The Supply to Native Townships," but I consider the internal wiring of the houses should be considered an integral part of the supply as the most well designed reticulation scheme will collapse if satisfactory arrangements are not made for the consumer to have his house wired. Could we not have some information from Mr. Masson relating to the methods of wiring adopted and the cost, and whether this cost is recovered in advance or by means of the unit charge, or a special fixed charge to the consumer?

In this regard I would say that it cannot be too strongly emphasised that if a house wiring scheme in any Bantu township is to be a success, then we must forget completely about our old standards of payment in advance. Here, I would like to say, I am in complete agreement with the view expressed yesterday by Mr. Carr about the need to keep in mind at all times the economic circumstances of the consumer. This is not a charitable gesture, but is quite a sound and firm business principle. In our area for instance we wire the house and provide the service connection without any cash payment by the consumer other than the deposit on the electricity account, which is a minimum of £1. As a result we find that we cannot keep pace with the demand and receive applications for the supply as fast as the houses are built and occupied, and, I may add, the incidence of bad debts is no higher on a percentage basis than in any European area.

The cost of the wiring and the service connection is recovered by means of a monthly fixed charge which is designed to cover the capital charges over a period of seven years plus a margin for maintenance. In Roodepoort we find that a monthly fixed charge of 7/6 per consumer, in addition to the unit charge, is quite adequate for this purpose.

The service connection, incidentally, is of the overhead type so much in disfavour with the Johannesburg municipality; in fact, I think some of us might have noticed that we have been held up as a horrible example in the photograph on Page 33. I have to admit that I recognise the house, and I recognise the reticulation system. I disclaim all knowledge of the character with the golf club. My chaps don't carry their golf clubs around with them, and neither do they wear their coats on the job!

With regard to service connections, I am quite adamant that this old method cannot be improved upon in Native townships where overhead street-lighting mains on suitable poles exist adjacent to the stands. It is patently the cheapest method in these circumstances, and the only disadvantage mentioned by Mr. Masson, viz. the possibility of an electrical accident during painting or working on the roof, after deterioration of the insulation, is largely obviated because the mains are brought in underneath the eaves and well clear of the roof. We use conduit for that purpose, and I would say that the PVC mains are as clear of the roof as the alternative PVC cables suggested by Mr. Masson.

With regard to the jungle-like propensities of small boys mentioned by Mr. Masson, in connection with low service mains, I would say that to my mind nothing is more calculated to attract aspirant dark-skinned tarzans than the PVC cables suspended between the eaves of the houses on a convenient supporting wire, as illustrated on page 35 of the paper.

With regard to tariffs, in Native townships generally, we must get away from the attitude that no surplus is permitted, because it is permitted, but cannot be used other than on the Native revenue vote. Apart from that the financial structure and setup of the Native revenue administration is identical for Europeans.

Although Native townships must be supplied in bulk, and at cost by councils, their consumers' tariffs must still be designed and applied by the council for the internal administrative purposes of the Native revenue vote, and unless engineers interest themselves in the tariff applied, although no surplus may be derived there from, we may find that the schemes founder on account

of the sheer inability of the consumers to comply with the financial demands made upon them through unreasonable tariffs.

A word about our own team and methods. From the outset we have used nothing but Native wiremen in the wiring of our houses. These Natives actually have no special qualifications, but were simply taken from the gang, and we trained them. Of course we did take advantage of the possibilities of mass production — the houses are all more or less identical, the conduit lengths are the same, the lengths of wire are the same, fittings are identical — and these Natives work in pairs, and each pair completes six houses per five day week. The wiring is all in conduit and the work is of a very, very high standard — equal, I would say to any European work that I have seen.

Once the houses are connected however, we do have the statutory difficulty of the approach of incompetent persons to live mains. We overcame this by employing a Native who has the wiremen's licence; he already had it in his possession when we employed him, and he does all the live maintenance work on the installations, reconnections, disconnections, and he generally supervises the work of the others.

We are catering for the future also by employing pupil Native wiremen whom we are training for this purpose of live maintenance work in the township.

In conclusion, Mr. President, my thanks again to Mr. Masson for his very stimulating and provocative paper, and my thanks to you for your forebearance.

THE PRESIDENT: Thank you Mr. Brown. We don't even play golf with our jackets on.

Mr. A. R. SIBSON (Bulawayo): I will be brief, Mr. President.

It is clear that this paper is arousing considerable discussion. I want to emphasise what has already been mentioned by several speakers — the need for keeping the costs of supply to African townships as low as possible, and in this respect I disagree with those who advocate underground mains, either for high tension or low tension supplies.

In Bulawayo, we have gone in for overhead reticulation, both for high and low tension mains, and the experience gained is no worse than in any European area, and I can see no particular reason why one should go to excessive steps in ensuring a higher degree of continuity to an African area than in an European one.

The system we adopt is to run 11 KV on wood poles, and in this respect I would add that our Director of African Administration, specifically asked me to use wood poles, because the only hazard he is aware of is the use of steel poles, together with a suitable piece of rock, for the purpose of transmitting messages from one part of a township to another.

The low tension reticulation is vertical construction, also on wood poles, with the usual split neutral that we have always employed in Bulawayo. Each service has a 50 amp Yorkshire cutout, and the houses are so arranged that they are in blocks of either two or four units, so there is only one service to each pair of dwelling units, or to each set of four dwelling units.

The overhead services are three core trefoil PVC leads which I showed to the Convention last year. Each dwelling unit has a miniature circuit breaker; some of the houses are metered, and in others we are experimenting with the load control type of metering. The internal wiring is done in conduit, and the approximate number of lighting and plug points in each is four to five lighting points and two plug points in each unit of dwelling.

Now I have detailed this with some care in order to tie it up with the costs that we have found on this sort of work. The cost of supply—i.e. high tension and low tension reticulation, with pole mounted transformers and including service connections, totals where there are two dwelling units per single block, £24.59 per dwelling unit, and where there are four dwelling units in each block, £21.48 per unit.

This includes for a meter. In those areas where current limiters are being used instead of meters, the two prices I have quoted go down to £21.17 and £18.06 per dwelling unit.

The scheme as a whole is designed on the basis of an after diversity demand of 1 KW per dwelling unit.

I was particularly interested, Mr. President, to hear of the experience in Pretoria in the use of current limiters. I have referred to our own intentions in this respect. I have yet to accumulate experience. For that reason I was very glad indeed to have Mr. Wilson give the figures that he did of their experience.

It is obvious that local habits and customs will vary the circumstances from place to place, but the load factors indicated by Mr. Wilson seem to suggest that the fear that the use of load limiters will encourage wastage is not sustained at all. In fact, if I read his figures correctly, it seems that the load factor is of the order of 32%, on the basis of the actual demand, and of something like 10% on the basis of the actual limiter setting.

I also noted from the Pretoria figures that, as far as I could see, the average revenue per unit sold was about 1.69d. which also indicates that the use of these current limiters does not result in flagrant wastage, and since a considerable saving can be effected by their use I myself am very much inclined to use them to an increasing extent.

Of course, they will not be so suitable where larger loads are required. I am referring to the type of house where an after diversity demand of 1 KW only has been provided for.

It would be interesting to hear if there are any other undertakings that have employed current limiters. I should be very glad to have any further information on this, as I am sure we would, all of us.

Thank you Mr. President.

THE PRESIDENT: Thank you Mr. Sibson.

Mr. F. STEVENS (Ladysmith): Mr. President, I would like to congratulate Mr. Masson on his paper. When listening to him presenting it, it occurred to me that if some of the more practical papers, such as the one we have just listened to, could be made available, at a small cost if necessary, for distributing amongst one's staff, they may be of considerable interest to foremen and men who take a keen interest in their work, and this would create a competitive spirit between various undertakings.

Most of the men I have in mind do not have an opportunity to inspect works of other supply authorities, consequently they cannot be expected to know the whys and wherefores connected with the practices of other undertakings.

The interest councillors have in such papers is mostly from the economic standpoint, while the engineer, though concerned with first costs, is to have new schemes economical, safe and trouble-free.

The commercial engineers learn from them the thoughts and tendencies of the consumer, or customer, which puts them in a better position to develop and stock the materials most sought-after.

While upstanding, I would like to refer to one or two points I have noted.

Mr. Masson referred to duplex and triplex service cables. We have used a fair quantity of both in our locations during the past five years, but are no longer doing so as we find it vulnerable to lightning, to breakdowns through moisture accumulating in the grooves between conductors if cracks exist, in the middle of sags or at make-offs. Finally because of flapping in windy weather.

The latter can be partly overcome by putting a number of twists in the dumbell type service cable; this, however, looks untidy. Instead we are going back to two black single core PVC service wires twisted together, as the insulation on a single wire seems superior and there will be no trough in which water can accumulate.

For the next part of our location to be electrified, I shall consider underground loop services which Mr. Masson favours.

Before concluding I would like to enquire from Mr. Masson how many lighting and

15 amp plug points were provided in each house, seeing the cost of installation in Johannesburg's locations was only £20.

In part of our location, comprising 1,000 houses, 200 have four lights, two plugs, and a meter board in each; installation, the wiring being ¾ screwed conduit, and the cost £27 10s. In an Indian housing scheme, comprising 50 houses, each has four lights, one plug wired in screwed tubing, as before, the cost being £15 8s. only. In this case the lights in adjacent rooms were placed back to back on walls instead of the centre of the room as an economic measure.

I might add, in connection with the services we do include a third wire for earthing purposes.

Thank you, Mr. President.

THE PRESIDENT: Thank you Mr. Stevens. If you are really serious about that suggestion of run-offs for staff, it would have to include the discussions too, gradually leading up to £1 1s. per copy which we are prepared to sell to you.

Frankly, if anybody desired to get additional copies, special copies run off for their staff, if you will let us know, then we will probably know what it is going to cost; in other words, we must know what quantity we have to prepare.

Mr. J. E. MITCHELL (Salisbury): Mr. President, when I was on the Papers Committee, we always found it very difficult to get men to write papers for our Conventions, but we appear now to have found a subject, and I want to congratulate Mr. Masson on getting in first. He only just made it.

THE PRESIDENT: I disagree, Mr. Mitchell. We have been trying to get certain facts out of Scotty Lees for years!

Mr. J. E. MITCHELL (Salisbury): What I was coming to was rather along the lines of what Mr. Stevens has just said, and I was going to suggest that I, for instance, could go up to the table there, and give you 20 years' experience from controlled lighting to uncontrolled lighting, to plugs, to limiters, and finally to meters in Salisbury, and it strikes me that there are quite a number in the same position. I am going to suggest that the Executive should give consideration to setting up a sub-committee on Electricity Supplies to Native Areas.

The idea I have in mind is that they would compile the statistics and ask the necessary questions of all undertakings which give electricity supplies to Native areas to contribute. There is no doubt about it in my mind that the sale of electricity to the African areas is going to be one of our major fields of sales, and it is also going to provide one of our major difficulties in regard to economics; not only from economics of supply, but the economy and economic status, as we have heard, of the Africans themselves.

This is something which is well worth a study, and it is obvious from what we have heard today, and possibly what is still to come, that everybody is going to give figures to this meeting, and it would be much better to compile those into a real statistical form than just have copies of the papers themselves. You get all the details then, instead of just two or three.

I would like to congratulate Mr. Masson again on his paper. I thoroughly enjoyed reading it, and I am very pleased that he has opened the subject.

There is just one item there I would like to comment on, that is distribution where he has a split neutral. I have had nearly 30 years' experience now of vertical low tension, and I have yet to find a phase wire fall without touching the bottom wire of the neutral. In fact we have tried it on many occasions to see whether it will work, and in every case it blows the fuse, so I don't really see why he should go to the added expense of a split neutral with guards across.

THE PRESIDENT: Thank you, Mr. Mitchell.

Mr. R. M. O. SIMPSON (Durban): Mr. President, Mr. Masson, gentlemen, I fully support Mr. Mitchell's proposals. As a matter of fact, I was on the point of making a similar proposal myself, because I cannot see a lot of benefit to anybody in read-

ing out figures to a meeting like this, there just isn't time, and if we could all get together and provide this information that could be published, I think it would be of great value to all of us.

My few remarks this morning are going to be somewhat different. I don't propose to make any comment on the methods of supply that we have in Durban, because, quite frankly, I am after information in this regard. Durban has several Native townships; we have just started on the construction of another fairly large one, of about 15,000 houses (something similar to the size of the Meadowlands one here), and any information we can get for comparison, and to try and learn ways and means of doing this job in the most efficient manner, we shall be very pleased to obtain.

I think from that point of view, if all these figures are published, and I have some which I can add but—which I won't read out this morning—I think it will be of more value to sit down quietly and study them.

However, there are one or two points I would like to make. The question of load limiters. Quite frankly, I am not very impressed with the idea of load limiters; maybe because we buy a supply from the Commission ourselves, and we don't generate, so we would have to be a little more careful—but just by way of an amusing approach to that particular problem, we did experience quite a heavy consumption of electricity in one of our Native compounds on one occasion and we found that, in this particular, where there was no metering of the individual person. They were allowed to use hot plates for cooking, and we found, to our amusement, in the winter, that these people used to put these hot plates under their beds, and leave them on all night, to keep themselves warm. That was accounting for quite a lot of unnecessary consumption of electricity.

There is one aspect that I have heard mentioned this morning—and I would like to hear some comment from Mr. Masson on this—and that is appliances that are used in these Bantu houses. We have one township that is completely reticulated in Durban, and have to carry out inspections very frequently there, just to get rid of the large number of very undesirable second-hand appliances which are used.

To me, the only way I can see of overcoming that is to encourage industry to manufacture suitable appliances, particularly in the form of a stove. They would, I think, at a very low figure, manufacture a very suitable plain stove that could be used, but before embarking on schemes like that, I feel sure they also want some security. I, personally, have suggested it on more than one occasion—that we should run, say financed out of Native revenue account, an assisted purchase scheme for Natives, so that they can buy these stoves.

With this as a background, with that adopted fairly fully, I think it could be turned into a very big industry, it would certainly give quite a fillip to the manufacture of these small appliances, and I am sure would improve the level of safety at present found in a lot of the average Native houses where these very dangerous second-hand stoves, connected up with bits of bare wire are used (they are quite frightening when you see them). How they don't electrocute themselves on some occasions I just don't know. It is sheer good luck, and nothing else.

From that particular point of view, I think that is something that could be followed, and I would like to hear some comment on it.

The other point I would like to make, is this question of bulk metering and the apparent tendency towards keeping the supply in the Bantu areas completely separate in Native townships. Now that might eventually react adversely to the cost of the supply in that township.

It could be, if the supply had to be metered on a two-part tariff, whether relatively low load factor of an area that you are trying to develop—you would start off with a very high unit rate, and getting down to the question of cost, which is a very wide figure, and a very difficult figure to pin down to exactly what you mean by cost,—what one means by cost—you may find yourself eventually paying more than is necessary; particularly if areas of another

ethnic group develop on the other side; and one might be faced with the fact, that—it would be very difficult, seeing you had not metered the incoming with one end, and you are faced with an extension supply through that on the other side. That could add to the cost of an installation.

So from that point of view, one wonders whether the use of, say, the Native revenue account, or the Native Services Levy, may not be better applied in the form of a . . . well, basing it on the same lines as is envisaged in the Electricity Act for extension to supply areas that are sub-economic; farming areas where you have long extensions and few consumers.

On that basis, it could be very readily worked out, and an annual sum contributed towards the cost of developing that area, until it is economic, then those costs would fall away.

I just hold that out because I can see some very difficult problems arising in our township in Durban. The township is being developed at the moment, purely and simply on the basis of street lighting, and low tension supplies to shops and institutions. But the Natives are being told, when they buy those houses, that if they like to pay for the cost of the installation themselves, they can have it.

We are already confronted in those areas with widely scattered Native houses that want electricity. They have been told they can have it, and it is going to be very difficult to give it to them at a reasonable figure.

It means that we shall have to put in considerable extensions for the very minmum of load.

That, I know, has been brought about by other factors, and I hope we will be able to get over them—there are ways and means of getting over them. As has been said today, by borrowing money, not from services levy or from revenue account, but as a separate loan to finance that particular aspect if your unit cost from the construction of the house itself is in excess or up to the maximum allowed by the authorities.

So we can overcome that, but it does become a question of economics and keeping the cost to the occupants down to a reasonable figure. I feel there that, if from the very word "Go" it could be regarded more on the lines of an annual subsidy, and the scheme was put into operation right from its initiation, that you could then go in for wiring of the houses on a mass scale, instead of doing them individually by the Natives themselves at a relatively high cost, and also you could then control the areas you want to develop in that manner.

I would just like to hear Mr. Masson's comments on that, and in conclusion I would like to thank him very much indeed for a most interesting paper, and I feel sure that if we can follow the suggestion which has been put forward by Mr. Mitchell, which I fully support, I think we could probably in Durban, at the next Convention, carry on with the results of that in the form of a very, very useful morning symposium.

Thank you Mr. President.

THE PRESIDENT: Thank you Mr. Simpson.

Gentlemen, it is now well after half past ten, and tea is being served, and we will carry on with the discussions this afternoon.

I would like to thank all the contributors, and would like to say that I also agree with Mr. Mitchell's suggestion.

ADJOURNMENT FOR TEA

On resuming at 11.00 *a.m.*

THE PRESIDENT: I think we will proceed gentlemen. Mr. Barnard here on my right is one of those harrassed young gentlemen, who has been very much in the background of the Convention arrangements, and I think he is suffering from butterflies at the present moment!

I will now ask him to present his paper.

Mr. W. BARNARD (Johannesburg): Meneer die President, dames en here, dit it vanmôre my vooreg om u toe te spreek in verband met die ontwikkeling van 'n Verspreiding Stelsel vir die Johannesburg Voorstad van Montgomery Park. Ek is van plan om dié te lewer in Engels, maar dit sal vir my 'n plesier wees om die onderwerp ook in Afrikaans te bespreek as u dit so kies.

THE DEVELOPMENT OF A METHOD OF RETICULATION FOR THE JOHANNESBURG TOWNSHIP OF MONTGOMERY PARK

by

W. BARNARD, B.Sc. (Eng.), A.M.I.E.E., A.M.(S.A.)I.E.E.

INDEX

1. INTRODUCTION.

For a number of years papers have been written at various times on the subject of township reticulation and in presenting this paper the author apologises for, what might be considered by some, as flogging a dead horse. However, although it would appear that in the design and layout of township reticulation there is a limited scope for further radical development, the Johannesburg Electricity Department has developed a township reticulation scheme which, in addition to having certain novel features, will provide a substantial saving in capital cost and it is hoped may be of interest and provide the excuse for raising this subject once more.

In principle the Engineer can only consider three general variables, namely :—

(i) *Type of materials and equipment*, i.e. concrete, steel or wooden poles, copper or aluminium, steel, bricks or concrete kiosks, links, fuses, isolators, oil circuit breakers, etc.

(ii) *Primary voltage*, i.e. any one of the standard high tension primary voltages. The secondary voltage to the domestic consumer is generally fixed at 220 volts.

(iii) Disposition of material and equipment, i.e. underground, overhead, street front, boundary, positioning and number of load centres, etc.

The decision in all three cases is usually largely dictated by prevailing standards and local conditions.

During the last few years, costs have continued to spiral upwards and the economics of township reticulation have virtually overridden all other considerations and in some cases have made the development of new townships uneconomical for the township owner.

Unfortunately, at the time of writing this paper the "guinea pig"of this scheme, Montgomery Park township, is still undeveloped. It was hoped to give actual operating results, but as the stands in the township will not be offered to the public until later this year, it is only possible at this stage to give a description of the reticulation planning.

2. GENERAL.

Montgomery Park is situated to the north-west of Johannesburg and consists of 468 stands of approximately 1/5 acre.

These stands are to be sold under the following conditions laid down by the Council :—

(i) No person already owning ground will be permitted to purchase stands.

(ii) Only one stand may be acquired by any one purchaser.

(iii) Purchase of stands will be limited to a specified income group.

(iv) Building of houses to commence within a fixed period (probably 12 months).

(v) No three-phase supply will be available to domestic consumers.

(vi) Certain stands will be subject to servitudes for kiosks and cables.

The above conditions will be the means of discouraging speculators from participating in the township and will ensure rapid development.

3. ANALYSISI OF PRESENT CONVENTIONAL OVERHEAD RETICULATION.

3.1 *High Voltage Feeders.*

In supplying a township where further development is expected beyond the township boundary, and where the feeder cable can be conveniently extended to complete a ring, it is the established practice in Johannesburg to utilise ·25 x 3 core high voltage feeders. These feeders supply the standard brick kiosk load centres en route, from which radial distributors are taken to supply the balance of the load centres required for the complete reticulation. For comparative purposes only Montgomery Park has been planned on a conventional reticulation, and the cost, which does not include for the supply cable up to the township boundary, has been estimated.

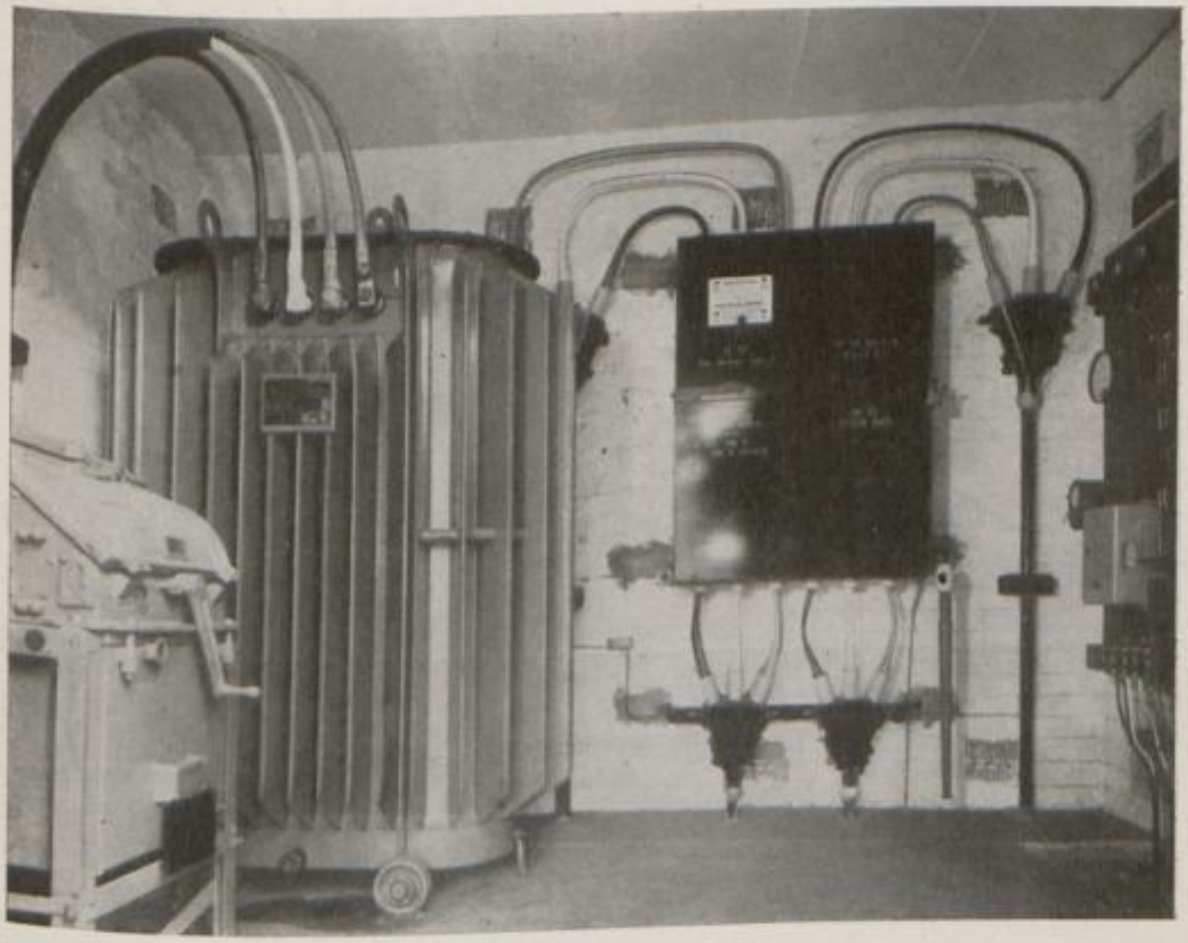


FIG. 1.

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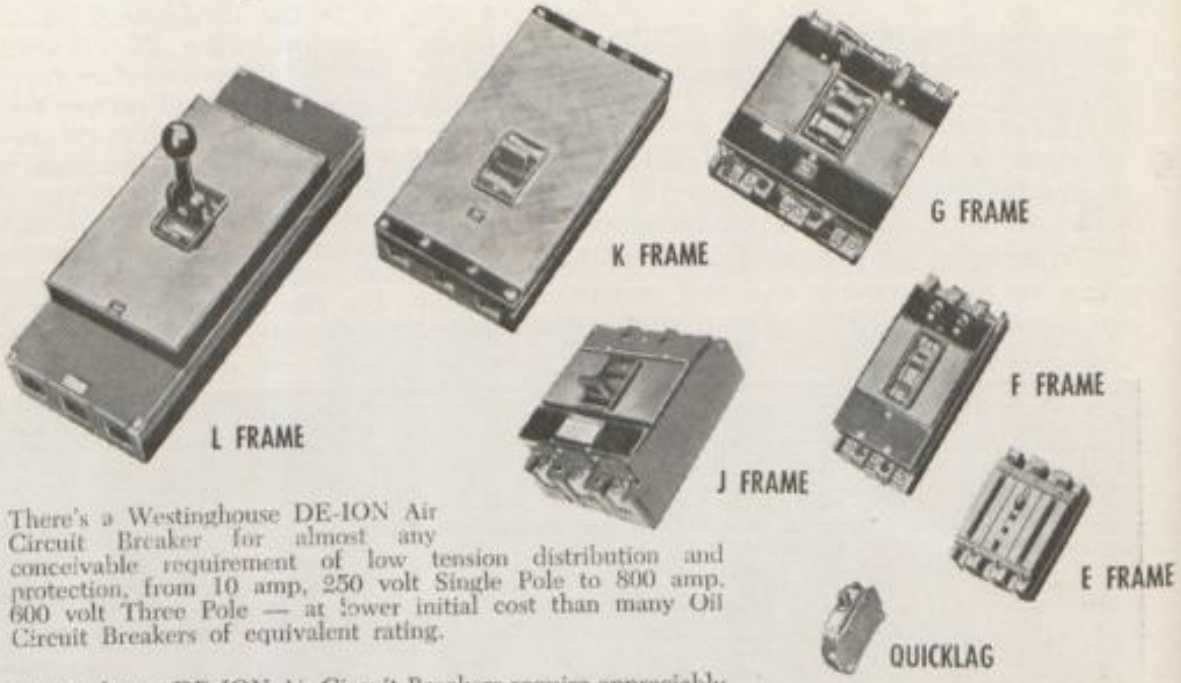

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3.2 *Load Centres.*

The establishment of additional load centres in existing townships has become a major problem in that the acquisition of ground for this purpose inside a stand boundary is not always possible. Consequently the selection of load centre sites in proposed new townships must adequately provide for future load development.

An analysis of loading in various townships shows a wide divergence in after diversity maximum demand, varying from 2 kW for older and poorer townships to 5 kW for the middle class new township. These figures are increasing annually at a rate of about 4% and at present there is no sign of saturation in load growth.

The loading for Montgomery Park has been estimated on the basis of an after diversity maximum demand of 5 kW per consumer, resulting in a total transformer capacity requirement for the township of 2,340 kW.

In Johannesburg we have standardised on a maximum size transformer of 400 kVA and this would make it necessary to provide at least six such transformers.

Although, where justified by load density, load centres have in the past been built to accommodate two transformers, the loading of the average domestic township permits a sounder low voltage reticulation where a larger number of single transformer kiosks, spaced 1,800 to 2,000 ft. apart to limit volt drop, is provided.

In estimating the cost, again for comparative purposes, of reticulating Montgomery Park on the conventional method, allowance is made for six brick kiosks to accommodate a 400 kVA transformer each.

The standard equipment for these kiosks being as follows:—

1—4-way double tier high voltage link cabinet.

1—switch fuse or oil circuit breaker.

1—transformer (maximum 400 kVA).

1—low voltage board (comprising 4 outgoing power circuits and 4 street lighting circuits).

(Fig. 1 and 1a are photographs of a conventional kiosk showing the general view and low voltage distribution board respectively. A schematic diagram of the internal connections of this distribution kiosk is shown in Fig. 2).

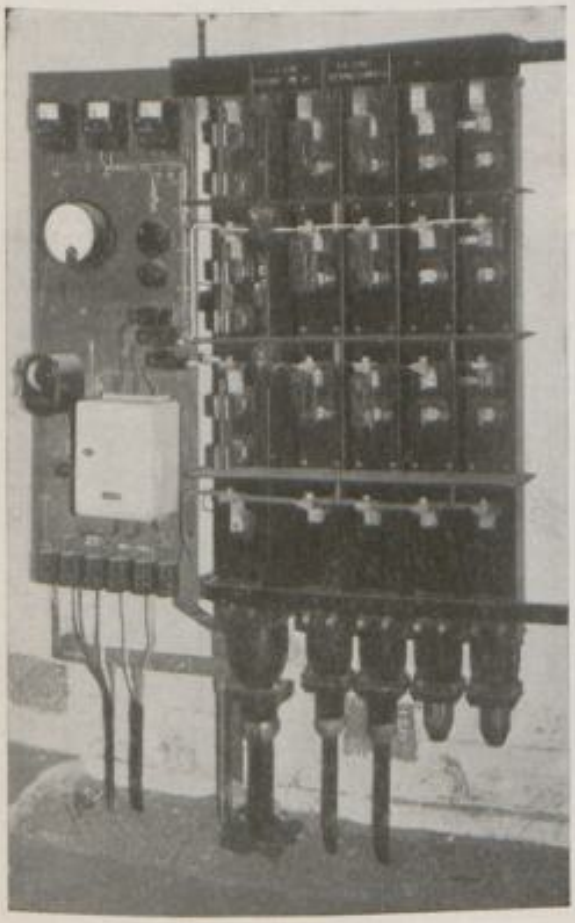
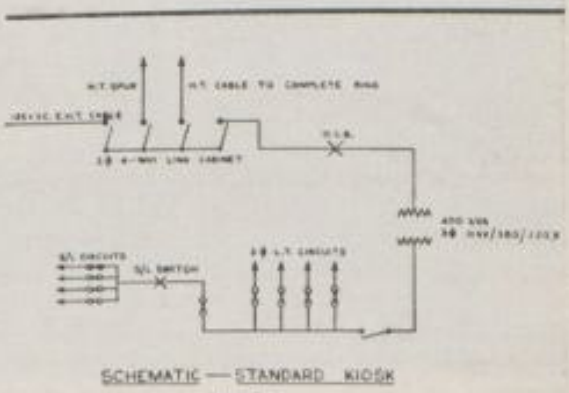


FIG. 1a.



SCHEMATIC — STANDARD KIOSK

FIG. 2

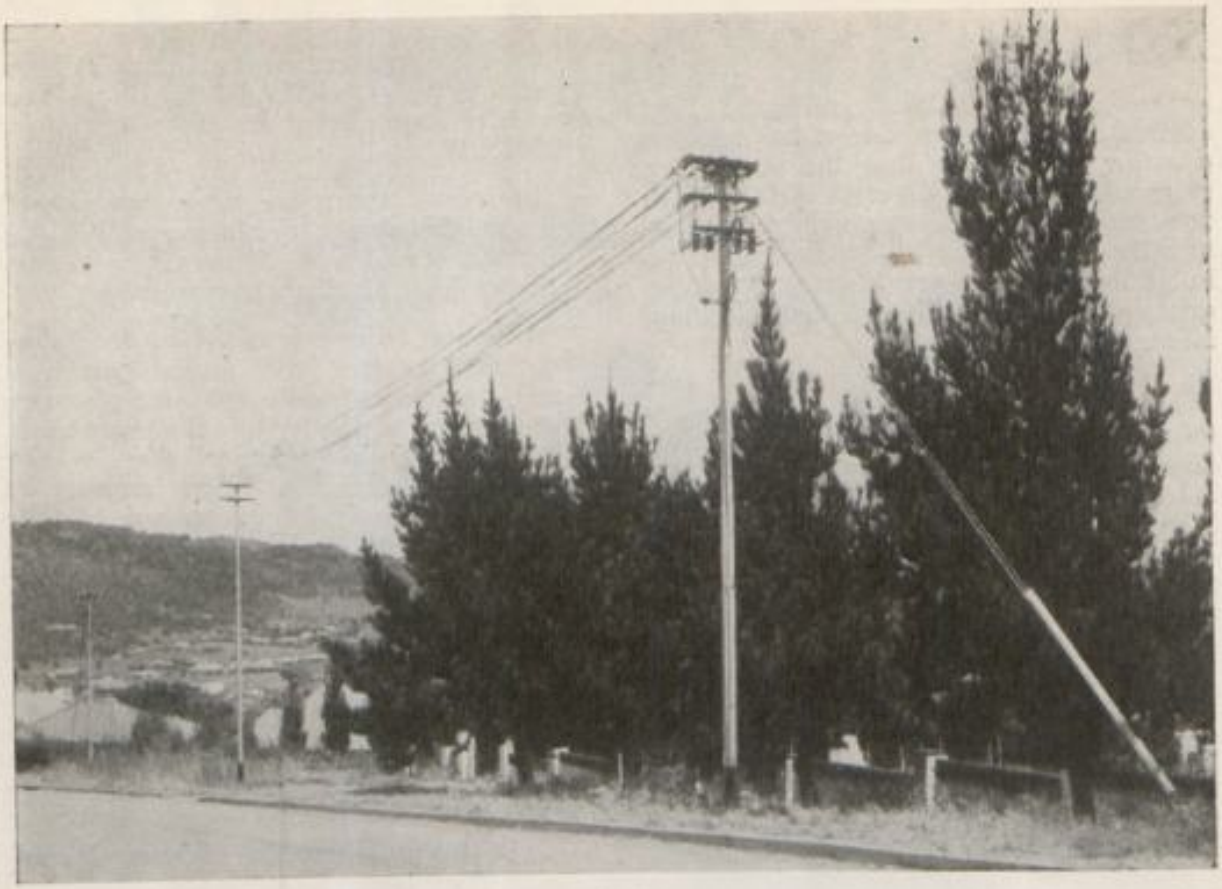


FIG. 3.

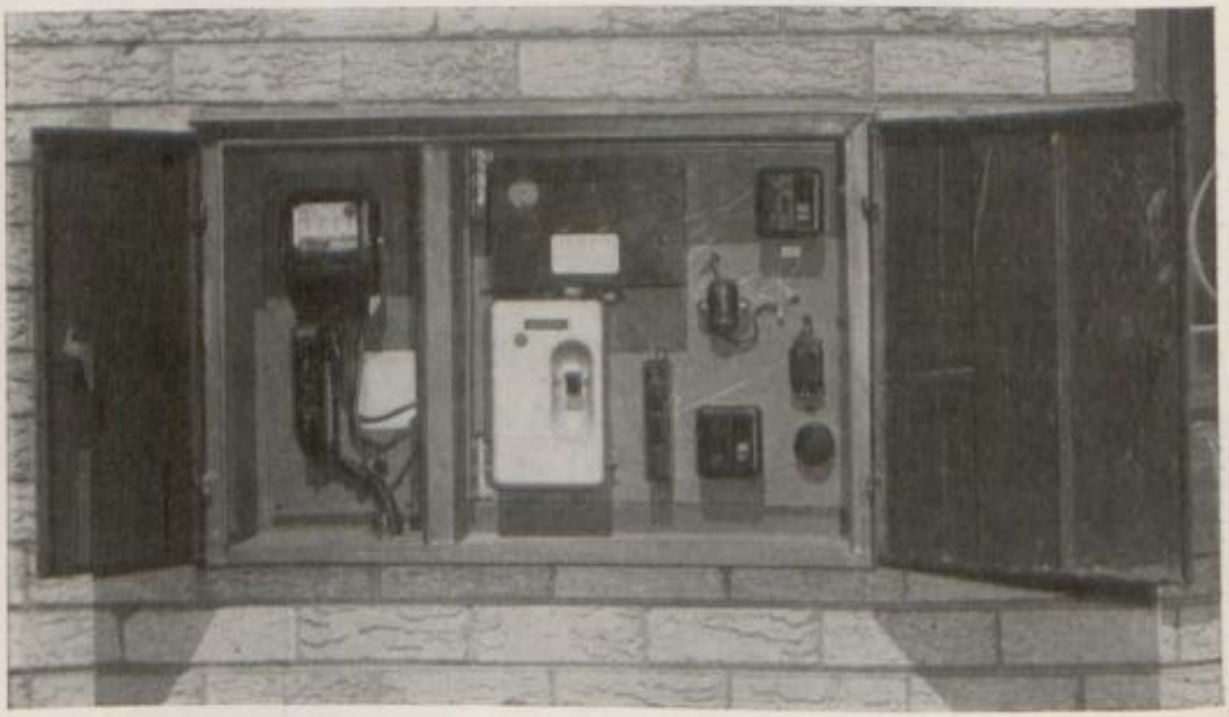


FIG. 4.

3.3 *Low Voltage Mains.*

In common with most cities in South Africa, Johannesburg reticulates residential townships by low voltage overhead lines. Where 3-phase power mains are provided, 4 conductors of 19/14 stranded copper are run on steel cross-arms mounted on tubular steel poles. For average domestic loading, distributors of not more than 900 to 1,000 ft. are permissible to maintain voltages within the statutory limits. Where distributors are extended beyond these limits doubling up or strengthening of the mains may be required.

3.4 *Street Lighting Mains.*

Street lighting mains are carried on separate cross-arms mounted below the power mains and in general consist of a No. 6 solid copper conductor which is adequate in cross-section to supply lamps at 80 yard spacing over a maximum line length of 1,000 ft. Two 7/14 copper earth wires on earth clamps are carried on the bottom of the street lighting cross-arms, and cross-pieces connected to these wires form a cradle to provide protection against the danger of broken conductors. At cross streets, jumper connections or cable jumpers are used for connecting sections of line.

(A photograph of a typical suburban overhead distributor is shown in Fig. 3).

In the Municipal Area street lamp brackets and fittings are charged to the rate fund and are not included in the reticulation cost.

3.5 *Service Connections.*

The standard service to any domestic consumer is a 220 volt single phase supply permitting a maximum load of 80 amperes. For this supply a ·0225 x 2 core cable is used except where the total cable length exceeds 250 feet in which case an ·04 x 2 core is necessary to limit the voltage drop.

Where the loading exceeds 80 amperes it becomes necessary to resort to a three phase 4 wire supply.

To protect the service cable against fault conditions and for disconnecting the supply, a wired pole mounted fuse is used.

The consumer is required to provide accommodation for the Council's metering equipment, and for this purpose a steel box must be built into an outside wall.

This box may serve a dual purpose and also accommodate the consumer's distribution board and fuse equipment.

(A typical dual purpose metering box is shown in the photograph—Fig. 4).

The total cost of the service connection, excluding the cost of the meter, is charged to the consumer.

The author apologises for having gone into such detail regarding the conventional method of reticulation, but this is considered necessary to provide a basis for comparison with the high voltage reticulation scheme developed for Montgomery Park with which it is now proposed to deal.

4. PROPOSALS FOR MONTGOMERY PARK.

4.1 *Single-phase High Voltage Reticulation.*

In analysing the costs and technical difficulties of low voltage reticulation, one is immediately confronted with the problem of voltage regulation.

The high voltage regulation can generally be limited by on-load tap-change transformers and line drop compensators.

Low voltage regulators are also used, but usually only on long lines in new reticulation schemes to provide temporary voltage improvement pending the establishment of further load centres. However, this method may become difficult and costly if used extensively and in many instances it is necessary to strengthen distributors to improve the line-end voltage.

In developing the proposed method it was decided to completely eliminate, if possible, all low voltage mains, and this has been accomplished by introducing small unit stepdown transformers directly supplying a limited number of consumers.

The standard voltage at which Montgomery Park is to be supplied is 11 kV 3-phase, which is a suitable voltage for the underground reticulation, but the layout and loading of the township did not justify 3-phase distribution feeders.

The planning for this reticulation has therefore been based on a conventional high voltage three-phase supply to a central switching station, from which 2-core 11 kV distributors will radiate to supply single

FIG. 5.

SINGLE PHASE H.T. CABLE NETWORK — MONTGOMERY PARK.

phase 11 kV/230 volt distribution transformers.

4.11 *Three-phase High Voltage Feeder and Switching Station.*

The central switching station will be supplied by conventional ·25 x 3 core high voltage feeder cable, and from this station six ·04 x 2 core radial feeders will supply the 39 unit distribution kiosks. Each pair of radial feeders can be interconnected at linking pillars as shown in the schematic diagram Fig. 6.

The oil circuit breakers to supply the three separate township zones are standard 3-phase breakers but only two poles on each breaker will be in commission. Two-pole circuit breakers are not obtainable as standard equipment at present, but if this reticulation is more widely adopted, such gear may become available and probably at a reduced cost.

From the schematic diagram it will be seen that the main incoming feeder cable will supply a standard 4-way 3-phase link cabinet. This link cabinet will make provision for two outgoing 3-phase feeders to high voltage bulk consumers in the township. A further set of links will supply the local switchboard. For future supplies to adjoining townships an outgoing isolator has been provided on the local high voltage switchboard.

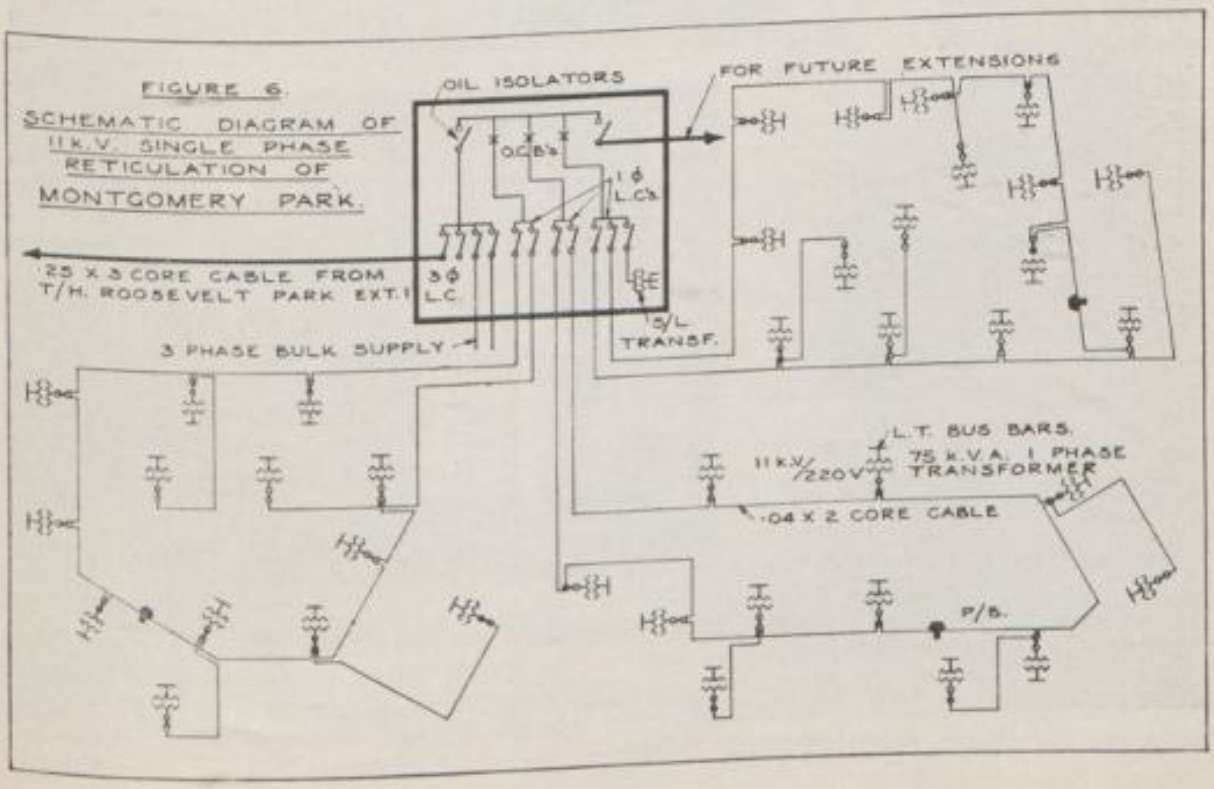
The oil circuit breakers will be connected to the three single-phase, or two pole link cabinets from which radial feeders will supply the unit distribution transformers in the township.

Two of these link cabinets are two-way and will accommodate two outgoing radial feeders while the third, a three-way, will accommodate the local and street lighting supply in addition to the radial feeders.

The local and street lighting transformer will be the standard unit distribution transformer and will be accommodated in the switching station.

4.12 *High Voltage Cabling.*

It is convenient to provide six radial feeders, two to each zone, for connecting the unit distribution transformers. The cable layout has been included on the Township plan and is shown in Fig. 5. Provision has been made for an alternative supply to each zone from the adjacent radial feeder on closing the interconnecting links, in the event of a radial feeder cable fault.



In determining the cable size three factors have been considered :—

(i) Cable loading.
(ii) Short circuit or short time rating.
(iii) Cost and manufacturing problems.

For normal operation the loading on any one feeder will not be greater than eight unit transformers each supplying twelve consumers. Assuming an after diversity maximum demand of 5 kW per consumer each cable must have a rating of not less than 480 kW. In the event of a cable fault, however, this cable may be required to carry a maximum zonal load of 900 kW. A ·04 x 2 core 11kV cable with shaped conductors has a continuous rating in soil of 1300 kW and should be satisfactory for the maximum anticipated loading.

In the manufacture of 2-core cables, shaped conductors are only practicable for a conductor cross-section of ·04 square inch or greater. Cables with ·0225 square inch conductors must be of circular cross-section and the resultant extra insulation makes this cable more expensive than the ·04 x 2 core cable.

The prospective fault current at the major stepdown substation is 13,100 amperes, but the cable impedance between this substation and Montgomery Park will reduce this to the safe short time rating of 3,500 amperes for 0·4 seconds for the cable.

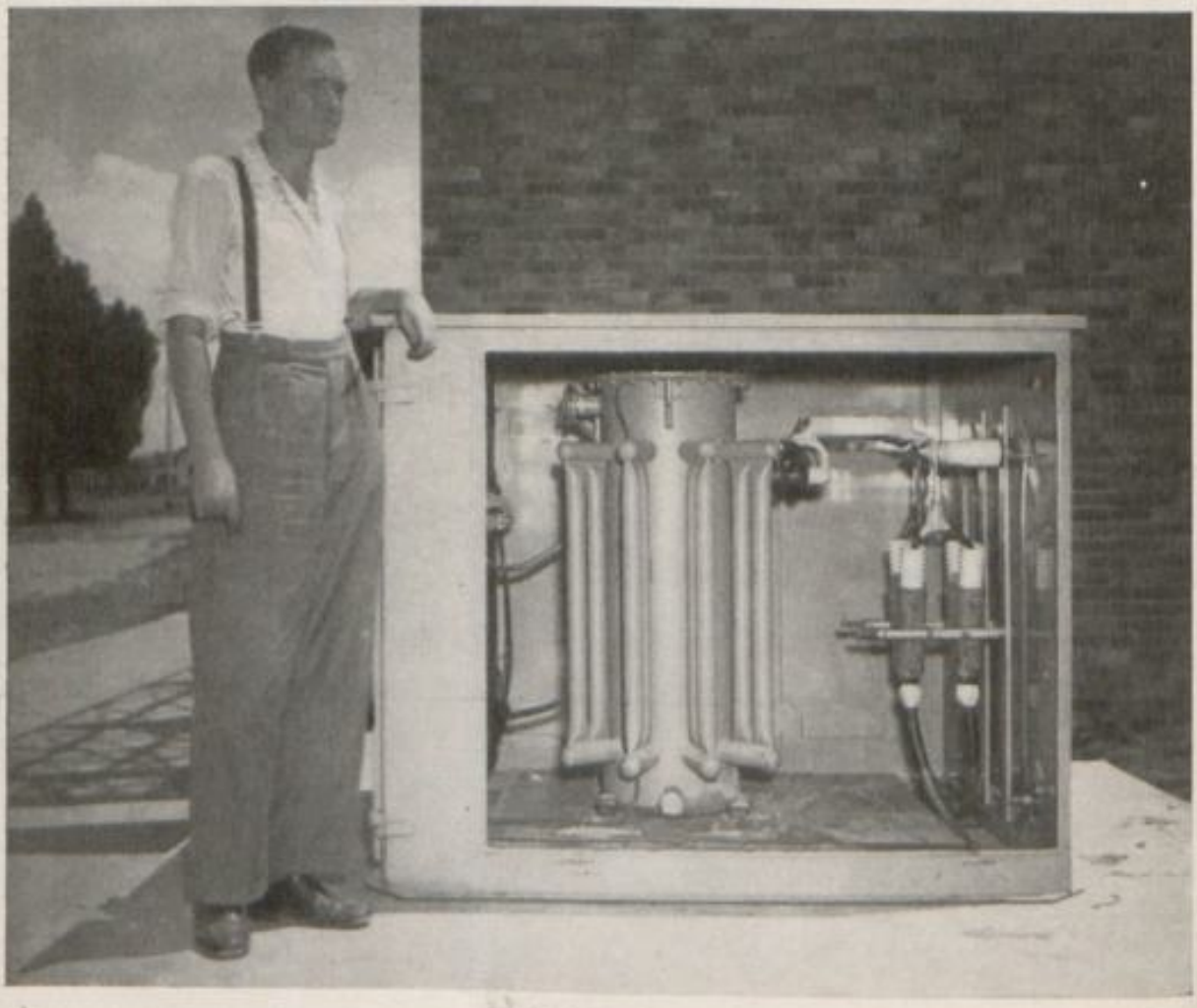


FIG. 7.

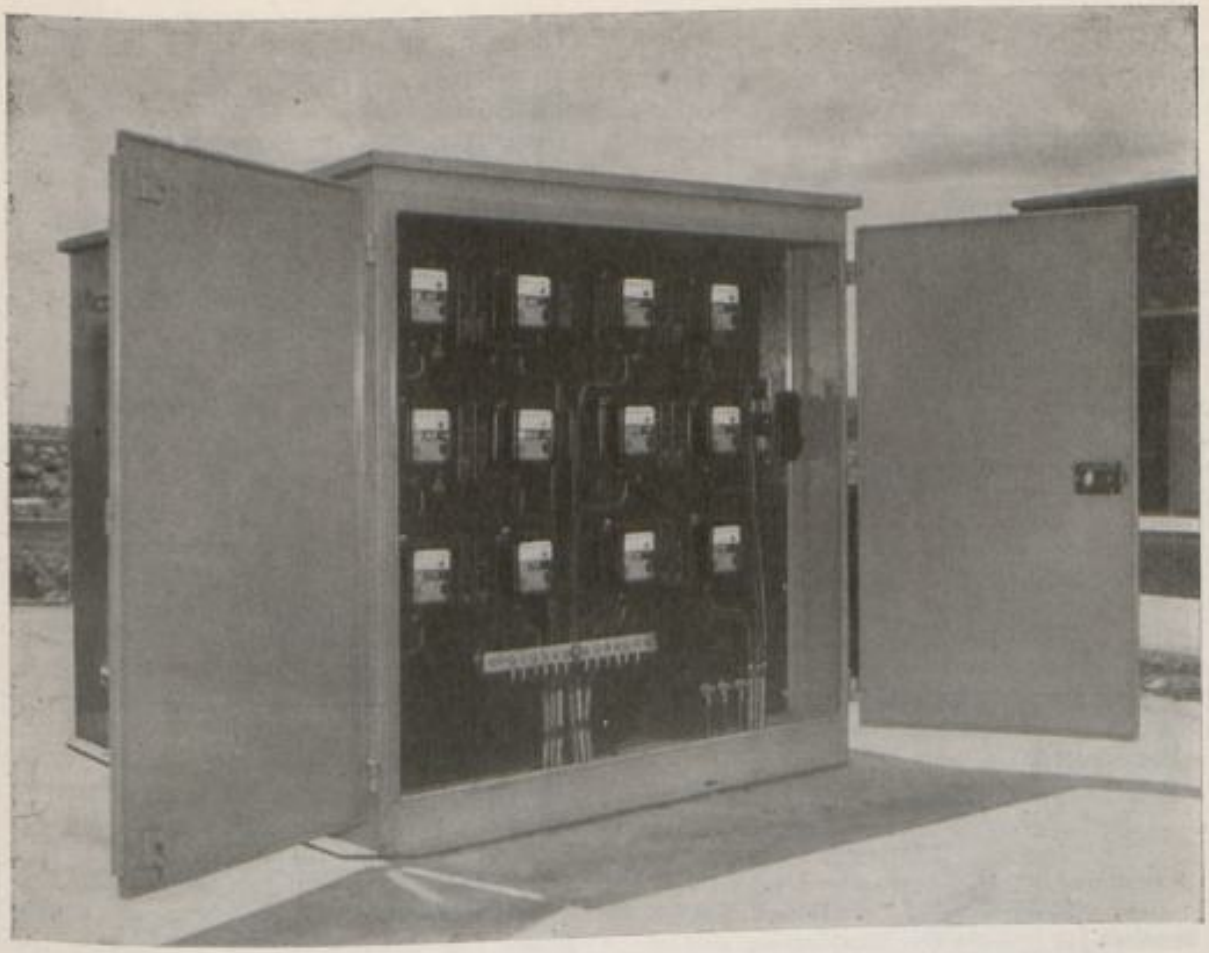


FIG. 8.

Specially manufactured 2-core, compound filled cable end boxes will be used for cable terminations in the unit kiosks and at the switch house.

4.13 *Unit Distribution Kiosks.*

In deciding on the most suitable type of unit distribution kiosk the following factors require consideration :—

(i) Accessibility.

(ii) Aesthetic appearance.

(iii) Capital and maintenance cost.

Initially, an experimental proto-type kiosk was built and subsequently it was decided that, to best meet the above requirements, a steel fabricated kiosk mounted on a brick platform was the most suitable.

The kiosk has been kept to the absolute minimum size of 4'6" x 4'6" x 3'6" high and is illustrated in the photograph, Fig. 7.

(Fig. 8 is a view of the low voltage and metering panel).

The kiosk is provided with removable panels at the front and top whilst access to the meter chamber is obtained by means of a hinged door on the left hand side. Two 10 amperes high tension h.r.c. fuses are mounted on the primary end of the transformer to provide fault protection. Three cable end boxes can be mounted on the high voltage end of the kiosk, which will permit the connection of a spur cable.

The estimated maximum loading of the unit transformers is based on an after

diversity maximum demand of 5kW per consumer which will make it necessary for these transformers to have a rating of 60 kVA.

In response to an enquiry for transformers, offers for 75 kVA transformers suitable for accommodating in the kiosk, and costing 10% more than similar 50 kVA transformers, were received and considered suitable, in that extra capacity of 25% could be provided at a relatively small increase in cost.

Although the transformers purchased are of the hermetically sealed type a small number were ordered and supplied with welded tank covers. No gauge glass, explosion vent or other openings are provided and it is the author's opinion that these transformers will give trouble free operation for many years, but only time will prove the justification for this hypothesis.

The transformer low voltage supply is connected through a 250 amperes h.r.c. fuse to the service connection isolators and consumers' meters mounted on the low voltage panel.

It is now the generally adopted practice in Johannesburg to provide miniature circuit breakers up to a maximum size of 80 amperes on the consumer's board and as no suitably rated miniature circuit breakers for use on the transformer end of the service cable is obtainable, it has been necessary to resort to isolators, and consequently individual service cable protection has been lost. A cable fault will result in twelve consumers losing supply, but this is, however, an infrequent occurrence and does not appear to merit any special provision.

4.14 *Service Connections.*

The standard service cable connection has proved very suitable for the average domestic consumer and this standard will be adopted at Montgomery Park, but as meters are to be mounted in the unit kiosk, none will be provided on the consumer's premises except where application is made for a check meter. The necessity for the consumer providing a meter receptacle therefore falls away, and only provision for the Council's miniature circuit breaker need be made.

On the basis of overhead low voltage reticulation, standard service connections costs have been standardised with provision for an average of 85 ft. of cable from the consumer's stand boundary to the primary pole fuse.

The standard cost will apply to Montgomery Park, and as this average cable length will be exceeded in the proposed reticulation, it has been necessary to make special capital provision in the reticulation cost to offset these charges, which will not be passed on to the consumer.

4.15 *Protection and Earthing.*

(i) Earthing:

In a system where a high voltage distributor is run in practically every street, efficient earthing is of prime consideration.

For the Montgomery Park reticulation all metal work, cable sheaths, armouring, etc. will be bonded together and bonded to the main earth plate at the switch house, in addition, at each unit kiosk a trench earth connected to an earth bar will be provided.

One secondary terminal on the transformer will be earthed, and each consumer will be given a further connection to this earth bar by bonding to it the lead sheath and armouring of the service cable.

The provision of earthing on the single phase low voltage system appears to the author to be quite unnecessary and an unearthed supply may possibly result in greater protection from shock for the consumer. Conservatism has, however, prevailed and earthing will be provided on one secondary terminal of each unit transformer.

(ii) Protection:

As in the case of earthing, the protection of this system has been of major consideration. Accepted conceptions cannot apply where the conventional low voltage mains have been discarded in favour of high voltage supply cables.

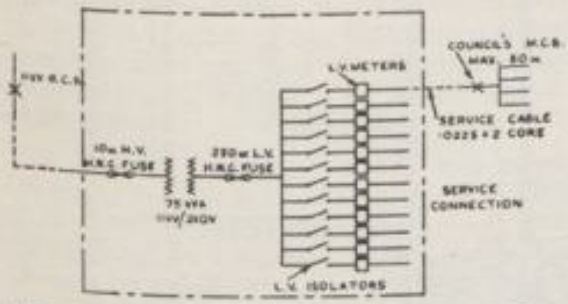
Due to the comparatively large number of unit transformers, fault protection must of necessity be by h.r.c. fuse both from cost and fault discrimination aspects.

In general, fuses are not suitable for overload protection, and this protection will therefore not be provided on transformers, but in limiting the number of consumers

connected to any one transformer, overloading is virtually impossible.

Overload and fault protection of the meter is provided by the Council's miniature circuit breaker, which is suitable for this dual purpose, mounted on the consumer's distribution board.

The high voltage distribution cables are each rated for the full section loading as previously mentioned, and overload protection on these feeders will be provided by shunt time-lag fuse tripping on the oil circuit breakers.



FAULT CURRENT		OPERATING TIMES (SECS)			
PRIMARY	SECONDARY	* O.C.B.	10 A H.V. FUSE	250 A L.V. FUSE	M.C.B. 80 A
40 A	2000 A	∞	2·0	0·62	·05 ·01
100 A	5000 A	∞	0·025	≪0·006	—
2000 A	—	5·21	≪0·001	—	—

* C.T. RATIO 100/5 — 5 A TIME LIMIT FUSE

SCHEMATIC DIAGRAM OF OVERLOAD AND FAULT PROTECTION

FIG. 9

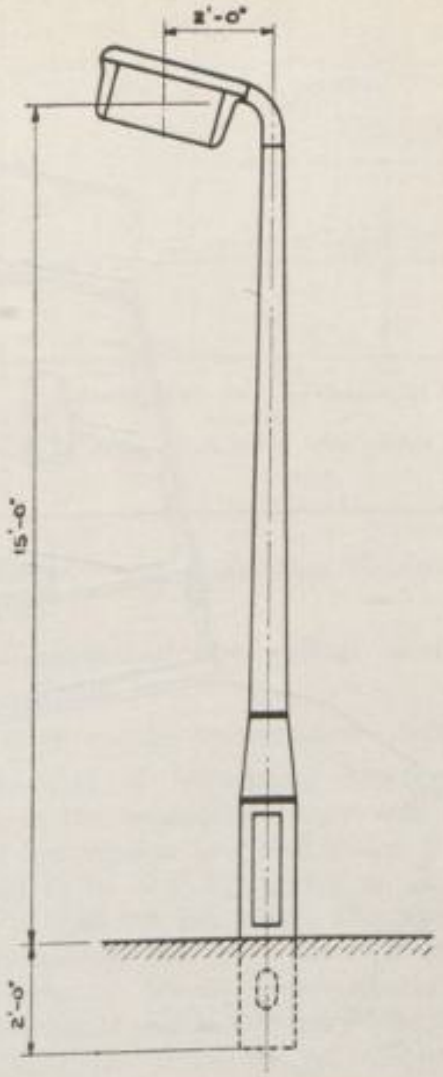
(Fig. 9 is a schematic diagram showing the switchgear and fuse layout, and a table of operating times for various fault conditions).

Earth leakage portection required to discriminate between earth faults in the three zones and operating the oil circuit breakers will be provided.

4.16 *Street Lighting.*

One of the accepted advantages of an underground system is that street lighting can be planned without taking into account overhead line span lengths. Light concrete poles, not always considered satisfactory for overhead line construction work, have many advantages where the street lighting supply is from underground cable.

A typical street lighting standard as proposed for Montgomery Park is illustrated



PROPOSED STREET LIGHTING STANDARD

FIG. 10

in Fig. 10. To supply the street lighting from the unit distribution kiosks several control points would have to be established. This is not considered desirable and it has therefore been decided to supply the street lighting from one central supply transformer housed in the central switching station.

To supply street lights of 200 watts each for the whole township from one central

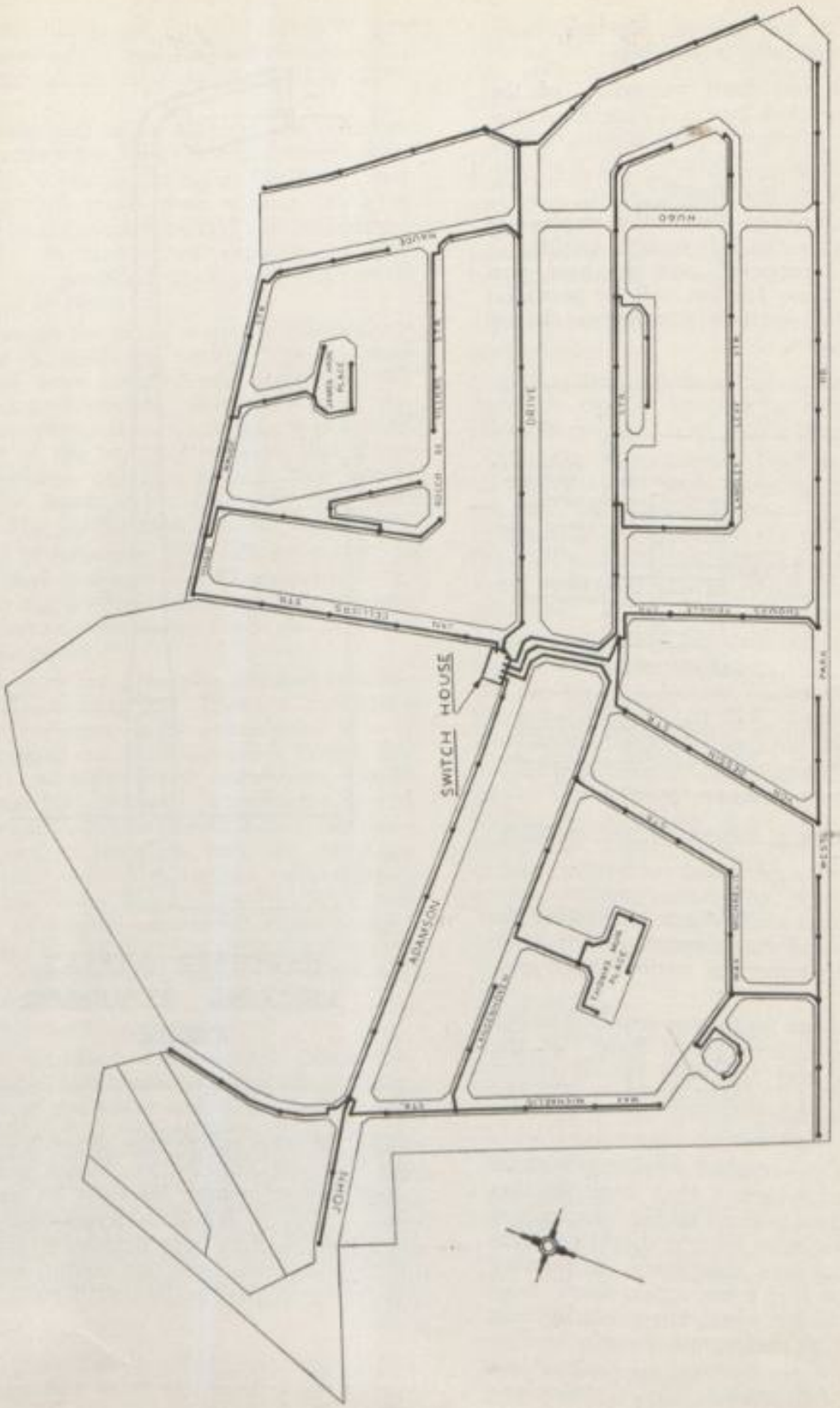


FIG. 11

STREET LIGHTING RETICULATION — MONTGOMERY PARK

point, requires a relatively large and expensive cable to provide acceptable voltage conditions at the remote ends. The same lumen output, can however, be attained by using two 40 watt fluorescent lamps and with a substantial decrease in cable loading.

The appendix gives the cable size calculation for the maximum length of street lighting feeder. Although a .0145 x 2 core cable is of adequate rating for Montgomery Park, a 3 core cable was considerd more satisfactory in that the alternate street lights in any one zone could be connected to different cable cores which will result in more reliable street lighting.

The capital cost of lanterns and poles for the proposed street lighting is estimated to cost no more than the conventional tungsten lighting, and the annual maintenance and operating costs will be appreciably lower.

A further advantage which will result from the centralised street lamp switching is the reduction in the number of time switches to be maintained and elimination of the possible erratic switching-on of street lighting in different sections of the township if time switches are not properly synchronised. For these same reasons Johannesburg is at present converting sections of street lighting to cascade control. (Fig. 11 street lighting layout for Montgomery Park).

5.0 ADVANTAGES AND COMPARISON OF COSTS.

In any reticulation scheme costs can be reduced by the lowering of standards and for this reason a comparison is not always reliable. The following comparison of estimates is based on prices ruling at the time the material and equipment was purchased and for cable and line conductor, prices are calculated on a basic copper price of £350 per long ton, and as this cost has since decreased substantially the actual costs and estimated saving should be adjusted accordingly. For this purpose, the graph (Fig. 12) has been plotted giving the reticulation costs relative to the basic copper price.

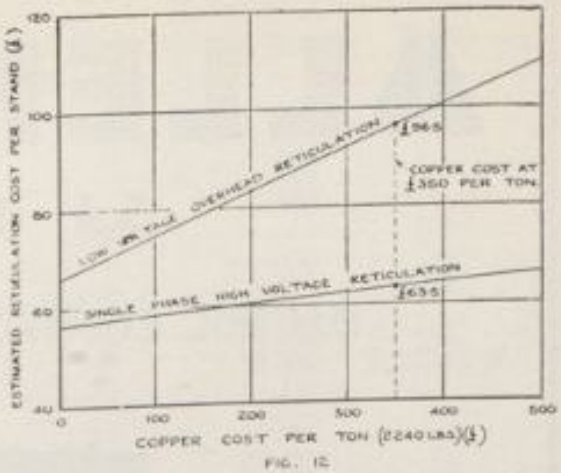


FIG. 12.

VARIATION OF RETICULATION COSTS WITH COPPER PRICE

Estimated cost, reticulation Montgomery Park :—

Conventional low voltage overhead £45,231.

High voltage underground—£29,655.

The cost of reticulating Montgomery Park in the conventional way with standard low tension overhead mains is estimated to be £45,231 giving an average cost of £96 10s. per stand. This figure is fairly average for this class of township although, in special circumstances e.g. sub-economic and Native townships, where the load per consumer is substantially lower and only a rudimentary supply is required, this figure has been reduced to £35 per stand.

In estimating the cost for the underground high tension reticulation of Montgomery Park actual prices for material and equipment have been used. This cost is estimated to be £29,655 with the additional service connection costs included, which results in a total capital saving of approximately £15,576 or 34% and gives an average cost per stand of £63 10s.

An analysis of the two estimates is given on the next page.

Item	Conventional Method	Single-phase High Voltage	Price Difference
(i) Buildings.			
Steel unit kiosks	—	3,030	
Kiosk foundations	—	390	
Switching Station	—	800	
Standard brick kiosks	4,200	—	
	4,200	4,220	Excess £20
(ii) Kiosk and switching equipment	6,592	2,041	Saving £4,551
(iii) Street lighting mains and poles	1,639	*6,809	Excess £5,170
(iv) 3-phase h.v. feeders	14,653	2,131	
1-phase h.v. feeders	—	11,954	
	14,653	14,085	Saving £568
(v) L.T. overhead lines	†18,147	—	Saving £18,147
(vi) Additional s/c costs	—	2,500	Excess £2,500
TOTAL	£45,231	£29,655	Saving £15,576

* Includes cost of street lighting poles.

† Includes cost of all poles.

However, this is not the complete picture as transformer costs, although not a charge against a reticulation scheme, should be included for a true comparison.

In the conventional reticulation method 6—400 kVA transformers (2,400 kVA) must be provided at a present day ruling cost of £849 each. This gives a total transformer cost of £5,094 i.e. £2 12s. per kVA.

For Montgomery Park 40—75 unit transformers are to be used which will give a total transformer capacity of 3,000 kVA. These unit transformers cost £219 each giving a total cost of £8,760 i.e. £2.92 per kVA, but for comparison this cost must be reduced to the equivalent cost for 2,400 kVA transformer capacity, which on a pro rata basis is £7,008.

Therefore when comparing transformer costs, based on an equal installed capacity, the unit transformer costs will be £1,914 higher, which is equivalent to an additional cost of £4.1 per stand.

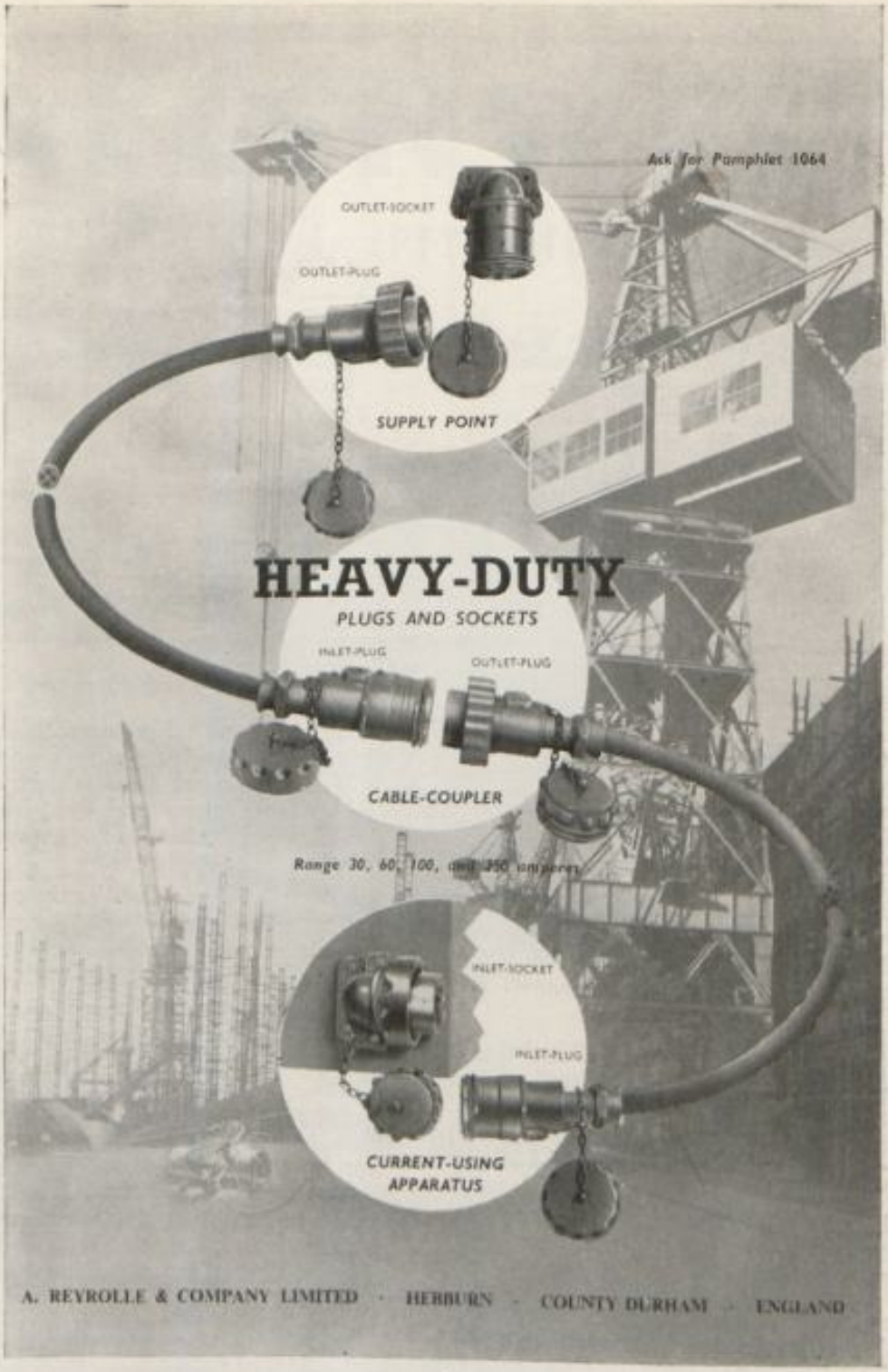
No figures are available for maintenance costs of a high voltage underground cable reticulation, but it appears to be safe to assume that this figure must be considerably lower than for low voltage reticulation with its overhead lines which are susceptible to malicious and vehicular damage and jumper cable ends exposed to the weather.

In areas where lightning is prevalent the underground system must be viewed with definite favour in that lightning trouble can be practically completely eliminated.

A very big advantage and saving in cost is accomplished by grouping consumer's meters on a panel in the unit distribution kiosks. Meter readers will be able to take meter readings more speedily, with greater ease, need not enter consumer's premises nor be exposed to the attentions of man's canine friends. All the advantages cannot easily be assessed in pounds, shillings and pence, but will serve to make this system of reticulation an attractive proposition.

6. CONCLUSION.

No claim is made that the proposed scheme for Montgomery Park is the answer to all reticulation problems or that it is entirely unique, but the author has no knowledge of this method being used elsewhere. This high voltage reticulation method has been developed to meet



specific conditions and existing problems and it is hoped that the presentation of this paper will evoke interest and lead to further investigation and development in this direction.

The digging and trenching in this Township will be easy as the ground is predominantly soft but substantial problems may arise where terrain is relatively rocky.

This underground scheme has been warmly welcomed by Town Planners and will most certainly present an enhanced aesthetic appearance. Fluorescent lighting will be novel for the Johannesburg European areas although it is extensively used in the Native Townships.

The unit steel kiosks have been completely moved off the side walks and although they now encroach on certain stands, have been kept to so small and compact a unit that they can very easily be screened in the garden layout by suitable planting of shrubs.

Underground reticulation of this Township can very easily assist in making this the garden township of Johannesburg.

7. ACKNOWLEDGMENTS.

The author wishes to express his thanks to Mr. R. W. Kane, General Manager and Chief Electrical Engineer for the opportunity of presenting this paper to the Association and for permission to use the various data and photographs included. Thanks are also due to all other members of the Electricity Department staff who assisted in the preparation of this paper.

APPENDIX.

CALCULATION OF THE PERMISSIBLE NUMBER OF LAMPS PER CIRCUIT

0.0145 x 3 core cable— Impedance per core per 80 yards = 0.137 ohms.

2—40 watt fluorescent lamps per lantern.

Spacing between lanterns—80 yards.

Current per lantern (I) = 0.4 amp.

Cable Impedance (Z) = 0.137 ohm. per 80 yards.

These flourescent lamps will start on 190 volts which permits a volt drop of up to 40 volts.

The following calculation is based on a line end voltage of 200 volts i.e. a maximum volt drop of 30 volts.

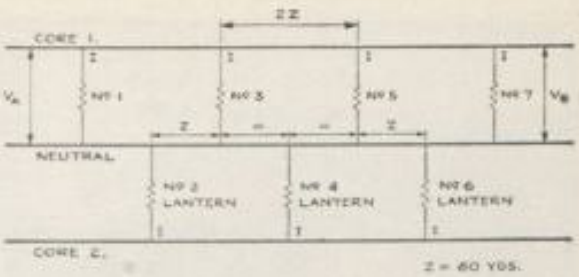


FIG. 13

$$V_A - V_B = 30 \text{ volts}$$
$$= 2IZ + 4IZ + 6IZ + \ldots\ldots 2nIZ.$$
$$+ IZ + 2IZ + 3IZ + \ldots\ldots 2nIZ.$$
$$= 2IZ\,(1+2+3+\ldots\ldots n) + IZ\,(1+2+3+\ldots\ldots 2n)$$
$$= 2IZ\left(\frac{n^2+n}{2}\right) + IZ\left(\frac{4n^2+2n}{2}\right)$$
$$= IZ\,(3n^2+2n)$$

Substituting $I = 0.4$ and $Z = 0.137$

$$30 = .0548\,(3n^2+2n)$$
$$3n^2+2n = 547$$
$$n = \frac{-2 \quad \sqrt{4+6564}}{6}$$
$$= \frac{-2+81}{6}$$
$$= 13.2$$

Permissible number of lamps per circuit = 13.

Permissible number of lamps per cable (3 Core) = 26.

The total number of lamps for the Township is 115 and as six street lighting circuits have been provided, the average number of lamps per cable will be 19.

The maximum number of lanterns per conductor will therefore be 10. Substituting this figure above gives a line-end voltage drop of 17.5 volts i.e. 212.5 volts which will result in a reduction of light output of about 1.2%.

I should like to thank you all for the opportunity of presenting this paper.

THE PRESIDENT: Thank you, Mr. Barnard. The reference to "canine friends" makes me somewhat suspicious, remembering the Mayor's remarks on Tuesday morning!

I think Mr. Mitchell has come prepared to propose a vote of thanks.

Mr. J. E. MITCHELL (Salisbury:) Mr. President, Mr. Barnard, gentlemen: I was very pleased indeed to have been asked to propose a vote of thanks to the author for his very excellent paper on the development of a method of reticulation for the Johannesburg township, Montgomery Park.

I feel that not only has the author considerable courage in giving a paper on such a revolutionary change in methods of distribution, but the Johannesburg Electricity Undertaking is to be congratulated for the same reasons.

I have no doubt that neither the author, nor, for that matter, the General Manager of the Electricity Undertaking of Johannesburg, expected this paper to be hailed with no criticism whatsoever, and he, I am sure, will find that that prognostication will be found to be correct.

In making criticism of the paper, however, I shall endeavour to be constructive, and hope that it will be taken that I am, in fact, being of assistance wherever possible in anticipating difficulties which such a system of distribution might expect to experience.

My first main worry is that although the author has used a diversity demand as high as 5 kWs., and I regret at this stage I feel there must be some reason for this increase of 4% annually other than lack of saturation, the 5 kWs seems to have been based on the after diversity demand of something over 100 consumers.

In a report on the design of underground distribution systems for new housing estates, published by the Central Electricity Authority and Area Boards in Britain in 1954, of which I have a copy with me if the author would like to see it, I note that whereas the diversity has flattened out to a multiplying factor for 100 consumers of 1.5, for twelve consumers it is nearly 3. What this means is, therefore, that whereas one could take an after diversity demand of 5 kWs based on the diversity one would expect from 100 consumers, one can expect something like double that when one is dealing with only twelve consumers, and the spread of diversity is so reduced.

On this basis, therefore, the load of twelve consumers, and on this housing scheme project there would be considerable similarity in the habits of the consumers, their after diversity demand could reach a figure of 10 kWs. The installation of a 75 kVA transformer, and high tension cables to suit might give considerable trouble to the Johannesburg Electricity Authority.

My second point, and obviously I must not take up all the points when proposing this vote of thanks, in order to leave something for the rest of the contributors to the discussion, is that I feel the author has not gone far enough in his comparisons.

He has started from the basis of what is standard for Johannesburg, and compared it with the new system in order to show that the new system is cheaper than the old.

If I may be so bold as to say so, I feel he has merely compared a non-standard system with another non-conventional system, and I feel that the paper should have been extended to a comparison of both these non-standard systems with a conventional and very well-tried system.

In Salisbury a new housing scheme was reticulated on the usual pattern of 11 kV ring main isolators and low tension underground reticulation, and low tension itself being interconnected between substations and made a very much safer supply and a very much more secure supply than the one envisaged by the author.

The cost of such a system worked out at £69 per consumer and compares very favourably with the cost of the system suggested by the author.

Mr. Barnard has, however, proved for me by his paper that the so-called conventional system of Johannesburg is, in fact, a much more expensive system than the conventional underground system, for a housing estate of this nature.

Mr. Barnard's paper is very interesting, and provides yet a further attempt to reduce reticulation costs, and at the same time to lend an ear to those cries relating to aesthetic values which have risen in volume over recent years, but I do feel he has sacrificed a little in network safety by the abandonment of standard type 11 kV switchgear in favour of solid connections.

In this system also a cable fault on one of the 11 kV single phase legs from the switching station will isolate 96 consumers for a considerably longer period than if switchgear of the conventional R.M.I. type were used.

This is occasioned by the necessity to break down solid connections in the smaller kiosks to isolate the faulty section.

The feature of the L.T. side of having twelve consumers isolated by a cable fault on any one service cable seems to me not entirely sound. Cable faults do occur, as the author himself admits indirectly when he refers to the safety of the street lighting scheme being improved by alternate street lights being connected to different cores of the street lighting cable.

It will also be interesting to find out, when the scheme is energised, just what the extra maintenance charges are.

A prominent feature of the scheme is the provision of a consumer's meter outside his property. This denies access to the consumer, who may wish to read his own meter, although it does give easier facilities to meter readers.

I suggest that a self-reading system by the consumer, which has already been applied to 15% of the consumers in Salisbury, will overcome these points.

Now, Mr. President, just a little on the purely technical side.

I feel that the suggested use of 11 kV.04 cable is bad in practice. The short circuit time and current of .04 seconds and 3,500 amps, that is approximately 70 MVA, are considered to be poor design figures, and it is suggested that figures should be a short circuit period under fault conditions of one second, that is allowing for mal-operation of one protective stage, and 150 MVA fault level at the intake point.

With regard to the 11 kV cubicles, I wonder if these are considered safe, and whether present regulations approve of operating live gang links and applying earths in close proximity to live connections.

With regard to earthing of the secondary, I feel this is most essential in order to give protection to the consumers from interphase winding faults. This has been known to occur, and if the author does not alter his scheme, a fair proportion of the 6,600 volt could be impressed on the consumer's services.

Finally I feel there may be some operational difficulties, but as I said at the beginning, both the author and the Johannesburg Municipality are to be congratulated on their courage in trying something new. Without experience of this type of reticulation nobody can be certain whether it is, in effect, a sound and safe cheap method of carrying out this work.

I am very pleased to see that Johannesburg have had the initiative to try this new method, and I am sure we shall all be very pleased to hear from the author in due course just what difficulties, if any, he has come up against after it has been made alive and in use for some time.

I have very much pleasure, therefore, in congratulating the author and proposing a very hearty vote of thanks to him for the preparation of the paper, and presenting it in such an able way to this Convention.

Thank you, Mr. President.

Mnr. G. C. THERON (Vanderbijlpark): Mnr. die President, here: Dit is vir my werklik 'n groot genoeë om die dankbetuiging wat mnr. Mitchell op mnr. Barnard se verhandeling voorgestel het, te sekondeer.

Die vergadering is inderdaad bevoreg om op so 'n dis getrakteer te word en die skrywer het nie nodig om daarvoor apologie aan te teken nie. In teendeel, ons wil mnr. Barnard gelukwens met die saaklike uiteensetting van die feite en die duidelike gevolgtrekkinge waartoe hy, na 'n vergelyking van verskillende versprei-netwerke, gekom het. Dit is 'n heel oorspronklike benadering van 'n ou probleem en 'n vingerwysing na 'n nuwe horison en ingenieurs sal baat deur die onderwerp nog lank te herkou.

Daar is seker nog baie persone wie kommentaar sal wil lewer op die besonderhede van die referaat maar ek wil tog die aandag vestig op die kwessie van aarding (Seksie 4.15).

In die dorp wat ek verteenwoordig het 'n kind onlangs die lewe verloor in 'n aardvrye omgewing omrede die verbruiker die verwarmer korrek ge-aard het, maar die toevoer verkeer deur die skakelaar geneem het. As die apparaat liewers nie ge-aard was nie sou die ongeluk moontlik nie plaasgevind het nie en ek voel sterk saam met die skrywer dat met 'n enkelfase-verspreinetwerk daar geen grond bestaan vir die aarding daarvan nie en die verbruikers daarsonder groter veiligheid sal geniet.

Ek kan ook die skrywer sterk ondersteun in sy vermoede dat instandhouding op 'n kabel sisteem veel minder sal wees as met 'n bogrondse netwerk.

Ons het geen gegewens vir 'n hoogspaningsnetwerk soos die wat vir Montgomery park voorgestel is nie maar daar is geen rede om aan te neem dat, indien die kabelspesifikasie met oorleg bepaal word, dit nie dieselfde steuringsvryheid as 'n laagspannings-kabelnet sal verseker nie.

Weens de verskillende metodes van kosteberekening en aanslaan van debites is vergelykende syfers moeilik bekombaar maar ek gee tog hieronder vir wat dit werd is, syfers wat 'n tyd gelede versamel is.

	Ondergrondse Netwerk	*Bogrondse Netwerk*		
Pennies per		A	B	C
eenheid verkoop	0.070	0.184	0.090	0.105
Eenhede verkoop (miljoene)	14	18	28.5	47

Mr. President, it now gives me great pleasure to second the vote of thanks proposed by Mr. Mitchell.

THE PRESIDENT: Thank you Mr. Theron.

Mr. E. L. SMITH (Boksburg): Mr. President, thank you very much for letting me speak, and for the assurance that the method of reticulation is not a patent. I would also hope that Mr. Mitchell's horoscope is incorrect this time, because if it is correct "is ek in die moeilikheid."

I wish to congratulate the author on a very interesting paper. Interesting to me because Boksburg may be the first to have the system of reticulating in operation. It is gratifying to see that our findings follow a similar pattern as that of Johannesburg's Montgomery Park scheme.

The Town Council of Boksburg propose to sell by public auction 151 stands in the new Township of Libradene before the end of the year. The smallest stand is $\frac{3}{8}$ of acre and the largest $1\frac{1}{2}$ acres. Before the stands are sold the reticulation of water, sewerage and electricity must be complete.

Tenders have been issued for all the necessary materials and equipment and it is hoped to commence the project in August this year.

The size of the stands show that the township is intended to cater for the upper income group, and we have also estimated electrical requirement of an after diversity demand of from 5 to 6 KW.

The electrical reticulation will follow the same pattern as Montgomery Park. The total estimated cost of reticulating the township with the conventional L.V. cable reticulation is £29,000. The estimated cost of reticulating with H.V. cable is £20,000, i.e. for L.V. reticulation £193 per stand and with H.V. £133 per stand.

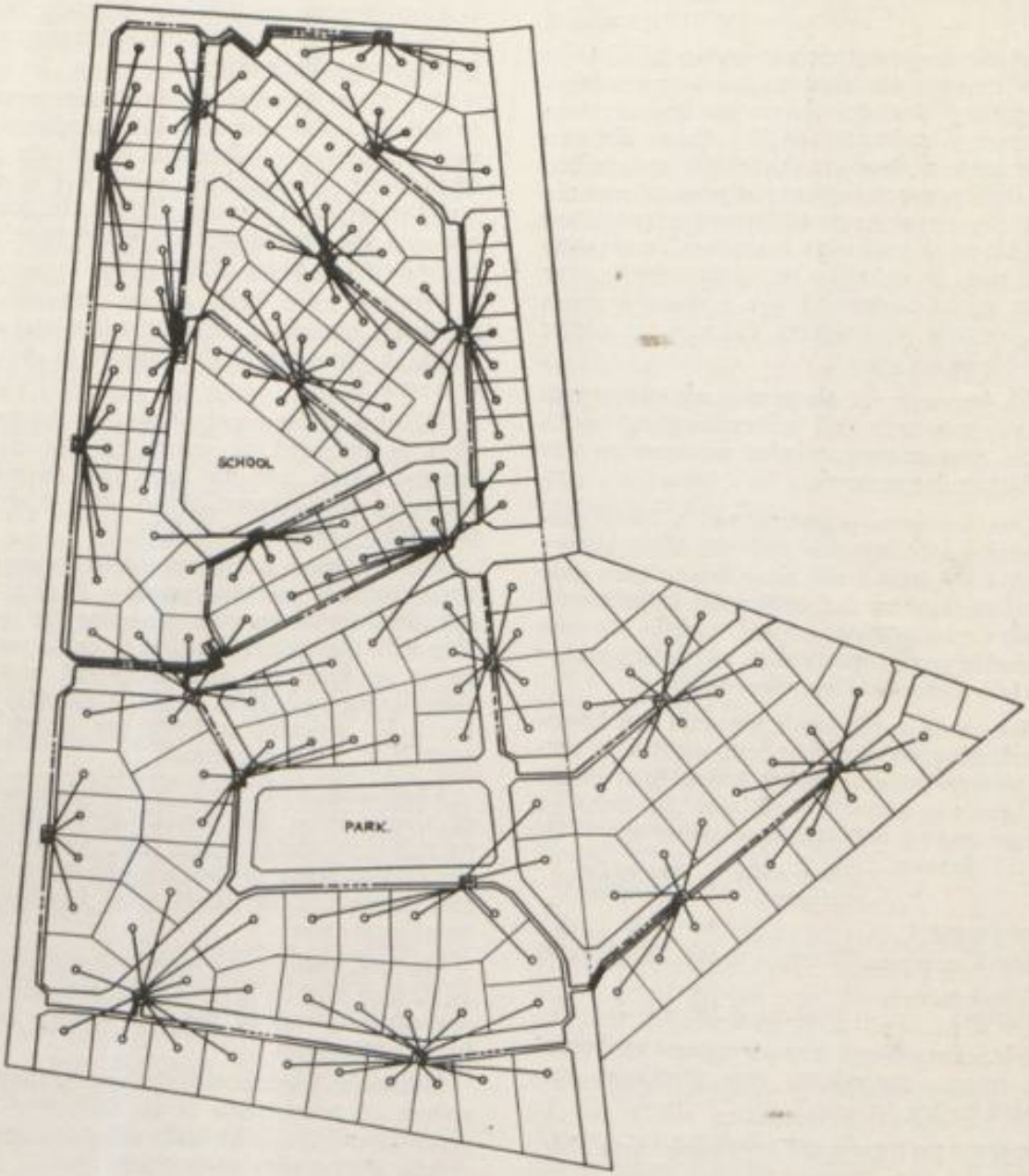
To reticulate with H.V. represents a saving of almost 30%. But the Council will have to subsidise some of the L.V. service connections as some of the runs are fairly long and because of the length some will have to be of larger size.

We are also of the opinion that greater protection will be given to the consumer by not earthing one of the low voltage transformer terminals.

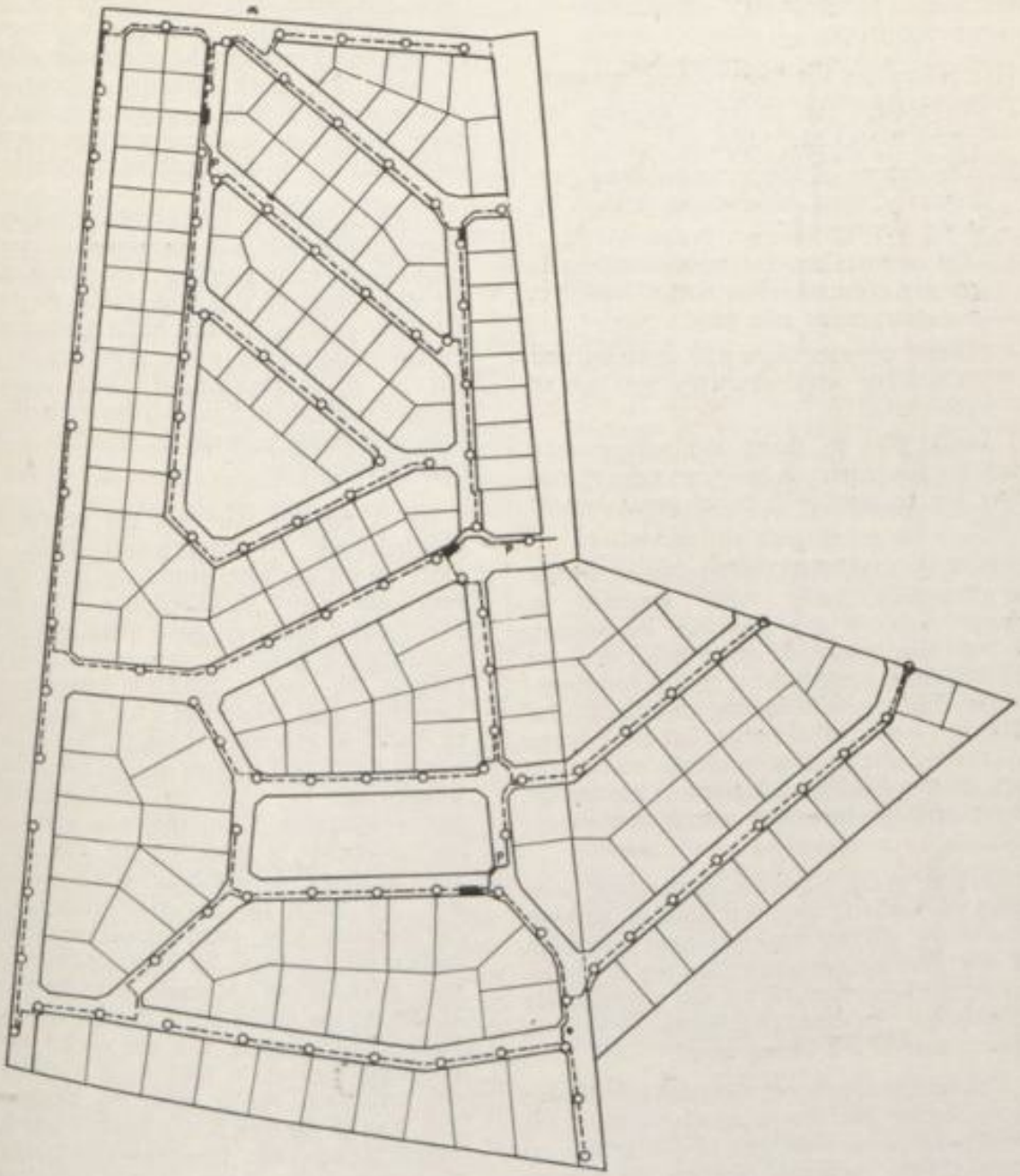
Otherwise I agree with the author that this system of reticulation is an attractive proposition and it will be interesting to compare results at the next convention.

The placing of consumer's meters in the kiosk is a step in the right direction, and has many advantages.

The Town Council of Boksburg, have agreed to a policy of having all meters removed from consumers' premises and placing them in the case of the old overhead



H.V. CONSUMERS RETICULATION. - LIBRADENE.



STREET LIGHTING RETICULATION. - LIBRADENE.

reticulations, in metal cabinets on the poles, in pillar boxes on the side walks where the reticulation is by means of LV underground cable, and in kiosks in HV reticulations as shown in the paper.

This policy has the following advantages:

1. All meters can be read whether the house is locked or not.
2. The danger of meter readers and particularly their boys being bitten by dogs is removed.
3. The time taken for meter reading is greatly reduced. The meter reader is not delayed by idle gossip.
4. Illegal consumptions and unauthorised tampering with council's services is eliminated

I would like to thank the author very much for his paper. It has been very stimulating for us, and will be of great benefit to me.

Mr. C. LOMBARD (Germiston): Mnr die President, here: Mnr. Barnard se referaat was vir my besonder interessant. Ek wil hom graag daarmee gelukwens en ook my dank teenoor hom en die Johannesburgse Elektrisiteitsafdeling uitspreek dat hulle ons 'n geleentheid gegee het om 'n insae te kry in hulle huidige praktyk ten opsigte van dorpsgebiedbenetting en toekomstige planne vir die benetting van Montgomery-Park.

Ek sou graag verskeie opmerkings wou maak in verband met die huidige praktyk soos in die referaat beskryf, maar aangesien ek weet dat die tydfaktor teen my is, sal ek my opmerkings beperk tot die voorgestelde enkelfasige hs.-benettingsskema wat vir Montgomery-Park beoog word.

Ten eerste mag ek net meld dat enkelfasige hs.-benetting nie iets vreemds is nie. Dit word alreeds vir baie jare in die V.S.A. op woongebiede toegepas ofskoon dit vereers hoofsaaklik tot bogrondse stelsels beperk was, en miskien nie heeltemal vergelykbaar is nie, aangesien dit in die meeste gevalle ook enkelfasige laagspanningstelsels ingesluit het. Om die onnette voorkoms te vermy wat die meeste van die V.S.A. se bogrondse stelsels in woongebiede kenmerk, is daar betreklik onlangs 'n begin gemaak met enkelfasige ondergrondse netwerke vir woongebiede wat ondermeer die gebruik van enkelfasige transformators insluit wat in beton- of metaalomhulsels gedeeltelik ondergronds geïnstalleer word om sodoende so min as moontlik aan die voorkoms van die omgewing afbreek te doen. Ek merk terloops op dat daar alreeds in die V.S.A. op sekere plekke oorweeg word om 'n transformator vir elke verbruiker in 'n dorpsgebied te verskaf.

Sover ek weet is Johannesburg die eerste onderneming wat die aanwending van 'n enkelfasige ondergrondse benettings-stelsel vir 'n dorpsgebied met erns ondersoek het en dit sover gebring het dat hulle gereed is om dit op 'n betreklike groot skaal toe te pas. Dit is 'n aansienlike afwyking van die huidige praktyk in Suid-Afrika en hulle verdien om geluk te wens te word met hulle ondernemingsgees.

As ek na die plan van die voorgestelde kabelnetwerk vir Montgomery-Park kyk, moet ek tot die gevolgtrekking kom dat die voorkoms van hs-kabelfoute in hierdie dorpsgebied veel hoër gaan wees as wat normaalweg die geval sal wees met stelsels wat volgens die huidige praktyk aangelê word, aangesien daar tenminste 3 tot 4 maal soveel hs.-kabel in gebruik sal wees. Wat ons nou ook al doen, beskadiging van kabels wanneer uitgrawings vir riole en rioolaansluitings, stormwaterpype e.d.m. gedoen word, skyn onvermydelik te wees en ek glo nie dat Johannesburg 'n uitsondering op die reël is nie. Ek merk op dat elke streek in die dorpsgebied met twee straaltoevoerkabels bedien sal word wat by 'n skakelpunt bymekaar aansluit om sodoende 'n kring te vorm en dat dit die bedoeling is dat die een straaltoevoerkabel lading van die ander een sal oorneem ingeval 'n fout in die ander een sou ontstaan. As ek egter na Beeld nr. 7 kyk, kan ek nie sien hoe 'n beskadigde kabellengte tussen twee transformatorkiosks van die aangrensende lengtes kabel geïsoleer kan word sonder veel tydverkwisting nie. Dit wil vir my voorkom dat om dit te doen, dit nodig sal wees om die isolering tussen die twee aangrensende kabelkaste te verwyder en die las tussen die twee los te maak. Ek sou ook dink dat heelwat tyd in beslag geneem sal word om vas te stel in watter lengte kabel so 'n kabelfout ontstaan het.

Ek sal graag die outeur se mening insake hierdie twee punte verneem.

Met verwysing na die outeur se aanmerkings insake die beskermingstoerusting wat in elke kiosk ooreenkomstig Beeld nr. 9 aangebring sal word, kan ek nie sê dat die voorgestelde skema my aanstaan nie, aangesien, soos die outeur self verklaar, 'n fout in 'n dienskabel die verlies van die toevoer na 12 verbruikers ten gevolge sal hê. Ek besef terdeë dat die outeur voor 'n moeilike probleem te staan gekom het om diskriminasie onder foutomstandighede te verseker en tensy mens die karakteristieke kurwes van die hoë onderbrekingsvermoë hs. en ls.-sekerings het wat gebruik sal word, is dit natuurlik moeilik om te oordeel. Ek meen egter dat dit beter sal wees om die 250 ampere h.o.v. ls.-sekerings aan die laagspanningskant van die transformator weg te laat en om instede daarvan, 'n h.o.v. sekering met 'n laer waarde vir elke dienskabel by of in die plek van die isoleerders voor die meters aan te bring. Die outeur verklaar self dat sekerings nie vir oorbelastingbeskerming geskik is nie, en word dus nie vir hierdie doel aangebring nie. Myns insiens sal die 10 amp. h.o.v. sekerings aan die hoogspanningskant van die transformator voldoende beskerming verleen teen enige fout wat tussen hulle en die ls.-isoleerders mag ontstaan. Ek is ook van mening dat indien foutwaardes aan die laagspanningskant van die transformators nog verder beperk word, dit diskriminasie onder foutomstandighede sal verbeter en dit selfs miskien moontlik sal maak om die 250 amp. ls.-sekerings te behou, aangesien hernuwing van die 10 amp. hs.-sekerings baie lastig gaan wees. Dit kan gedoen word deur hoë reaktans transformators te gebruik en ek wil die outeur vra of die installering van sulke transformators oorweging geniet het. Die hoë reaktans sal feitlik geen nadelige invloed op die spanning by elke verbruiker hê nie, aangesien die lading hoofsaaklik 'n weerstandslading is en die arbeidsfaktor gevolglik hoog sal wees.

In verband met die montering van meters in die kiosks moet ek meld dat ek nie seker is dat dit teenoor die verbruikers regverdig sal wees nie. Ek is van mening dat elke verbruiker die geleentheid gegun behoort te word om self, as hy so voel, sy meter te lees en sy lesing met dié van die meterleser te vergelyk. Al maak hy miskien nie daarvan gebruik nie, is die sielkundige uitwerking vanuit die gesigspunt openbare betrekkings beskou, ten bate van die onderneming. Ek sou dus verkies om die meter in alle gevalle by die verbruiker se huis te installeer.

Die outeur het 'n vergelyking getref tussen die koste van 'n konvensionele skema en dié van die voorgestelde nuwe skema en hy het bewys dat laasgenoemde 'n aansienlike geldbesparing sal meebring. Ek het nie 'n kans gehad om vas te stel hoe dit met 'n konvensionele skema in die onderneming waaraan ek verbonde is, sal vergelyk nie, en sal nie verder oor hierdie aspek uitwei nie. Afgesien van die kapitale besparing is dit egter duidelik dat stelselverliese laer as in die geval van 'n konvensionele skema sal wees en as die vermindering in stelselverliese gekapitaliseer word, sal dit moontlik 'n aansienlike som bedra. Aangesien die verbruikermeters aan die toevoerkant van die ls.-dienskabels aangebring sal word, is stelselverliese feitlik geheel en al uitgeskakel. Nogal 'n slim set van Johannesburg om die verbruiker regstreeks vir die koste van ls.-kabelverliese te laat betaal en miskien een van die redes waarom die installering van die verbruikermeters in die kiosks verkies word.

Ter opsomming is ek van mening dat sekere van die kenmerke wat in 'n konvensionele skema voorsien word, in die voorgestelde skema prysgegee moes word en dat vanuit 'n bedryfsoogpunt beskou, laasgenoemde ietwat te wense oorlaat. Net die ondervinding sal egter bewys lewer of hierdie leemte van 'n ernstige aard is. Johannesburg se eksperiment sal met belangstelling gadegeslaan word en ons wens die onderneming alle sukses daarmee toe.

Mr. F. STEVENS (Ladysmith): Mr. President, I would like to congratulate Mr. Barnard on his paper. Papers describing the practices of various undertakings have always been well received. Sometimes one wonders where there can possibly be any new ideas, but sure enough there always are.

Without praise and criticism no good purpose would be served in presenting such papers, so I would like to first thank Mr. Barnard for his interesting paper, and then question some of the ideas mentioned in it.

It would appear that an attempt has been made to supply a large European housing scheme with electricity at the lowest possible outlay, the question of continuity of supply and safety of operation taking second place. My reason for saying this is that, from experience, I consider high tension air break links should be avoided whenever possible on account of the possibility of their being open under a load. A set of such links installed with a cable box, costs approximately £30 while an oiled immersed isolater incorporating a cable box costs £120 i.e. £90 more, but it does eliminate any possibility of accidental contact and arc-ing which can be equally dangerous and lead to fire.

Another practice described in the paper, which I cannot see the force of, is having so many transforming points solidly connected, making it difficult to locate faults and to isolate them, again resulting in a large number of consumers being inconvenienced unnecessarily while the faults are traced. Here again, by having one oiled immersed isolater controlling an incoming feeder at each kiosk, the switching on and off of sections with their accompanying transformers can be done safely under live conditions, and the faulty transformer or section isolated to work on.

To finance the provision of oil break isolaters I suggest some form of load control to be introduced, either frequency, DC bias, load limiters, maximum load circuit breakers, ampere demand metering, whatever you like — all of which can, with a suitable tariff, reduce supply costs.

If the extra outlay for isolaters, and the load control equipment, and then the saving in demand charges are capitalised, I feel sure the one will offset the other.

We find the after diversity for domestic loads in Ladysmith to 5.1 KW without load control; but with load limiters in one area this is reduced to 2.5 and 3.5 KW. With DC bias off peak control in a number of other sub-stations the A.D.M.D. per consumer is 3.6 KW. The latter reduces the overall costs and enables us to finance the more conventional system.

I realise there would be difficulty in having a tariff for consumers only in one part of Johannesburg. The point I wish to make is that every endeavour should be made to safeguard operations and reduce the duration of outages, if consumers are to be encouraged to become wholly dependent on electricity for cooking, heating and cooling. The idea of low-tension single phase distribution is certainly worth considering, but here again, if one disregards the safety factor, single core cables could be used, and reliance placed on earth returns.

Side swinging doors for outside meter boxes we find lead to doors being left open. We discourage meter boxes being built into outside walls. When they have to be we insist on the doors being hinged at the top so that they drop closed.

Although my commetns have been critical I still appreciate Mr. Barnard's paper. Thank you.

THE PRESIDENT: Thank you Mr. Mr. Stevens. Any further discussion?

Mr. R. M. O. SIMPSON (Durban): I would like to join the other speakers in thanking Mr. Barnard for his most interesting paper. New developments and attempts to try and reduce the costs of distribution are to be definitely approved of, and any author of these to be congratulated, and there are points that come up in this paper which are worthy of quite considerable discussion.

Generally single phase distribution on the low tension side has been practised in Durban for many years. We have quite considerable areas which are supplied at single phase, and have been handled quite satisfactorily from that point of view.

We have also had overhead systems of 11 KV and 6.6 KV reticulation working from single phase as well. You might say to some extent, these are comparable with the author's suggestion, but there are certain differences.

So that fundamentally the principle of single phase high voltage and single phase three wire low voltage distribution systems are I think commendable and eminently satisfactory. There is nothing wrong with them, and they certainly can be more economic in quite a number of cases.

Regarding one or two points in the paper, I do not altogether like the idea of metering in cubicles. The idea that you disallow, virtually, a consumer from seeing or reading his meter is not, I think, to be commended. I would sooner allow the consumer to see his meter. I think it is better. As far as speeding up meter reading — dogs might even help that, you know, occasionally. That may not even be the case now, where you take them out of the vicious range of the animals.

And in any case I think if the author hasn't gone into it, if he reconsiders the particular case in point, he may find that it may be cheaper to meter the houses with the meters in the house, fed off a cable which you can taper down in size. I think you would find your cable costs over the whole scheme might be some £5,000 cheaper which might actually give a saving.

The other points — the flexibility of the system — that I feel sure . . . or the lack of flexibility may lead to some difficulties in the event and when faults happen. It is a little unfortunate that so many consumers can be interrupted say with an 11 KV fault on a portion of the system, where you might have a very large number of consumers off when you are trying to locate that fault and repair it.

The other difficulty will be — we have had some experience of this type in Durban, where we have installed a solidly connected (or we shall say it is inoperative) virtually equivalent to a solidly connected series of transformers operating off one feed, (we actually run them off a 3 phase 6,600 volt cable, so that in the event of a cable fault, or for that matter a transformer fault, you do lose that whole circuit. In our case we have means of isolation, which enable us to avoid un-bolting (?) and we can locate the fault reasonably soon. It suffers from one disadvantage, that it might lead to more than one re-closure on the fault, and when you come to put a loop on the cable you find you have burnt it through, so that you are then thrown back on to some capacity tests with not altogether always successful results, which also increases the delay in restoration of supply.

Offsetting that we may tend as engineers sometimes to try and put in too much protection on a system. You know you can spend a lot of money on oil circuit breakers and relays to give protection, and I think you will all agree that it is only too often that those do not perform their function when you want them to, and you might as well have dispensed with their use and gone in for something cheaper.

So I think any investigations into the reductions of plant with safety are to be commended.

I won't comment further, because I feel sure that others are waiting to join in congratulating the speaker and offer some constructive criticism, but I would commend a little more thought in the question of the size of the kiosks. I can see possibly some difficulties coming in there.

Mr. Mitchell has pointed out a good point there on the diversity. That is a very live factor. The diversity of demand is definitely a function of the number of consumers, and and the reduction to 12 might lead them to some difficulties in that particular respect.

The other point in regard to the individual consumers again, it is unfortunate that some enthusiastic gardener with a spade may put 12 consumers out of action for quite a long time. Whereas that could be overcome by means of fusing, or, in this particular case, very simply he could fuse each circuit and reduce that possibility.

Thank you.

Mr. G. C. DOWNIE (Cape Town): Mr. President, and gentlemen: I have some comments to make on this paper, and I have brought them with me from Cape Town. I have also brought along with me some comments from Harry Wood, who, as you know, presented the paper on mid-boundary construction at our Convention in Cape Town last year, and I don't know, but would you like me to read them to you when I have completed my own?

THE PRESIDENT: Mr. Downie, the meeting would like to hear your comments, and Mr. Wood's.

Mr. G. C. DOWNIE (Cape Town): Mr. President, gentlemen: The distribution sys-

tem outlined in Mr. Barnard's paper appears to be well worth the attention of electricity supply authorities. It would, however, only be practicable to apply a scheme of this nature to completely new townships wherein provision has been made at the Town Planning stage for accommodating the unit distribution kiosks. It is, in fact not clear from the paper just where these kiosks are to be placed, and as it appears from the illustrations that access to both front and back is necessary it would seem operating personnel or meter readers must have access to private property if the cubicles are placed in the boundary walls or fences.

It must not, of course, be overlooked that new townships are usually developed in stages and if this is to be the procedure at Montgomery Park one complete zone may be fully developed and occupied before a second is commenced. This would mean initially an unbalanced single phase load of some 700 to 1,000 kVA, being imposed on the three phase supply system, which would have a detrimental effect on the voltage regulation.

From the aspects of continuity of supply and of safety of operating personnel, the scheme is not so attractive. For instance, in the event of an H.V. H.R.C. fuse on a unit transformer blowing, the supply to at least half the unit distribution centres in a zone would be interrupted whilst it is replaced, which would cause considerable inconvenience to consumers.

The use of 11kV bare links and link sticks and the attendant risk is not favoured in Cape Town and such equipment was removed on the score of safety many years ago.

As far as can be seen from the photograph (Fig. 7) of the Unit Distribution Kiosk, the 11kV cable terminations and the 10 amp H.R.C. fuses protecting the unit transformers are not shielded in any way once the kiosk door is opened. Supply is, therefore, presumably cut off to 8 kiosks, i.e. 96 consumers whilst *any* work such as locating and repairing of cable faults, maintenance on a transformer or even replacing a fuse is carried out. Such an outage cannot be limited to only 12 consumers as stated at the end of paragraph 4.13.

While little or no maintenance may be required on a hermetically sealed transformer there must in time be a deterioration in the quality of the insulation and some trouble must be expected after many years of service. It would also indeed be interesting to learn how the Johannesburg Engineers have overcome the perennial breakdown of cables at the crutch of the end boxes.

It would appear, therefore, that the residents of Montgomery Park must be unusually patient and understanding consumers, or are they going to be "conditioned" in the years to come?

It is interesting to note that the street lamps and brackets are charged directly to the Rate Fund. Is an equitable contribution also made from this fund to cover the cost of supply to and maintenance of the street lighting system.

Mention is made that on the standard overhead reticulation with cable connections, a wired pole-mounted fuse is used. Is such a fuse really necessary, as with the advent of P.V.C. insulated, wire armoured and P.V.C. sheated cable, the incidents of faults on the connections to the consumers must surely be very low.

However, it is felt that the objectives which the author had in mind when developing this scheme, namely reduction of cost, the avoidance of the use of unsightly overhead mains and the simplification of meter reading, warrant serious consideration and if further information in regard to the operation of the system at Montgomery Park can be supplied in due course it will be welcomed by all supply authorities.

COMMENTS ON PAPER BY MR. BARNARD

By H. Wood, A.M.I.E.E.
(Cape Town Electricity Dept.)

I should like to congratulate Mr. Barnard on his excellent paper and even more on the development which forms its subject.

Single phase high voltage distribution is, however, not an entirely novel idea, the writer of these comments having spent a

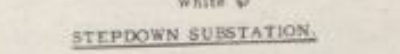
considerable time on a similar network in England. This network consisted of a central stepdown substation 6.6/2.2kV. from which 2-core 2.2kV. ring main distributors radiated to supply single phase 2.2/0.22kV. 50 kVA. transformers. In some areas, where it was considered more economical due to loading conditions, 100 kVA. transformers were installed.

The protection on the 2.2kV. cables and high voltage side of the transformers was by means of HRC fuses and the low voltage side of the transformers was solidly linked to the LT bus-bars in the feeder pillar. The transformers were placed in underground steel tanks provided with diving bell lids, and the feeder pillars were mounted in the walls or fences on the boundary of the property, thus causing no obstruction on the sidewalks.

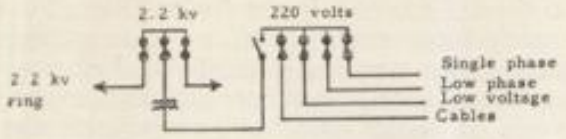
Photographs of a transformer and a feeder pillar are shown below:—

From the feeder pillar four single phase LT cables radiated, each supplying approximately 8 consumers, or up to 16 where 100 kVA. transformers were installed and were protected by means of re-wireable fuses, these cables being interconnected by means of underground link boxes. The Admd's obtained were very small compared with South African standards, being only of the order of 1.5 — 2.0 kW.

Details of the substation and feeder pillar are shown diagrammatically below:—



STEPDOWN SUBSTATION.



FEEDER PILLAR.

This single phase high voltage distribution has been in operation for approximately 35 — 40 years and is still in use today, but, on economical grounds, it was decided in about 1930 that all future development on the distribution system would be by means of the conventional 3-phase 4-wire underground system.

Some of the main difficulties associated with a single phase system is the balancing of the load on the main stepdown transformers, voltage regulation and also extreme care has to be taken when transferring load from one phase to another. This latter problem does not apply in the network proposed by Mr. Barnard as no means of interconnection between the single phase areas are available

The Admd of 5kW. is very surprising. In Cape Town the figure for this type of township would probably be of the order of 3 kW. Could Mr. Barnard give any indication of the individual consumer maximum demand under these conditions? Has any trouble been experienced with excessive voltage variation with these high demands especially in view of the fact that loads of 80 amperes are permitted on a single phase 0.0225 service connection up to a length of 250 ft. The total permissible voltage variation at the consumer's terminals is 10% (i.e., ± 5%) and the high regulation obtained in the service connection under the above conditions, namely 6.8%, would severely restrict the design of the HV and LV networks or might even make it impossible to maintain the voltage within the statutory limits. This condition appears to be exaggerated in the proposed network, especially for the consumer furthest from the kiosk where the service connection may be up to 150 or 180 yds. in length.

Could Mr. Barnard supply details of the service connections and the estimated regulation of the system

In Cape Town, when the estimated maximum demand exceeds 10 kW. or 46 amperes, a three-phase service connection is provided.

The lack of discriminative protection on the single phase high voltage rings is noticeable. A fault on any section will cause a complete shut-down of the whole single phase until each section has been isolated, tested and the fault located.

With no alternative supply available on the LT supplies to the consumer, could Mr. Barnard give details of how and when maintenance on the transformers and kiosks is to be carried out without inconveniencing the consumers?

The omission of a scale on Fig. 5 has made it difficult to design an alternative network in order to make a comparison with the costs given in the paper. A detailed comparison of costs showing labour, materials, etc., would have been more useful to enable an essessment of the savings to other undertakings to be calculated.

Mr. Barnard comments on the advantage of being able to plan a good street lighting layout when using an underground system. This, however, is not obvious from the layout shown in Fig. 11 where the single-sided arrangement has been used throughout. This design has probably been adapted in the interest of economy but it is certainly not in the interest of good street lighting.

A far better arrangement, although a little more expensive in initial cost, would be to provide staggered lighting on both sides of the road and so obtain a more even level of illumination on the road surface without any high contarts or shadows.

Another desirable feature would be to "tie-in" the street lighting cables thus obtaining an alternative supply to the lighting under fault conditions.

Mr. Barnard's intention to provide fluorescent lighting is commendable but the initial cost of the totally enclosed lantern shown in Fig. 10 is surely liable to be three or four times the cost of a 200 watt tungsten lantern, not the same as stated in the paper.

THE PRESIDENT: Thank you, Mr. Downie. Gentlemen, is there any further discussion?

Mr. J. A. MORRISON (Johannesburg): I did indicate to Mr. Barnard that I would be prepared to support the findings contained within his very excellent paper, but the points that I had intended to dwell upon have already been amply covered by Mr. Smith.

For some time now, we have been advocating underground reticulation in preference to overhead schemes, not only from the aesthetic viewpoint but also on account of security and the considerable reduction in maintenance charges. Until the present date, the cost of a project utilising metering kiosks and underground cables has been between 5% and 12% more expensive than conventional overhead systems and despite the many advantages, some engineers have been reluctant to incur the additional expenditure.

The scheme now presented by Mr. Barnard shows a saving of 34% on the costs of existing overhead systems in Johannesburg and, despite the misgivings of Mr. Mitchell, which I am sure will be answered to his satisfaction, I recommend that the principles involved should be given serious consideration.

Speaking personally, I do not share the doubts expressed concerning centralised metering. Quite a number of Municipalities and E.S.C. housing projects locate six or twelve consumers' meters in one kiosk—in preference to placing them in the respective homes, and I have not heard of a single criticism that the consumer has not been able to read his own meter.

This method, which also embraces the Municipal M.C.B.'s in the Kiosk, not only speeds up the meter reading, but provides the Municipal engineer with complete control of his domestic consumers at an easily accessible point.

Gentlemen, as I have said, Mr. Smith has already extolled the virtues of Mr. Barnard's scheme and all that remains is for me to associate myself with those who have congratulated him on a very fine paper.

THE PRESIDENT: Thank you, Mr. Morrison.

Mr. Downie suggested that Mr. Wood's paper of last year had possibly started something. I quite agree. I particularly feel that the type of paper produced by Mr. Wood, and also by Mr. Barnard, is of decided interest to a meeting such as this, but I want to stress that both young men, I am sure, will also have benefitted considerably from the experience gained in presenting their papers, answering the discussions, and listening to the criticisms.

I am now closing off. Mr. Barnard will be here for a short time early this afternoon, and I would like to know if there are other discussions possible on both papers.

I suggest that we start at 2.15 p.m.

LUNCHEON ADJOURNMENT

On resuming at 2.15 *p.m.*

Mr. R. K. JOOSTE (Oudtshoorn): Mr. President, gentlemen, the question of losses was briefly mentioned this morning by a previous speaker. In this regard I would like to ask two specific questions.

Firstly, did the author make any attempt to estimate what the probable losses would be with his scheme as compared with the conventional scheme? I mean, all losses including copper losses in cables, copper loss in transformers, and also iron loss in transformers.

That leads to my second question. In view of the fact that iron loss in transformers must attain significant proportions in the author's scheme, due to the high connected transformer capacity, in the purchasing specification for the transformers, were transformers with specially low iron loss specified or not?

Thank you.

Mr. A. F. TURNBULL (Vereeniging): Referring to the older native townships where no provision has been made for electricity.

Previous speakers have stressed the importance of taking into consideration the economic capacity of the consumer.

Mr. Carr quoted figures of income which appear to show that the average Native household cannot afford the additional charges which an electrification scheme will impose, unless of course it can be shown that electricity is cheaper than the usual methods used by the Native for lighting and heating.

In undertaking a house-wiring programme, may I ask if a tenant is given the choice or is it compulsory for all to take electricity and what is the reaction of the average Native who may not initially be unduly interested in acquiring an electrical installation.

It is also interesting to hear that whilst the Johannesburg Natives all opposed the adoption of flat rate charges, Pretoria appears to be successfully operating a scheme based upon load limitation. Has any local authority conducted a survey into the merits of the two schemes. The load limiting scheme does save the expenses caused by metering and may therefore be the more economic method for initiating an electrification scheme. Mr. Simpson has mentioned possible abuses of the system, and it is worth further investigation.

Some Local Authorities, including my own, are of the opinion that the time is not yet opportune for embarking upon large scale schemes. Only by gaining knowledge from the experience of others will the smaller Local Authorities be able to venture into this relatively new field of development.

THE PRESIDENT: Thank you, Mr. Turnbull. Is there any further discussion?

Mr. G. H. MARTIN (Johannesburg): Mr. Masson is to be congratulated on the clear and lucid manner in which he has presented the problem involved in Native Township reticulation. It is clear that he has tackled the problem from fundamental principles and has tried to steer clear of conventional practices which have been evolved on other types of schemes. He has been burning the candle at least at one end, if not two!

Mr. Masson says that his paper is submitted in the hope that others will let him have the benefit of their experience. Unfortunately, I can't let him have any practical experience of my own in township reticulation, but I do have a few ideas which have not been fully worked out, but which seem to be worthwhile investigating.

Mr. Masson has mentioned duplex or triplex cable with PVC insulation and he has also mentioned the use of bare aluminium conductors.

I have here a sample of Triplex Aluminium Conductor which is made by South African cable makers in Port Elizabeth.

This triplex cable is made up of the same sizes of conductor used in the Western Native Townships. All the conductors, however, are fully compacted and thus comprise of a round central wire as overlain by six segmental shape aluminium wires. The main reason for compacting in this case is to reduce the over-all diameter and close up the interstices between the strands thus reducing the amount of insulation material required.

This triplex conductor consists of a .04 sq. inch copper equivalent aluminium steel reinforced neutral which also acts as a messenger supporting the two insulated conductors. These are: a .04 sq. inch copper equivalent all Aluminium Phase Conductor, and a .025 sq. inch copper equivalent lampline.

The advantage of this type of cable are: Firstly, economy. In Native Townships the average frontage of the properties is only about 50 feet. If service connections are taken from the poles a relatively large amount of service wire will be required. Triplex conductors of this type may be tapped in midspan. It is of course, advisable to have two tappings fairly close to each other on opposite sides of the wire to balance the pull. This means that the minimum amount of conductor is used for service connections.

Secondly, a further advantage is that fewer poles can be used as spacings are not dictated by tap off positions, and moreover the use of insulators can be completely eliminated as the bare neutral can be attached to the pole by means of a metal clamp.

Thirdly, insulated conductors are more free from hazards, particularly in Native areas, and the complete elimination of insulators is of course also the complete answer to stone throwers and sharp shooters.

When using triplex conductor with midspan tappings the service wire would be a duplex (perhaps sometimes triplex) with a bare ACSR neutral. This would also act as a messenger supporting the insulated wires and is attached to the bare neutral of the distribution lines by means of a simple clamp. The conductors are separated by means of a simple tool and temporary spacers inserted to hold the conductors apart while the connection is made. The most compact connection is achieved by using a compression line cap, but a universal parallel groove clamp may also be used. The joints are taped overall, and the temporary spacers may be removed if desired.

Incidentally, midspan tappings may also be used with open wire vertical construction by using ACSR for one of the conductors and attaching the ACSR neutral of the service wire to this. This would necessitate core attachment to regulators.

Wiring Regulations.

Where an open wire construction is used it is of course not usually necessary to use insulated conductors. However, the use of compacted conductors or Alpac or Smooth Body as they are known, lends itself to insulation due to the smooth surface. I also have here a sample of .04 sq. inch copper equivalent Alpac Aluminium which had been insulated with a thin skin of PVC. This insulation is only .01 to .018 inches thick and I have called it "skin insulation," as it is not intended to withstand full voltage under all conditions. The idea is simply a thin skin of insulation as a protection against arcing for those people who are concerned about baling wire and pieces of scrap iron being thrown up into the line in Native areas.

The skin insulation of Aluminium Conductors only adds a small percentage to their cost.

Mr. Masson has, of course, already adopted aluminium for his overhead lines. It is by far the most economical conductor, enabling a 50% saving to be effected on conductor costs, even at the present time. It is pleasing to learn that Aluminium Conductor has given such satisfactory service in spite of some initial doubts on the matter.

There is just one point that I would like to clarify; I am sure that Mr. Masson appreciates this, but I don't think he has made it quite clear. He states that due no doubt to the dry climate no signs of corrosion have been experienced on the Aluminium Conductors, and that no elaborate measure has been taken to obviate corrosion. I think Mr. Masson means bi-metallic corrosion, not corrosion on the aluminium as such.

Pure aluminium and most aluminium alloys have very good resistance to all types of atmospheric corrosion. Its corrosion resistance is in fact superior to copper. We have a corrosion test stand on the roof of a building on the beach front in Durban, and after two years' exposure the following results were obtained. Pure aluminium .048 mills per year, copper .099 mills per year.

We were hoping for further results after five years' exposure, but unfortunately our copper specimens were stolen, however, results in America of tests by the American Society for Testing Materials carried out at La Jolla, California (which is the most corrosive of a number of tests sites), show an average corrosion rate of .028 mills per year for aluminium compared with .052 mills per year for copper.

Mr. Masson's report regarding the absence of bi-metallic corrosion confirms experience accumulated by numerous other undertakings in the inland areas of South Africa during the past ten years. Obviously you can't get electrolytic corrosion if you

don't have an electrolyte. Even rainwater which might be present in joint areas for a short time before the sun dries them off can hardly be classed as an electrolyte.

For rainwater to act as an electrolyte one must have dissolved salts. This could be achieved in a polluted industrial atmosphere by SO 2 or SO 3, forming weak solutions of sulphurous or sulphuric acid, or in marine atmosphere where salt spray can give you a brine solution.

I don't know of any heavy polluted industrial areas in South Africa where you can get this type of corrosion, such as you have in many areas in Great Britain. Considerable experience in the use of aluminium has now been obtained in South Africa and I think that we should not blindly follow British practice. For example, it is normal practice in the United Kingdom to specify steel reinforced conductor, having the steel core greased. This is generally not necessary in South Africa, and usually the greasing is more nuisance than it's worth. I think I am correct in saying that this is recognised by Escom who now usually specify that their ACSR should be supplied with the steel core non-greased.

I think very much the same goes for much British practice regarding bi-metallic connectors.

In coastal areas, where you are sufficiently close to the sea to have salt spray, which is usually not much more than a quarter to half a mile, depending upon the situation and prevailing winds, it is necessary to take special precautions with bi-metallic connections. These precautions, however, are extremely simple, and take the form of using suitable compounds or grease impregnated tapes for covering the fittings, or the use of compression accessories, where you achieve such intimate contact between the two metals that crevice corrosion cannot take place.

Last night Mr. Lombard gave three criteria in the selection of overhead conductors, viz: technical, economic, and price stability. I feel that aluminium conductor meets all these three. There are no great technical difficulties on the use of low voltage lines. The economic considerations — well, you can save about 50% on conductor cost, as I have mentioned. Price stability — a point worth remembering is that aluminium is not traded on the London Metal Exchange, and it is not subject to day to day fluctuations in price. In fact at the present time the price has been fixed firm for a six month period.

Two other factors which I might add to those mentioned by Mr. Lombard possibly, are educational and logistical, or the question of store-keeping. At the present time it is the question of training personnel which does seem to be one of the main factors. On the question of store-keeping, the handling of two different types of material at the same time can complicate matters, but the economic advantages make the use of aluminium still well worthwhile.

In conclusion, I would like to thank Mr. Masson for his extremely interesting paper.

Mr. C. LOMBARD (Germiston): Mr. President, gentlemen: I think I am going to skip most of the remarks I intended to make. I know we are pressed for time, and many of the points I wished to make have already been covered by previous speakers.

Mr. Masson's paper is undoubtedly of great interest to all municipal electrical engineers, and I would like to congratulate him on a most valuable and informative paper.

Mr. President, I was interested to note that the design and methods adopted and/or favoured by the author for Native Township reticulation schemes correspond with those adopted for the Natalspruit Native Township at Germiston, such as underground high tension scheme, brick kiosks built by Native labour, impregnated wood pole overhead low tension lines with aluminium conductors in vertical configuration, etc. I would, however, like to assure you Mr. President that we haven't pinched any ideas from Johannesburg and I don't think that Johannesburg has pinched any of our ideas.

However, for Natalspruit Native township, steel re-inforced aluminium conductors were used throughout for street lighting circuits, as well as overhead feeder lines. It was found in other areas that severe burning, often resulting in conductor breakages, occurred when wires were thrown across all aluminium lines, and it was considered that the steel reinforcement would reduce the possibility of conductor breakages under these conditions.

This has proved to be the case, and with something like 36.7 miles of ASCR lines in service in Natalspruit Native Township, no conductor breakages have so far been recorded.

I would like to ask Mr. Masson whether consideration was given by him to the use of ACSR.

In regard to service connections, it is noted that the author favours underground looped service conections. I agree that this is a most satisfactory method, but it is not practical unless used in conjunction with house wiring schemes, where a large number of houses in groups are wired and connected at the same time.

Where individual houses have to be connected from time to time at various points in a Native township, some other method must be adopted. One such method was mentioned by the author, i.e. rear boundary reticulation with overhead services. For Natalspruit, where the overhead mains were run on the same poles as the streetlighting circuits, PVC underground cable connections are provided from the nearest pole to individual houses, each cable terminating in a meter box, mounted on the outside wall of the house.

For service connections to houses on the opposite side of the street, a twin figure 8 all aluminium PVC insulated overhead cable is taken to a wood pole planted at right angles to the line on the opposite side of the street, from where PVC underground cable connections are taken to three houses.

In this way no re-instatement work is required, and the difficulty of maintaining clearance over the roadway to low roof height is avoided. Calender Brown insulators are used on the lines, and for these cable road crossings, and contribute greatly to making the job present a neat appearance.

Referring to the use of fluorescent fittings, I wish to endorse the author's remarks on the vulnerability of the power faction correction capacitors to lightning.

We have found it necessary to provide a lightning arrester in each fitting, which adds approximately 15/- to the cost of the fitting, but it is hoped that the extra cost incurred in this way will eventually prove worthwhile. At this stage it is too early to say whether satisfactory results will be obtained.

Once again — thank you Mr. Masson, for your most interesting paper.

Mr. J. L. VAN DER WALT (Krugersdorp): Mr. President, through you—Thank you very much Mr. Masson for the very interesting paper on this most controversial subject.

Turning to Photograph F, which was primarily reproduced to show us the street lighting, can I suggest to Mr. Masson, seeing that he is employing a multiple earth system, he can save a few shillings by eliminating the two insulators on the neutral conductor?

Can he tell us why they use insulators on the split neutral conductors if it is multiple earthed?

Then, coming back to the main purpose of the photograph the fluorescent street light fitting: I am still not convinced that the flourescent street light fitting is the correct fitting for Native locations even in our European areas they are very rarely employed as a method of street lighting.

I would also like to endorse the danger of the vulnerability due to riots, stone throwing, etc. We still stick to the very old-fashioned method of incandescent lamps—150 W. lamps — but I am very keen to try out, if one can get a manufacturer to produce a fitting cheap enough, of which the reflector is made of fibre glass, which I think should be very foolproof against riots, stone-throwing etc.

Coming back to — I think Mr. Mitchell suggested this — the fact that a sub-committee be formed to go into this matter and get a more standardised form of supplying electricity to Native locations, I hope that that will materialise, but I would also suggest that if that is done, the staff of the Government Native Administration Department be invited to be represented on that sub-committee. I think it will help us a lot. We will clear up many difficulties and will also prevent this ping-pong business of correspondence with that department, impossible splitting up of costs, one has to re-design a scheme sometimes three times before it is finalised, and then you find that you have been done out of a thousand pounds here and there because you didn't split your costs correctly and so forth but I think a lot of difficulties can be ironed out if they are also represented. Or some means should be devised whereby better consultation could be had with the Administration Department.

Mr. Carr made the remark that we should go all out for the Native as a potential consumer of electricity, yet legislation does not give us that incentive, because the electricity departments may not trade in Native locations. I wonder how we will overcome that handicap?

THE PRESIDENT: Thank you Mr. van der Walt.

Mr. G. C. MOLYNEUX (Rhodesia Railways): Mr. President, I have been most interested in Mr. Masson's paper, and the discussions that have taken place on it. There is very little that I can add. We have a number of undertakings in Southern and Northern Rhodesia but speaking broadly our policy has followed very much along the lines that members of this Association have advocated.

There is just one departure we are making which would perhaps interest your Association, and this is in the nature of an experiment as far as we are concerned, and that is in some of our higher income group African housing, to get an indication of the extent to which the African is going to use electricity if he has an unlimited supply, we are putting in pre-payment meters. I know there are attendant troubles, but I will be very happy to report to you in the fulness of time our experience with this particular type of metering.

THE PRESIDENT: Thank you Mr. Molyneux.

I am going to ask Mr. Masson to reply, unless anybody else has any other questions.

Mr. G. J. MULLER (Bloemfontein): Mr. President, I would like to congratulate you on the independent thinking of the members of your staff. And I would like to congratulate both Mr. Masson and Mr. Barnard on the quality of their papers, and the contents.

Whether Mr. Barnard has gone too far in trading continuity of service for cost, time alone will tell. Nevertheless, he has given us plenty to think about.

Mr. Masson's paper interests me considerably as we are at the moment considering the question of supply on a rather large scale to our Native areas.

Mr. President, our trouble does not lie so much in the newer areas where design is relatively free, but we have a large built-up area where perhaps we are unique I am not sure, but building in Bloemfontein is on an ownership basis — or has been until very recently. Even now it is still continuing but not on the same scale.

In other words the Natives built their own houses on lease-hold stands to plans approved by the Native Affairs Department. With so much freedom of design of houses, even in construction, standard wiring of the buildings, and even the method of distribution, is perhaps not always amenable to the methods suggested.

I had hoped that either Mr. Barnard, Mr. Masson, or any member of the audience, had done some work on the reticulation of, shall we say, older and owner-built houses.

Thank you Mr. President.

THE PRESIDENT: Thank you Mr. Muller.

Regarding continuity of supply, I think it would be a good idea to arrange to shut down some of our areas, so that consumers would appreciate their past good service!

Mr. G. MASSON (Johannesburg): Gentlemen, I would like to say, very sincerely, "Thank you" to all the speakers who have made such valuable contributions to this paper. I do feel that their contributions have made the work that I put into this paper worthwhile I am really very gratified at the response.

It will be difficult this afternoon to answer all the questions, and perhaps enlarge on all the questions that were put to me, but I will try to answer as many as I can now, and perhaps I can give written answers to the questions that I have missed.

Mr. Downey asked several questions, and I would like to answer those if I can. Before I do that, I would like to say that Mr. Downey's joke about me creeping out to Springs to have a look at his installation I know was meant in a joke, but he was confusing me with a dark, tall, handsome man, and I don't comply with those specifications.

Where adequate funds have been available we have standardised on 80 yd. spacing of street lights. Due to insufficient capital having been provided, for some townships it has been necessary to adopt 160 yd. spacing in certain cases and only alternate streets have been illuminated. I agree that the wider spacing is inadequate and that lighting must be provided in every street. It is the intention to remedy this when money is available. I like the thought of a street light on every pole with 40 yd. spacing, but since we have not attained this ideal in the European suburbs of Johannesburg, it will be some time before this will be practicable in the Bantu townships.

The after diversity demand of 680 watts per consumer is interesting. The figure of 500 watts has been adopted in Johannesburg on the basis of our experience at Eastern Native Township where the demand is less than this figure after ten years' operation. The figures given by Mr. Wilson (Pretoria) appear to bear out the contention that 500 watts is adequate for the initial stages of development. I do agree that we will have to cater for an A.D.M.D. of 1kW per consumer and possibly higher in years to come. It is therefore essential that the reticulation scheme be designed so that its capacity can be readily increased. I submit, however, that it is wasteful of capital to now provide a reticulation scheme of a capacity that will only be required in 10 to 15 years' time.

I was interested in Mr. Downey's remarks on guards for street lighting. Our experience has been limited, but we have one township where the superintendent's control seems to be very strict and very satisfactory, and in two years' experience we have had practically no fluorescent lamps broken. In the adjoining township nearly 40% of the lamps are replaced because they have been broken, so I do think that control exercised by the Non-European Affairs Department or the residents would reduce the amount of breakages.

A suitable wire guard will cost something like 15s. to £1, and should be provided wherever there is a lot of vandalism.

On Mr. Lee's comments, I must agree with him that the number of faults that one gets on an underground cable system is very small and if we had the choice most of us would have an underground system.

Thank you for the description of Daveyton Reticulation Scheme. The figures given us are most interesting and will be studied with interest by us all.

The remarks about illegal wiring are interesting. An inadequate wiring installation will give rise to illegal wiring that is difficult to control. It behoves us therefore to introduce new methods that will permit the maximum number of lighting and plug points for the amount of money available.

The costs given under the heading "comparison of costs" include H.T. and L.T. reticulation, street lighting and service cables but they do not include the price of meters.

Mr. Brown's notes on the use and training of Native wiremen are very interesting. I would like to know what wages one pays

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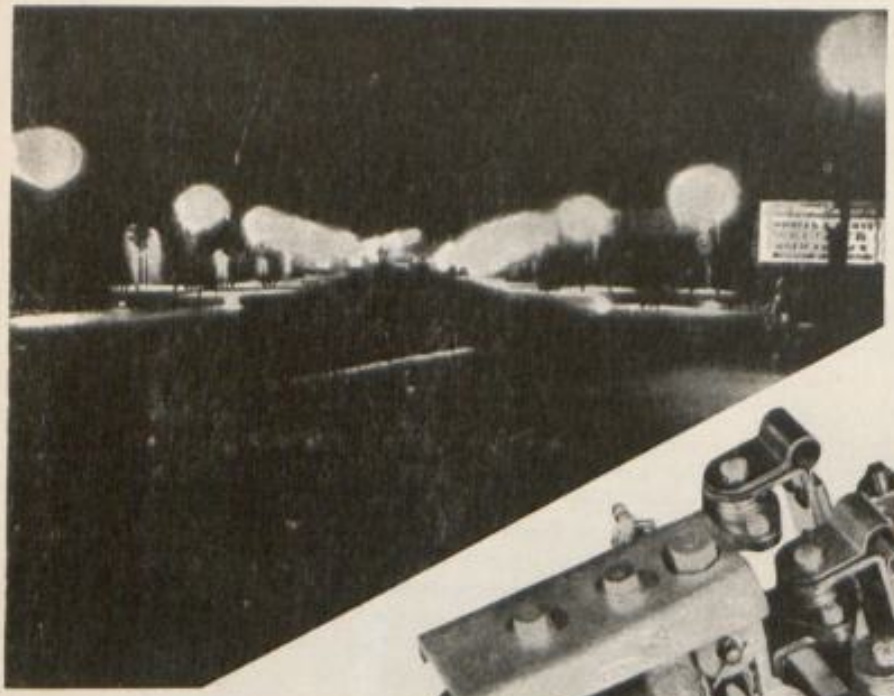

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these trainees, and also qualified wiremen if you can get them. We do know the wages that are laid down in the Building Workers' Act for the trades of carpenters, bricklayers and plumbers, but it would seem that these Native wiremen trainees feel that they are of a higher standard than the building worker and should get better pay.

With regard to the cost of wiring our house wiring installations are all conduit, and lights are mounted back to back. One light is provided in each room and the light switches are grouped at one point. The meter box costs approximately 19/-. The circuit breaker, meter, meter board, terminal blocks, and miniature circuit breaker, come to roughly about £5. We have provided one plug point in each house except the bigger houses (there are some four and five-roomed houses) where we have given two plugs. In the smaller houses the plug point is mounted back to back with the meter. The cost of our wiring installations vary from approximately £4 for a 2-roomed to £5 10s. for a 4-roomed house. Service connections cost approximately £10 to £11 per house.

Mr. Sibson and others have stressed the point that the vandalism in Native areas is not really different to what you have in comparable European areas. We have found that much of the vandalism has really been not due to children, but to adults. Some of our Native townships appear to be the resting place of many stolen cars. The thieves strip them of the parts that they want, but before doing so, of course, they put out the street lamp.

Details of load control metering would be of interest as well as further reports on the use of current limiters. It would seem to me that current limiters will be suitable where the consumer is prepared to accept a restricted supply of energy but metering seems necessary where unrestricted use is required.

When the Eastern Native Township was established, the Natives were consulted and we pointed out to them that if we could dispense with the expensive meter, we could perhaps give them a more lavish wiring installation. I remember their reply was very definitely that if a meter is good enough for a European it is good enough for a Native.

Straight reading meters have therefore been adopted as a standard and I think experience has proved, from the limited number of consumers that we have, that the account meter is the fairest method of charging consumers albeit an expensive one.

Replying to Mr. Turnbull, it is not the intention to make it compulsory for tenants in the Native areas to use electricity supply but on the basis of our experience at Eastern Native Township it would seem that the inhabitants desire the use of electricity. It can be expected however that there may be a lag in the demand for supply, particularly where consumers find it difficult due to economic reasons to make the initial consumption deposit.

The Natives are treated the same as Europeans in that a consumption deposit is asked for. They have to pay a deposit the equivalent of two months' consumption. It may be a hardship to quite a few of them to pay that consumption deposit, but when it has been paid, I think the use of electricity will be popular. At Eastern Native Township, out of 620 odd consumers, there is only one who does not take supply, and the reason for that is that he works for a candle factory, and he doesn't need electricity.

Mr. Martin's remarks about aluminium conductors were very interesting. I would confirm, as he said, that when I was talking about corrosion, I was thinking of bi-metallic corrosion.

We have given consideration to the all-insulated conductor, because we have had trouble in one particular township where we have a 6.6 kV overhead high tension line, that has had many outages due to baling wire having been thrown over the line. The all-insulated conductor has the disadvantage that if the conductors do break, for any reason, they can lie on the ground for a long time, and our experience with Natives is that they are not as ready to report faults as the European consumer.

As far as greasing of aluminium is concerned, I agree that it is not necessary on the Witwatersrand.

The facility of using mid span tappings for service connections cannot of course be adopted as done overseas because of the Factories Act regulation that lays down that service droppers must be taken from a point of support.

Mr. Mitchell's recommendation that a sub-committee be established to discuss Native housing is an excellent one. Standardisation in some form would be a good thing and it would be a good idea if we could get a Code of Practice laying down at least minimum standards.

Mr. Mitchell suggests that a split neutral is unnecessary. It is interesting to hear that in his experience, a broken phase conductor will invariably fall upon the neutral at the bottom and so isolate the circuit. I have been concerned about the extra cost of a split neutral, but there is of course also the point that a single neutral wire itself can break and be just as dangerous as the phase conductor itself.

Mr. Simpson of Durban asked whether we have any regular inspection of appliances.

We have not found it necessary to have regular inspections of appliances or wiring. Where we have repeated trouble due to a fuse blowing or circuit breaker operation we inspect the installation and appliances for any illegal wiring or faulty appliances. We have not found much trouble with appliances. I do agree that with some of the appliances on the market control is necessary, but I don't think that is really the local authority's responsibility.

If manufacturers could be encouraged to produce cheap and satisfactory appliances it would be an excellent thing. There is a very fertile field for some ingenious designer who can manufacture a dual purpose type of appliance to take the place of the "under-the-bed-radiator-on-the-table-cooker."

As far as assisted purchase schemes are concerned, from the consumer's point of view, I think it is an excellent one. From the supply authority's point of view I am not so keen unless it is restricted to cookers and water heaters. I think however we should leave the administration of such a scheme to the Non European Affairs Department.

I think the figures I quoted yesterday of the appliances which are in use do indicate that the Natives are building up their stock of appliances, and I do think that the particularly small appliances will be very popular, and as the electricity supply in townships becomes more universal, there is a possibility of Natives going over to electrical cooking, even if it is only a simple type of plug-in stove.

We have been forced to provide street lighting in many townships on a rudimentary basis—that is every second street—this is in effect the scattered development referred to by Mr. Simpson and is undesirable. Initially the Department of Bantu Affairs was very keen that we should space our street lights at 300′ intervals. We resisted that very strongly, and pointed out that 120′ spacing is a good one for wooden poles, and it does permit street lighting that complies with a code of practice. We have put up street lighting in every township, but some have street lighting in every second street, at 240′ intervals. Photograph 1 showed that every pole is drilled with five holes to take six conductors if they are required. It is planned at this stage to cater for a demand of ½ KVA per stand and three phases are provided in the main streets, with single phase in side streets. There is therefore the facility for three phasing, the single phase mains as and when the loading justifies it.

Mr. Lombard's comments about ASCR conductors are noted with interest. We haven't used any yet, because the 5% increase in price over all aluminium did not seem justified with 120 ft. span construction.

I do think that ASCR is definitely worthy of consideration where experience indicates that malicious damage can be expected. To comply with the S.A.I.E.E. code of practice requirement in regard to the minimum breaking strength of conductors, we have used 7/.110 in. aluminium conductor, which is equivalent to a .04 copper. The double neutral is of course of greater cross-section area than is required for street lighting load. It was felt that we can use the neutral wires as power conductors at a later date if neces-

sary and put up a smaller A.S.C.R. conductor for street ighting when the time comes to change over power distribution.

Mr. Lombard mentioned the difficulties experienced with fluorescent street lighting fittings. The auxiliaries are a bugbear and I feel very strongly that power factor correction in these street lighting fittings is not justified. If we are concerned about the power factor of the system, it would seem preferable to effect power factor correction at the transformer kiosk, and eliminate the capacitors in the fittings.

Mr. Van der Walt asked why we used insulators for the split neutral. I agree they are not necessary, but we have not found a cheaper metal bracket suitable for use with the all aluminium conductor. Reel insulators cost a couple of shillings, and give a fairly big bending radius for the aluminium conductor. If Mr. Van der Walt knows of a cheaper metal clamp or bracket suitable for A.C.C. I would be interested to have some details.

Since running costs were the first consideration we were forced to fluorescent fittings. I do agree that they are not really a robust type of fitting, and whether they will last 25 years I am not sure.

Mr. Molyneaux's remarks about the prepayment meters are noted with interest. In Johannesburg we have not used them in recent years. Their disadvantages appeared to be the greater amount of maintenance required in comparison to the straight reading meter. Their capital cost is high and troubles are experienced with bent coins and the difficulty that when the meter is read, the meter reader invariably refunds to the wrong person.

Mr. Muller asked whether we had any experience with owner-built houses. At the township of Dube a small number of houses have been built by owners and some by organisations such as the B.E.S.L. and one of the mining groups, who have built houses for their employees. Their consumption is little different from the other consumers we have. As far as wiring installations are concerned, the owners of the houses have engaged private electrical contractors to do the work. Being in our area of supply we do insist that licensed contractors and wiremen should be employed, and we have had no difficulty from that aspect.

We have a problem facing us. Some business consumers which have been in existence for a number of years in areas where no supply was available, have in certain cases bought lighting plants, and they have engaged unqualified Native wiremen to do the work. Some of the wiring, probably with slight modifications, could be made to comply with the regulations, but most of it will have to be dismantled.

Where he can afford it, the Native owner does want the best installation he can get.

Gentlemen, if there are any questions I have overlooked, I will endeavour to reply to them as soon as I can.

Thank you, gentlemen.

THE PRESIDENT: Thank you, George, for your very full reply. I don't think you have missed anything, but we will give you a further opportunity tomorrow morning.

I am proposing to go on with the reports of representatives now, and I think Mr. Muller will make a brief statement on Supplies to Rural Areas.

Mr. G. J. MULLER (Bloemfontein): Mr. President, the report has been circulated and members have no doubt read it.

We had hoped at this stage to be able to tell you a little more. We had hoped that the Control Board would have sent their revised conditions to the United Municipal Executive, who, in turn, would have sent it to us. Nothing of the sort has happened and we are therefore not much further than the report leads you to think.

Your Executive has, however, decided to write to the United Municipal Executive to get in touch with the Control Board to see if we can speed up this matter, because several of our members are in a hurry to get on with schemes.

I would, however, like to appeal to those members not to be stampeded into any action which may jeopardise the negotiations of the United Municipal Executive.

After all, we are basically there to look after the interests of the municipalities, and if we help the rural areas we do so, but not at the cost of our municipalities.

CONTROL OF ELECTRICITY SUPPLY TO RURAL AREAS

REPORT TO THE 1959 CONVENTION ON PROGRESS IN NEGOTIATIONS WITH THE ELECTRICITY CONTROL BOARD

Mr. President, Gentlemen,

In this matter of supply to rural areas, which interests quite a number of municipalities it is pleasing to record that in seeking the support of the United Municipal Executive Council, your Council has received all the co-operation it could wish for. The U.M.E. representing S.A. Municipalities as a whole, thus a very large section of the South African population, have made the dispute which arose from the new conditions of supply proposed by the Electricity Control Board, their own and arranged a meeting with the E.C.B. on the 21st November, 1958.

Your Executive was asked to prepare a memorandum and nominate representatives to assist the U.M.E. in the discussion to be held in Pretoria. Our Association was represented by six members of the Executive Council, and the memorandum submitted by your executive was taken as the basis of discussion, both for the advance meeting of delegates and the subsequent meeting with the Electricity Control Board.

The discussion centred mainly on the following points of dispute, in connection with the proposed conditions of supply to rural areas.

(a) The limitation of the permission to a specified number of years, in itself not very palatable, further aggravated by the proviso that the E.S.C. could take over at any time, without any apparent safeguards for the commitments of Municipalities.

(b) The basis of taking over at original cost less depreciation, without regard for the financial interests of Municipalities, whose assets most likely would have appreciated considerably in terms of the currency at the time of taking over.

(c) The unilateral change of Rural tariffs. On behalf of the Municipalities it was submitted that rural tariffs must be tied to the general tariffs, as independent lowering of the former could not be contemplated by any local authority.

(d) The extent and frequency of data to be submitted by local supply authorities to the Control Board. To comply with these requirements would amount to separate accounts being kept for the Town and rural systems. This would involve the Municipal Technical and accounting departments in considerable extra trouble and expense, for which no extra return could be expected, and the accuracy could be subject to query on account of the difficulty of correctly allocating capital, management and maintenance costs.

The interview being arranged by the U.M.E., the main speakers for the delegation were Mr. Warmback Chairman of the U.M.E. and Mr. Tees of Bloemfontein, both of whom were well primed on the views of the delegation at the private session in the morning.

Mr. Warmback broadly outlined the views of Municipalities, and put it clearly to the Board that Municipalities considered rural supply as a service to their rural surroundings which might benefit the Town to some extent, but stressed if undue difficulties were not created and as long as it could be justified to the Municipal ratepayers.

Mr. Tees dealt in more detail with the proposed agreement.

Period of Agreement.

On behalf of the Municipalities it was submitted that they could not contemplate any agreement which did not guarantee ten years tenure at least, and then only provided agreement was reached on the method of taking over, and provided a period of adjustment of its commitments of say five years was allowed to the Municipality which could be extended by representations to the Board if considered necessary. In very special circumstances the Municipality could of course contract out of its right and agree to a taking over at any time.

Period of Taking Over.

The Municipalities could not agree to the disposal of Municipal property at anything but an economic value. The currency might appreciate, but was much more likely to depreciate and the only basis acceptable to Municipalities would be a fair market value at the time of taking over. The Board could not legally prescribe a method of compensation, but Municipalities would be willing to accept an agreement incorporating acceptable conditions, in which connection Section 34 of the Electricity Act referring specifically to licencees was mentioned as a guide.

The general impression gained was that the Board decided to drop all reference to the terms of taking over, leaving this to negotiation.

Unilateral Change of Rural Tariffs.

It was conceded that 25% surcharge may not be equitable in all cases, but it was stressed that once agreement had been reached with the Board, the Municipality must be free to control the finances of the undertaking as one concern, increasing or decreasing all tariffs according to the finances of the undertaking as a whole.

This subject was discussed at length. The Board appeared to be not adverse to the idea of tying Rural tariffs to internal tariffs, but the finer mathematical points of such a tie appeared to worry certain Board members, while delegates argued that 10% surcharge on internal tariffs, must mean 10% surcharge on rural tariffs, as they stand at the time of the surcharge.

As the discussion appeared to get bogged down in percentage calculations, a delegate was prompted to ask if it was so difficult to leave rural consumers to the tender mercies of the Municipalities, would the Board prefer to have rural supplies dealt with on a bulk supply basis, leaving the rural authorities to find their own capital and frame their own tariffs. This brought the admission from the Board that such procedure may make rural electrification impossible.

Information to be Rendered to the Board Annually.

Mr. Tees said that Municipalities were congniscent of the fact that the Board in terms of the act could demand certain information and could in addition send a representative to examine the Municipal accounts, but pointed out that certain of the items of statistics required in the proposed agreement woud be difficult if not impossible to render accurately. As it would be obligatory under cancellation, it could happen that unsatisfactory statistics may lead to cancellation of the agreement. It is not likely to happen in practice, but Councils are loth to agree to more than they can digest, and it was put to the Board that they should accept the annual accounts rendered by Municipalities, which if they felt that it was called for, could be amplified by an inspection of records which they are entitled to. Councils considered it undesirable and difficult to keep profit and loss accounts for different types of consumers on their system.

In all it can be said that the delegation was sympathetically received, and the Board appeared to appreciate the views and difficulties of the Municipalities, and their chairman Dr. Gaigher made it clear that it was not their wish in any way to retard rural electrification by Municipalities, particularly where such areas were not in an E.S.C. area or included in E.S.C. planning for the immediate future. Such cases would he said, naturally be treated differently. He intimated that the conditions for what he termed "Straight forward" areas would be considered *de novo* in the light of the discussions and a new draft submitted to the U.M.E. for comment.

In retrospect, we cannot claim to have reached final agreement, but a very considerable step forward has been made by the Board undertaking to consult the U.M.E. before a new agreement is submitted to any individual municipality and it behoves every member undertaking of this Association to refrain from signing any agreement for rural supply, which has not been approved by the U.M.E. and through them by your Executive Council. In doing so individuals may have their rural work retarded somewhat, but the best interests of Municipal Electricity undertakings as a whole will be served, and as their work affects not a mean proportion of the total population, it can also be said to serve national interests.

G. J. MULLER.

THE PRESIDENT: Thank you, Mr. Muller. Any discussion, gentlemen?

Mr. C. LOMBARD (Germiston): Rights of Supply to Industrial Consumers.

Mr. President, gentlemen: I have pleasure in formally presenting this report for adoption. The report has been circulated and I have nothing further to add at this stage.

REPORT OF RIGHTS OF SUPPLY—INDUSTRIAL CONSUMERS SUB-COMMITTEE

Mr. President, Gentlemen,

At the Annual Convention held in Cape Town during April, 1958, a sub-committee was appointed to interview the Electricity Supply Commission on the rights of supply of electricity within the areas of jurisdiction of urban local authorities. This sub-committee met the Chairman and Management of Escom during May, 1958. In compliance with a request received at this meeting, copies of the Memorandum submitted to the Electricity Control Board during 1955 together with an Addendum to this Memorandum which was prepared to include certain representations and points made by the sub-committee at the abovementioned meeting, were forwarded to Escom.

A memorandum in reply to the representations made has recently been received from Escom by the Association and is now under consideration.

A memorandum has also been prepared and submitted by this Association to the United Municipal Executive for transmission to the Borckenhagen Commission with the concurrence of the Institute of Municipal Treasurers and Accountants. We are now informed that the memorandum has been formally adopted by the United Municipal Executive.

C. LOMBARD,
Convenor.

THE PRESIDENT: Any discussion?

The South African Bureau of Standards. Mr. Downey.

Mr. J. C. DOWNEY (Springs): Mr. President, gentlemen: The report is in your hands. It has been tabulated for you to exactly see what progress has been made during the year, but I would like to draw your attention to the second last paragraph of the report. May I suggest Mr. President, you ask Mr. Chris du Toit, to speak on this matter. He will probably have some information to give us on it.

Mr. C. W. H. DU TOIT (S.A. Bureau of Standards): Mr. President, at the last convention of this Association in Cape Town, the Bureau was asked to give attention to two points; the first one was when we were asked to see what could be done to get the Electricity Safety Specifications for Domestic Appliances finally promulgated by the Minister. The second point of interest was that we were asked to see what could be done to control the workmanship of the repair business.

As regards the first point, Mr. Chairman, I am very pleased today to report that the Minister has now finally agreed to promulgate safety specifications, and we hope that when your next conference comes around the scheme will be in full swing.

Unfortunately, Mr. President, I am not in a position to divulge any details as regards levies, or the administrative procedures, since these have to be discussed first with the appropriate sections of the industry and commerce, and your representatives.

Mr. President, these will be published in due course in the appropriate quarters and everybody will be given the opportunity to comment.

As regards the second item I am afraid results are not very encouraging. The repair business likes to stay out of any control.

I would like to draw your attention to something of interest however. When these safety specifications are finally promulgated, the promulgation will read, "No equipment shall be sold . . ." (I want to stress the word "sold" because that applies, obviously, to imported articles, locally manufactured articles, and items repaired and offered for re-sale. That will, to a certain extent, cover some of your second problem, and we do

feel that it might be possible to find some means of controlling the other kind of repair —where I send my own stove to be repaired and it comes back to me. In view of all this talk today about the electrification of Native areas, I feel it might be very opportune to have some control on the safety requirements of electrical equipment.

In conclusion, Mr. President, I would like to thank your representatives on the Bureau's committees for their very generous co-operation, and I would like to say that we appreciate it very much and it has often helped us out of a difficult spot in our somewhat awkward job.

Thank you, Mr. President.

REPORT OF THE TECHNICAL COMMITEES OF THE SOUTH AFRICAN BUREAU OF STANDARDS

Mr President and Gentlemen,

The following specifications have been completed and are shortly to be submitted to the Standards Council for approval :—

1. Low Voltage Lightning Arrestors.
2. South African Bureau of Standards 97, for Paper Insulated cables (Revision Specification).
3. South African Bureau of Standards 555 of 1959 for Overhead Service Line Connector Boxes.
4. South African Bureau of Standards 165 of 1959, for Lamp Holders.
5. Transformer and Switch Oils.

The Standards Council has approved of the following specifications which will be published shortly :—

6. Specifications for Wall Outlet Boxes and Cover Plates.

The following is still under consideration by the respective committees :—

7. Revision of South African Bureau of Standards 155 for Miniature Circuit Breakers.
8. Induction Motors.
9. Insulating Tapes.
10. Codes for Installation and Operation of Electric Cables.
11. Safety specification for Electric Heating Pads and Blankets.
12. Domestic Radios and Electronic Apparatus.
13. High and Low Voltage Bushings held its first meeting in April.
14. Distribution Transformers.

The following specifications were finalised during the year and are now available in the printed form :—

15. South African Bureau of Standards 150 for P.V.C. Cables.
16. Fixed Electric Storage Water Heaters.
17. South African Bureau of Standards 153 for Electric Stoves and Hotplates.

A report of the work of the sub-committee dealing with the electro-technical nomenclature in Afrkaans is as follows :—

AFRIKAANSE ELEKTROTEGNIESE NOMENKLATUUR

18. Die Standaarderaad het 'n hoofkomitee aangestel om 'n Nomenklatuur in Elektrotegniese Ingenieurswese op te stel. Daar is dan 'n subkomitee aangestel om 'n Afrikaanse Elektrotegniese Nomenklatuur op te stel.

Hierdie Subkomitee is alreeds die afgelope drie jaar besig om so 'n Afrikaanse Nomenklatuur op te stel. Vergaderings word gereeld elke maand gehou en die taak vorder fluks. Die jongste dokumente van die Internasionale Elektrotegniese Kommissie word as basis vir die Afrikaanse vertaling gebruik.

Die volgende groepe is alreeds vertaal en is verkrygbaar by die Suid Afrikaanse Buro vir Standaarde :—

Groep 05 : Grondterme/Fundamental Terms.

Groep 10 : Masjiene en Transfomators/Machine and Transformers.

Groep 11 : Statiese Omsetters/Static Convertors.

Groep 12 : Transduktors/Transductors.

Groep 16 : Beveiligingsreles/Protective Relays.

Groep 30 : Elektriese Traksie/Electric Traction.

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trotechnical Letter Symbols and Unit Abbreviations.

U vereniging is op hierdie onder-komitee verteenwoordig.

Daar word op die oomblik aan VERLIGTINGSTERMINOLOGIE gewerk.

Hierdie woordelys behoort lede baie behulpsaam te wees.

It will be remembered that the question of the Safety Codes was raised at the last convention held in Cape Town when it was suggested that we try to persuade the Minister to promulgate these specifications as soon as possible. I understand this matter has received the serious attention of the Bureau of Standards during the year, and that a statement in this regard on the progress, may be given by the representative of the South African Bureau of Standards attending this convention.

In conclusion I should like to express my appreciation to all the members of the A.M.E.U. who have so ably assisted me in the work of the various technical committees of the South African Bureau of Standards and to thank the Bureau Officials for ther kind co-operation and assistance at all times during the year.

J. C. DOWNEY,
Representative.

THE PRESIDENT: Thank you Mr. Du Toit. Any discussions?

Mr. J. L. VAN DER WALT (Krugersdorp): I wish to say "Thank you" to Mr. Downey for his report, Mr. President; but we must also realise the importance of the step that is being taken to one nearer our aim. You will remember—I think it was as long ago as Bulawayo, 1952—this Association in full conference resolved to approach the Minister to have some Safety Specifications promulgated, and it is gratifying to see that we are one step nearer.

THE PRESIDENT: Thank you ever so much Mr. Downey, Mr. Van der Walt, and Mr. Du Toit, for a very interesting report. I think Mr. Van der Walt has covered any remarks that I may have made, particularly on the period we have been waiting for some decision.

Mr. J. L. VAN DER WALT (Krugersdorp) "Electrical Commodities":

The report, as you will see, is short; we have had three meetings. We cover quite a lot of work at these meetings, things are thrashed out very fully; but at one stage the committee felt that it was probably doing all this work in vain, because from reports and information received it appears that members do not take into consideration the recommendations of that Committee.

Your Committee may recommend that they do not find certain articles suitable for use; yet you will find and hear that it is generally used throughout the country.

But after thrashing it out it was felt that the Committee was doing some useful work, and we decided to carry on, but with this plea to members, that they should take our recommendations, or findings, into consideration. These are usually circularised in the Newsletter.

REPORT OF THE RECOMMENDATIONS COMMITTEE FOR NEW ELECTRICAL COMMODITIES

Mr. President, Gentlemen,

The Committee continued with the valuable work and three meetings were held during the year. All recommendations were made known to members through the news bulletin. Various applications are still under consideration, and tests on these commodities are being carried out by the Bureau of Standards.

The Committee only considers commodities for which no precise specifications are available.

New materials and methods for wiring of premises have been submitted to the Committee, such as "Power Skirting" and "Q Flooring." The attention of the Safety Precautions Committee of the South African Institute of Electrical Engineers has been drawn to this development for incorporating in any intended admendments of the Wiring Regulations.

The Committee also fully discussed the possibility of overlapping functions, com-

pared with the Safety Precautions Committee. Some doubt was expressed as to the usefulness of the work of the Committee, as it does appear that members in many instances do not refer to or take into consideration the recommendations of the Committee. If this is a fact, then valuable time is wasted by all members of the Committee.

It was however, unanimously felt that the work of the Committee was valuable and essential and must be continued. The Executive Council concurs.

An appeal is made to members to refer to the recommendations of this Committee whenever possible.

During the year Mr. Kane was co-opted to this Committee in his own right.

J. L. van der WALT,
Convenor.

THE PRESIDENT: Thank you. Any questions or discussion?

I think members will remember that this Committee was set up to attempt to create some uniformity throughout the country in the approval or otherwise of certain equipment. It didn't mean to say that any particular authority was bound by the decisions of this committee, but it has been rather shattering of recent months to get certain appliances produced to the Committee, and to be told that certain of the larger towns have already accepted them without following the procedure laid down by the Association.

Mr. C. LOMBARD (Germiston): Import Duty—Overhead Line Hardware.

Mr. President, gentlemen: According to a notice which appeared in the Government Gazette of the 17th April, 1959, representations have been made to the Department of Commerce and Industries on overhead electrical transmission hardware, such as strain clamps, tension clamps, suspension hooks, etc. by 10%. This matter was considered by your Executive, and it was felt that such an increase in Import Duty is not justified at this stage, and it would have an adverse effect on the cost structure of electrical supply undertakings throughout South Africa—bearing in mind the fact that the range of overhead electrical transmission-hardware produced in the Union is strictly limited.

On behalf of your Executive the following resolution is submitted to the Convention for adoption.

"That this, the 33rd Annual Convention of the Association of Municipal Electricity Undertakings of Southern Africa resolves that in view of the limited range of overhead electrical transmission hardware produced in the Union, an increase in Import Duty is not warranted and will have an adverse effect on the cost structure of electricity undertakings. It will have a particularly adverse effect on rural electrification projects. The Convention further resolves that representations be made to the Department of Commerce and Industries to oppose any increase in Import Duty on overhead line hardware."

Thank you, Mr. President.

THE PRESIDENT: You have a resolution before you. Any discussion—or opposition?

(THE RESOLUTION WAS UNANIMOUSLY ADOPTED)

As Mr. Mitchell is with us, does anyone wish to continue with the Forum this afternoon—or shall we break early and use tomorrow for the Forum?

(IT WAS DECIDED TO BREAK EARLY)

Gentlemen, I have found that one of the reasons for Mr. Milton's non-attendance all this week is the unfortunate death of his mother, and on your behalf, I would like to convey to him our deepest respect and sympathy to him in his loss.

(THE CONVENTION STOOD)

Thank you.

Mr. W. MILTON (Escom): Thank you very much, Mr. President.

THE PRESIDENT: I declare the meeting closed until tomorrow morning at 9.30 and I hope to see the bulk of you this evening upstairs at the Ball.

(CONVENTION ADJOURNED)

FOURTH DAY

On Resuming at 9.30 *a.m.*

THE PRESIDENT: Good morning, gentlemen.

I neglected to welcome Mr. Ford, of Lusaka. Is he here this morning?

And before I forget, Councillor Snyman, Mayor of Windhoek is here this morning. Do you want to say anything, sir?

Councillor J. VAN D. SNYMAN (Windhoek): Mr. President and gentlemen, I am very pleased that you asked me to say a few words here this morning on behalf of South West Africa, especially in my capacity as President of the South West African Association. I can assure you that I will be very brief, because in South West we still believe in the good old saying that one thing a speaker should remember for sure is that the brain can absorb only what the seat can endure! After the long talks we have had, I will be very short, sir.

Mnr. die President, van Suidwes-Afrika stel ons baie belang in u Institute en Verenigings in Suid-Afrika. Ons is 'n baie jong land wat nou begin vooruitgaan en ons is weer drie afgevaardedigdes hier by kongres, as u weet, Mnr. Belligan en my elektrotegniese stadsingenieur Mnr. Salton, van die Suidwes-Afrika Administrasie.

Ons het nog nie al die probleme wat u het nie, maar ons weet voor of later moet dié na ons toekom en daarom stel ons baie belang in.

Ons het ook alreeds verteenwoordiging op die uitvoerende bestuur van die Vereniging munisipale vereniging, en ons probeer om nou kontak met u te hou hier, want ons weet een van die dae sal ons edie Unie moet inlyf en dan wil ons 'n bietjie op hoogte wees van wat u eintlik hier doen.

Nou, Mnr. die President, ek wil net vir u kortliks 'n klein beeltjie gee wat Suidwes-Afrika (baie van u weet nie wat daar aangaan nie). Dit is ongeveer twee derde die oppervlakte van die Unie, met een distrik groter as die hele Vrystaat. Maar dit is feit. In Windhoek self die hoofstad is met geweldig uitbreidings besig om maar net een of twee te noem—ons is nou besig met 'n miljoen pond uitbreiding op 'n kragstasie, wat seker u afdeling baie sal intereseer. In hierdie verband is ek baie jammer dat ek nie kan terug gaan en vra dat ons 'n atoom kragstasie moet bou nie, maar Mnr. Belligan na die Referaad het vir my gevra om liewerste af te sien daarvan.

Dan is ons besig op die oomblik met 'n miljoen en 'n half pond se water skemas—ons is 'n bietjie kort aan water. Een en 'n half miljoen pond nuwe lokasie in Windhoek —en daar is veral baie belang gestel in die verspreiding van elektrisiteit so ver die naturelle gebiede betref. En ek is seker, Mnr. Belligan, met die hulp van Mnr. Dalton, sal ons seker goeie advies kan gee na wat hier bespreek is.

Mnr. die President, ek het ook twee ver-

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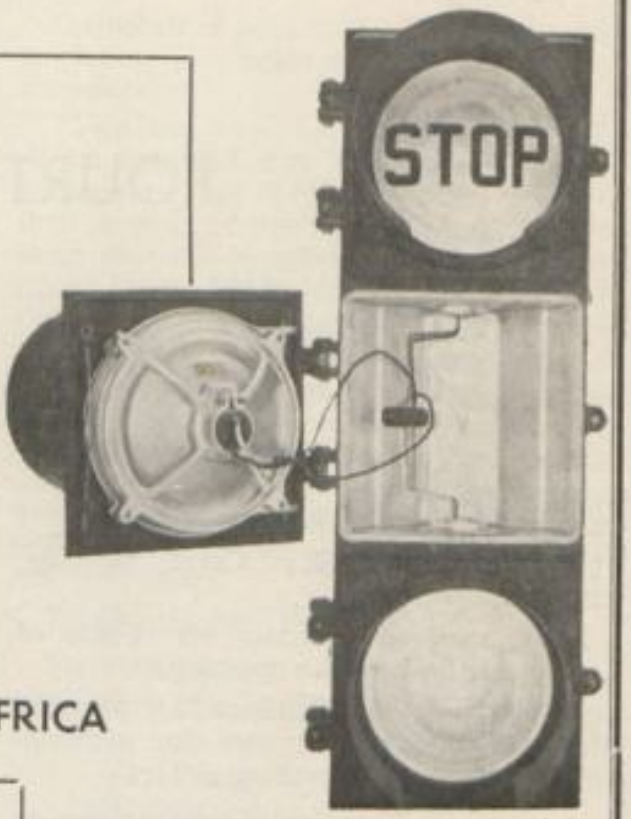

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soek op hierdie stadium as ek dit mag rig nou. Ons sal nog verdere organisasie werk doen in Suidwes-Afrika, en probeer nog om van ons munisipaliteit te kry om aan te sluit om ook Suidwes saak te sterk en dan miskien later verteenwoordiging te kry op die uitvoerende bestuur, dat ons op hoogte kan bly.

Mr. President, the last thing is this: I would very much like to put it into the minds of your Executive: we are only three hours' flying from Johannesburg—to think it over whether you cannot arrange for say 1961 or '62—for your congress to be held in South West Africa, in Windhoek.

On behalf of the Municipality as Mayor, and also as President of the Association, I would very much like to invite you to come there in 1961 or '62. I think we would be prepared to meet you then.

We are getting the Town Clerks Institute up next year, and the Civil Engineers the following year, so that once you can get away from here and come back to civilisation, you will be able to see what it looks like.

Thank you very much indeed, ladies and gentlemen—and on behalf of South West Africa our best wishes to you for your future.

I am very sorry we must leave immediately, and I hope you will excuse us at this stage.

Thank you.

THE PRESIDENT: Thank you Councillor Snyman, I gather that you are going into training by getting the Town Clerks first, and the Civil Engineers, and finally ourselves

What is the tent accommodation like in Windhoek?

Thank you ever so much.

Before we go on to other business, I do want to apologise to all the factories that we should have visited on Wednesday. I am indeed sorry that you were put to all that inconvenience, and preparation, for an attendance that by no means came up to expectations.

I have Mr. Barnard and Mr. Powell here this morning, and if anybody is prepared to go on with further discussion on Mr. Barnard's paper, or any further contributions on Mr. Powell's paper, may we have them please?

Mr. P. A. GILES (East London): Mr. President, I don't want to say too much about the paper of Mr. Barnard, because a great deal of ground has already been covered, but I do want to take the opportunity of congratulating the author on his refreshing approach to our very pressing distribution problems.

In my opinion the proposal is real pioneering in electrical reticulation and it seems to me it has every prospect of success.

I think that all points of difference between conventional schemes and the scheme envisaged in the paper have been discussed. The only point that eludes me is why No. 6 solid copper street lighting conductor is used when I think a stranded wire is the practice nowadays.

Thank you Mr. President.

Mr. W. BARNARD (Johannesburg): Mr. President, gentlemen:

I have been assured by the President that I have the last say on this subject, so I hope you will bear with me if I indulge myself a little.

I would like, before I make any further comments, to sincerely thank everyone who has not only criticised but also given advice. In particular I would like to thank Mr. Mitchell, and I want to assure him that we will most definitely bear in mind all the points he has raised and will be prepared for the difficulties he has predicted should they arise at the time of commissioning Montgomery Park.

Referring to certain particular points he has raised, the first one which I would like to discuss is the question of after diversity maximum demand.

In the paper it was stated that we are working on an after diversity maximum demand of 5 kW. This is based on an absolute maximum demand of 12 kW per consumer. I think, gentlemen, you will all agree with me that this is a conservative and very liberal figure. As a matter of interest we took a maximum

demand test on our President's house, and found that it didn't even reach 10 kW.

To continue, a coincidence factor of 3 was used in arriving at an after diversity maximum demand of 4 kW. This factor is referred to by Mr. Mitchell as a multiplying factor. The coincidence factor of 3 has been derived from curves which were developed by Bary and Hamilton. Mr. Wood of Cape Town has used those curves and I assure Mr. Mitchell that this figure has proved to be accurate for Johannesburg conditions when considering 12 similar consumers on the same phase of a feeder cable.

Using a figure of 10 kW, which I think is more realistic for the maximum demand, and taking a coincidence factor of 3, an after diversity maximum demand of 3.3 kW is obtained. Cape Town mentions 3.5 as the figure they use, which I would consider satisfactory for Montgomery Park, were it not for the fact that a relatively large number of transformers are involved and the additional transformer capacity can be provided at very little extra cost. Furthermore, if eventually the load grows to such an extent so as to exceed this figure, which I very much doubt, we would probably have to cut in additional unit transformer kiosks. I don't anticipate that this will happen within the foreseeable future. I would like to ask Mr. Mitchell what coincidence factor is being used in Salisbury, as in my opinion, if a figure of 1.5 is being used, then they are putting in twice as much copper as is necessary. This might be a very subtle way of subsidising their copper mines, which I very much suspect.

The second point discussed is the comparison made. This Mr. Mitchell states is with a non conventional system.

Although not in my presentation yesterday, which I made very brief, but in the paper I tried to make it clear that I felt it was the only basis of comparison to take the existing Johannesburg standard and compare this with the proposed reticulation scheme.

It is possible for instance to compare Montgomery Park with dozens of schemes, such as in the Native areas where we are reticulating at £30 per consumer.

Such a rudimentary standard would, I am sure, not be acceptable in Salisbury.

Finally, I want to comment on the remark Mr. Mitchell made regarding the meter position. In my opinion there is only one correct position for the meter and that is in a meter chamber outside the consumer's premises.

In Johannesburg the reading of meters by the consumer is not favoured for a number of reasons. They are probably more dishonest in Johannesburg and it would be possible for consumers to under-read their meters for months and then move to some other area making electricity account recovery extremely difficult. Further, with the application of the meter code where it is necessary for an Electricity Authority to remove a large number of meters daily for calibration and maintenance, access to the consumer's meter board becomes a major issue. Should the consumer insist on having a meter on his premises, as some might do —people seem to occasionally read meters as a hobby—then a second meter will be provided on their premises on payment of the installation and meter cost. This meter will not be maintained in accordance with the meter code and will not be read by the Supply Authority.

Finally the remarks made by Mr. Mitchell in connection with the earthing which is a point of major importance, were of great interest to me. To a certain extent I agree that there is always a danger of the high voltage being impressed on the low voltage system. I would point out, however, that we are going to earth the low voltage system at Montgomery Park, but in my opinion, a screened transformer with the low voltage winding completely unearthed would have provided a safer low voltage reticulation.

I was very pleased to hear that Mr. Theron agrees with the above view point and has had practical experience which supports this contention.

Mr. Lombard states that due to the fairly comprehensive high voltage network the number of cable faults will be high. I can assure Mr. Lombard that the standard of work in Johannesburg is extremely high, and few cable faults are anticipated.

Most of our power failure is usually on the low voltage system caused by vehicular damage to the poles carrying overhead lines.

One query Mr. Lombard raised, and he is correct when he assumes that to isolate a section of cable it will be necessary to unbolt the connections. To my mind this should take less than a few minutes and not half an hour or an hour, and there is the advantage that a tower wagon is not required.

Mr. Lombard also mentioned the protection of individual service connections. The number of service cable faults anticipated are very few and it does not appear to be a hardship for 12 consumers to be off for a short period in the event of a service cable fault. Mr. Lombard suggested that we should put in individual high-rupturing capacity fuses for each service connection—in other words the 12 consumers would be fused separately. I cannot see this as the solution in that it is difficult to provide discrimination between the consumer's miniature circuit breaker and the service connection fuse and to instal the consumer's miniature circuit breaker in the kiosk where it is not accessible to him, defeats the object of using miniature circuit breakers.

Mr. Lombard made a remark about metering on the kiosk side of the service connection which results in the consumer paying for the low voltage cable losses. This I consider a fortuitous advantage which has not been considered.

To Mr. Smith I would like to say that I am endeavouring to purchase a stand for myself in Montgomery Park, but should I fail, I will most definitely endeavour to obtain one in Libradene.

I must apologise to Mr. Downie in that I did not make myself quite clear on a number of points.

First of all, the kiosks will be erected on the street front stand boundary and half the area encroaches on the one and half on to the adjoining stand. The kiosks will be accessible only from the street and the front panel and the lid being completely removable will give access to the transformer. Space provided on the left-hand side of the kiosk will provide access to the metering panel.

Another remark by Mr. Downie was that I had stated that a cable fault would limit the outage to 12 consumers. This reference was to a low voltage or service cable faults. In the event of a high voltage cable fault 90 consumers may lose supply, but I submit that is no worse than most existing systems utilising 400 kVA transformers which supply probably more consumers.

May I just very briefly make a few remarks about Mr. Wood's contribution. As I have stated before, I agree with his A.D.M.D. of 3½ kW and this figure has been used extensively in designing reticulation systems in Johannesburg.

Regarding voltage regulation, I think that the high voltage system has a big advantage and that we have virtually solved our voltage regulation problems in that low voltage line drop has been eliminated, which permits a greater regulation on the service cable.

Mr. Wood expressed an interest in our detailed estimates, and these I will be only too pleased to let him have.

Mr. Jooste mentioned the possibility of using low loss transformers. In the conventional method Johannesburg has always purchased transformers on the basis of a capitalisation formula, which compromises between the losses and the capital cost, and I think that is a very sound basis, and I see no reason why any other practice should be adopted in the case of Montgomery Park, especially bearing in mind that the major loss in a reticulation scheme is usually a low voltage line loss which has been eliminated in this scheme.

Thank you, Mr. President.

THE PRESIDENT: Thank you, Mr. Barnard.

I think you will agree with me that we listened the other day to a very interesting paper, and I don't want to discuss his replies too much, but I am just wondering when he is so emphatic about the low voltage loss, if he has forgotten what is happening on the high voltage side in the first place!

Will you join me in thanking him for a very pleasant contribution to our proceedings.

Now I want to make a statement on level price tendering. Your Executive considered it the other day, and members will recall the discussions at Cape Town last year on this

subject. A number of your Executive discussed this matter with representatives of the S.A. Federated Chambers of Commerce early this year. However, the City Council of Cape Town held a subsequent meeting at Cape Town at which local authorities only were present, and the following resolutions were adopted:

1. That the combating of such monopolies which are not in the public interest is the vital duty of all public bodies.

2. That a request be made, through the Provincial Municipal Association to the Action Committee of the United Municipal Executive to adopt a similar resolution and to consider the establishment of a semi-permanent anti-monopolistic body without delay.

3. Such body to approach the various firms and cartels and to recommend to the Union Government that it approach the Governments of the respective countries in which the cartels are operative, and urge them to take steps to eliminate this practice.

Since the resolutions have been forwarded to a higher authority, your Executive has resolved that we should await the outcome or results (if any) of an action taken by the United Municipal Executive.

I heard last night that Mr. Marchant of Witbank, an Associate member, took ill on Tuesday, and is in a local nursing home, and on your behalf we shall send our regards and wish him a speedy recovery.

Well, Mr. Mitchell, I think we must call on you to carry on with final questions of the Forum.

Mr. J. E. MITCHELL (Salisbury): This might give me a chance of the last work to Mr. Barnard! Well, gentlemen, we cleared up quite a number of questions to the Forum on Wednesday evening, and I propose to go backwards through these questions, but before starting, I would like to go to No. 26.

"Certain silicone compounds are now readily available for the coating of EHT insulators in areas where frequent pollution may result in flash-over. This Department has been considering using the compound in some areas where salt atmosphere from the sea at present leaves deposits on insulators, but so far have had no experience in its use.

"It would be appreciated if other Undertakings who have used silicone compounds would tell us their experience in its use, how effective it is in avoiding frequent washing, and for what period the compound is effective before it has been removed."

The reason why I brought this one up is because Mr. Lane, lately Transmission Engineer to the British Electricity Authority, cannot come this morning, but he has left me an answer to Question 26 which I feel might be of great interest to the poser of this question, and possibly to any of the Undertakings who have lines round the coast.

He states as follows: "The reference to silicone compounds is presumably to silicone greases; although such greases have been tried in Britain they are not widely used because of their high cost. Heavy mineral greases are preferred, such as Otina C marketed by Shell, I believe, because they give satisfactory performance and are considerably cheaper. They have been found very effective in some very contaminated areas. In one case of a 132 KV substation which was frequently swept by winds carrying dust from the refuse dumps of a nearby chemical plant, it was at one time the practice to clean the caked surfaces of the insulators by immersing them in a bath of strong cleaning fluid every two or three months in order to avoid repeated flash-overs. After applying a thin coating of grease flash-overs were almost entirely eliminated, and although cleaning and re-greasing is now undertaken at six-monthly intervals the operation is much more simply accomplished, and the time interval could probably be extended without serious risk. The greases are equally effective in salt laden atmospheres. The time interval between applications will depend on local conditions, sun temperatures, exposure to storms, exposure to salt, but it should not be less than 12 months and will probably be about 2 years. A thin film of grease can be wiped on to the whole insulator surface with rag, or where convenient, the insulators can be taken down and dipped or spun in a bath of heated grease. There is quite a lot of experience

with silicone greases in Australia and the United States, and I am sure that the above remarks will apply equally well to the silicone type. There seems to be no reason to discriminate on technical grounds. Maximum sun temperatures, magnitude of storm conditions are important local factors, and some trials will therefore be desirable to find the most suitable grease for any given location."

He finally states, "If anyone is particularly interested I will give more details from London."

That is a very good opinion on these silicone compounds or mineral greases, but as he says, experience is required on local conditions. This question really asks whether anybody has had local experience with these greases, or silicone compounds, and I throw it open to the Forum to see whether anybody has had this experience and can give their results.

It would appear that nobody has used them so far but now you have a very good opinion, and it is a fact that they would be of use, and therefore those at sea coast towns, or even in dust or chemical dust laden areas, you have some information.

We'll now turn to Question 28.

Question 28.

"A certain Municipality is proposing to provide underground cable connections to houses from the LT. overhead reticulation in the streets. It has been the practice with overhead connections to provide Yorkshire fuses on a pole to protect each phase of the connection. However, with undeground cable connections it is being considered that the Yorkshire fuse protection on poles is probably unnecessary. The feeder cables supplying the overhead reticulation are protected by oil circuit breakers in the substations. I should like to have views of other undertakings in regards to the necessity or otherwise of Yorkshire fuses on individual connections."

Mr. K. W. J. HALLIDAY (Port Shepstone): Mr. Quizmaster, because I have been adopting the same practice with overhead lines with LT service cables into the different houses, I would definitely say that, down in our portion of the country-side it seems as if the Yorkshire fuse is a must. We have had about 8 installed in the last year; we have had two of them gone through with a garden pick, and one of them with a lightning flash over the crutch, so I think from the point of view of continuity of supply to consumers who would ring up very quickly when the supply goes off, it is far better to isolate one at a time.

THE QUIZMASTER: Thank you, Mr. Halliday.

Mr. A. R. SIBSON (Bulawayo): Just one point, which may not be important in some of your towns but it is in Bulawayo, and that is the question of cutting people off for non-payment.

It can sometimes happen that the gentleman who calls for that purpose is denied access to the premises, and if he can get at an alternative point of disconnection it is of great value. I would, however, warn you that there has been an occasion on which one of our men was up the ladder disconnecting the Yorkshire cutout when a rather strong woman below pulled the ladder away . . . .

Mr. R. M. O. SIMPSON (Durban): Referring to Mr. Sibson's remarks, we had a case like that in Durban one day, because if you have an underground LT cable reticulation, and a service cable off that, unless you have some undeground box or means of tapping the cable with a fuse, you have to be solidly connected, so if you have got to disconnect these is only one way to do it, and that is what we had to do — dig up the T joint and cut the cable away. We couldn't get in.

But seriously, it is a problem that has been proved to all of us, I think, when we change over, as we are doing in quite a few places, from overhead to underground services, as to whether one should put in a fuse at the T-off position at the cable from the line.

With overhead lines and cable boxes or tails, I rather favour the T-off through a fuse and in the case of an undeground cable service I think unless you go in for a series of pillars let in to the building line or alongside the pavement, where you can fuse each service, you may be forced to face a direct T-off the low tension cable.

QUIZMASTER: I am a bit worried the way this is going; it seems to be going for Mr. Barnard's scheme!

Any other comments?

I would like some further comments, if anybody has an overhead system without Yorkshire fuses. As Mr. Simpson has told you the normal underground system — you merely T-off the low tension cable and therefore have no method of disconnecting the service; in a similar manner you have overhead Yorkshire fuses. Have we any undertakings with overhead systems who do not use Yorkshire fuses on services? If we have, we would like to hear their experiences.

Mr. R. W. KANE (Johannesburg): Some years ago we attempted to cut down the cost of service connections by eliminating these Yorkshire fuses, but there seemed to be a fair amount of opposition from the staff, and this question of disconnection, particularly in an overhead system is not such a serious matter, surely. It is just as easy to unclip a couple of nuts. That is just about as easy as disconnecting a fuse.

Mr. C. LOMBARD (Germiston): Mr. Quizmaster, I think that in the case of an underground cable system where it was mentioned that no fuse protection is provided, we should bear in mind the fact that you are not likely to have much difficulty under lightning conditions, but I can tell you that if all cable service connections are taken off an overhead line, you will have a lot of trouble when the mains in a house break down.

You will probably find under such conditions that the protection provided for that particular circuit in a substation will not operate, and you may have anything from 20 to 30 houses on that particular circuit, and you are going to find out that it is a very difficult job to determine which house is affected.

QUIZMASTER: Thank you Mr. Lombard.

Mr. G. C. MOLYNEUX (Rhodesia Railways): Mr. Quizmaster, I didn't intend to speak on this, because our conditions are somewhat different from municipal authorities, but we have a number of installations throughout the two Rhodesias, where we do not have any means of isolation.

It is only because Mr. Lombard has mentioned the possible trouble on the mains between the point of supply and your Board that I have answered.

We have not had any of the trouble which Mr. Lombard anticipates, sir.

QUIZMASTER: Thank you.

Mr. K. W. J. HALLIDAY (Port Shepstone): You did ask about the possibility of overhead lines with no pole service disconnection fuses, and I thought Mr. Milton might have mentioned that, when they put in Kestol and Warden about 1945 (I think it was) I was in the ESC in those days, and Kestol was put in with Yorkshire fuses, and even had them included in the neutral. When they came to Warden they must have run out of Yorkshire fuses, and they had none at all. The first lightning season came round, and I spent a month up there taking fuses out of the neutrals at Kestol and putting them in at Warden, because whole sections were out.

QUIZMASTER: Think of the fun and variety it gave you.

Mr. J. L. VAN DER WALT (Krugersdorp): Mr. President, we are going one better than Yorkshire fuses in Krugersdorp. I think the other local authorities are starting to play around with them too. That is the pole-mounted circuit breaker with the indicating tag, so there must be some reason why we are doing it. I don't know whether fuses blow more in Krugersdorp than in other places, but that is purely for staff convenience, getting around quicker, no necessity to put up the ladder to climb the pole to repair the fuse.

We have just started on that so we can't give you much operation experience.

QUIZMASTER: Thank you Mr. van der Walt. It sounds as if you are in the same position as Mr. Kane; your staff run you!

Mr. R. W. KANE (Johannesburg): I was going to suggest that the real reason is that there has been high pressure salesmanship in Krugersdorp!

THE QUIZMASTER: I think we have had a fair go at No. 28. No. 27 I am not going to pose because the answers to No. 27 are in the 1956 Proceedings. This question was thoroughly thrashed out by the Forum at the Salisbury Convention in 1956, and if anybody wants the full answers regarding what anybody is doing in obtaining of substation sites, they should look at those Proceedings.

No. 24.

"In the case of a house whose water supply is derived from non-metallic mains, including the connection from the meter to the building, does the Forum consider that the metallic water pipes in the building should be used for earthing the various components of the electrical system, as has been the practice generally?"

Mr. F. STEVENS (Ladysmith): Mr. Quizmaster, I would say definitely not, unless there is some other earth — such as an earth brought in with the service. Whereas at Ladysmith we have a multiple earth neutral, we do bring into each service an earth wire, on to which the earth in the installation is connected. So in time we do connect to any water on the property but we do not place much reliance on any plumbing on the premises I would definitely advise against earthing to plumbing on the premises, alone.

Mr. W. MILTON (Escom): Mr. Quizmaster, I would advocate strongly against such earthing.

QUIZMASTER: Gentlemen, this is an important question for the convention, because there is sure to be this practice continuing, because electricians and wiremen have got so used to putting a clip on the inside metal water mains, that it is very difficult — and I don't consider that it is likely that inspectors are making absolutely certain that it is more dangerous than having anything at all. I would like to know the experiences of various undertakings as to whether they instruct their inspectors to make certain that the water mains are connected at least to some metal mains in the ground, and whether they insist on the removal of the earth clip from the inside mains if they find that they are polythene or asbestos piping.

Mr. G. J. MULLER (Bloemfontein): We have also, in recent years, had some townships reticulated with piping where earth continuity could not be relied on. The alternative was then to run an earth continuity conductor on the overhead system and take a further wire across an overhead to the building, or to bury an earth continuity conductor with the water mains, when they were laid.

The latter was chosen because nobody liked to see any more wires across the street than are actually necessary, and we thought that the reliability of the underground earthing system would be greater.

By arrangement with the Waterworks Department they now actually lay the conductor which we provide them with when they lay the piping, and they bridge across (their plumbers do the job) just to beyond their meter, and the earth is then picked up on the consumers' water service beyond the meter; so that virtually although the piping system may not be a good earth, a very long conductor buried at three feet usually is.

To make assurance doubly sure, for many years, we had a system of checking our earthing before the connection is finally handed over to the consumer by means of a gadget which I think is used locally only. It is merely a resistance box with an ammeter and a volt meter on it, to give us the volt drop on the earth wire with a 20 amp load flowing. The idea of the 20 amp in preference to a small milli-amp instrument, is to avoid bad conductivity through a pinpoint contact. In other words, if it can carry 20 amps then you are reasonably sure that it is a substantial connection.

QUIZMASTER: Thank you Mr. Muller. That is very interesting. I doubt whether anybody else goes to such lengths, but I think it will definitely come to that, especially with the use of PVC piping for actual service water mains themselves. I think you have something there.

Does anybody else use a similar system?

Mr. R. M. O. SIMPSON (Durban) For many years in Durban considerable lengths of asbestos cement water piping have been used in the mains, and in consequence we are

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now, with all new services, and as rapidly as we can, and all existing services, providing a separate earth.

In some cases, on the single phase side of the low tension system, where we have single phase three wire reticulation systems, we have had multiple earthing of the neutral in some of the country districts where earths have been very difficult to obtain. In the towns we have installed a third service wire from our own earthing system to the house, and of course, called for the earthing or bonding of all metallic water piping in the building to earth, but they don't rely on that for the earthing system.

When underground cables are put in, the leads and armours of the cable, at both ends, have been wiped and an earth connection taken from that, and that is given to the consumer. So in every earth case we do attempt to give the consumer a first class earth from our own system irrespective of what he can do. We do insist on earth plates being put down as well, but irrespective of what he can do, we do attempt to give him a first class earth as well.

QUIZMASTER: Thank you, Mr. Simpson.

Mr. F. STEVENS (Ladysmith): Mr. Quizmaster, we are about to do something of the sort, as Mr. Muller has just explained to you. What we have been doing for a long time now is to furnish the electrician who puts in the service with a form on which he records continuity, polarity, and earthing conditions on the site. I would here, again, like to reiterate, under no circumstances do we rely on the little bit of water piping on the premises.

They take particular notice of that. We frequently test for the blowing of fuses on premises to check on our third wire if the earth provided is a main earth on premises.

QUIZMASTER: Thank you Mr. Stevens. Once again I must thank contributors to the Forum. We have got through over 20 questions on Wednesday night and this morning, and I think we have done very well this year.

Don't forget for next year, start thinking up your questions now. As you go through the year, and you come up against any problems which you feel will be interesting to the Convention, note them down, and let us have them before end of February next year.

Thank you very much indeed.

THE VICE-PRESIDENT: Thank you Mr. Mitchell. I am sorry Mr. Kane, the President, is not here to formally thank you Jimmy for handling the Forum. I think the Forum is one of the events of the Convention that is always looked forward to and I am sure is of very great value to all of us, and will you all join with me in thanking Mr. Mitchell for carrying out his duties as Quizmaster in his usual inimitable style, with a sense of humour, to make it a very pleasant function.

CONVENTION ADJOURNED FOR TEA.

On Resuming at 11.00 *a.m.*

THE PRESIDENT: Good morning ladies and gentlemen. I am pleased to see you all here and to have with us, the Acting Mayor. I am going to call on delegates to express their greetings as is customary.

Mr. T. S. BELL (Representing the Federal Government of Rhodesia and Nyasaland): Mr. President, Your Worship the Acting Mayor, ladies and gentlemen:

I should like to say how very much I have enjoyed and appreciate, and derived profit, I think, from this Convention. I have not been quite up to the electrical discussions, but I think I have taken in the principles that have been discussed, and the parts of the Forum that I have attended.

I am very grateful indeed for the hospitality, for the efficiency in running the Convention which has enhanced the cordiality of the welcome given here, the opportunity of seeing African Cables the other day, and also for the hospitality of the Johannesburg Municipal Council.

During my time here I have found the chance of seeking advice, wrinkles which I think might help me in my job in the Federation from the Government in South Africa, and I have found the usual helpfulness and eagerness to assist us in every way.

I feel that while I am thanking you, I am also thanking the Union itself, Mr. President, for our cordial attention here.

Clr. C. F. CASTELYN (Bloemfontein): Mnr. die President, ek wil in die eerste instansie vir u, Mnr. die President, geluk wens met die hoë gehalte wat ons bereik het met hierdie besprekings. Ek het nou al 'n hele paar bygewoon en ek kan u verseker, dit is die hoogste wat ek nog bygewoon het, en dit is toe te skrywe aan u bekwame leiding en ek is daarvan oortuig.

Mnr. die Onderburgemeester, Mnr. Ross-Spencer, ons was werklikwaar beïndruk by die aangename gees dwarsdeur met die pragtige wyse waarop u ons trakteer het. Ek kan u verseker dat ons wat van ver kom heerlike lieflike herinnering met ons saam neem, en ek wil u verseker dat ons dit besonder hoog waardeer.

Ek het nie gedink dat Johannesburg regtigwaar die plek is wat ek nou uitgevind het. U weet, ons het altyd 'n indruk van hierdie stad. Hy sit 'n bietjie ver van ons af, want hy leef in 'n ander sweer van die wêreld, maar ek het nou uitgevind hier woon ook mense, en liewe mense en aangename dames!

Meneer, ek dink ek spreek namens ons almal as ek sê dat ons dit werklik geniet het, en dat u organisasie nie kon verbeter word nie. Ons waardeer dit besonder hoog, en ons wil ons innige dank daarvoor betuig.

Clr. P. BLIGNAUT (Pretoria): Meneer die President, Meneer Onder Burgemeester, Raadslid Ross-Spencer, namens my Raad en ons afvaardiging van Pretoria wil ek u almal baie hartlik bedank vir die gasvryheid wat ons hier geniet het. Ons wil die Stadsraad van Johannesburg, sowel as almal wat bygedra het om ons verblyfie aangenaam te maak, bedank. Ons het dit waardeer.

Ook wil ek al die gene wat referate gelewer het, bedank vir hulle bydraes; ek dink ons het dit baie leersaam en aangenaam gevind.

Ek kan u verseker nou dat ek alles weet van kernkrag sentrales. Ek het besluit dat ons in Pretoria maar net so 'n kleintjie sal bou om ons oor die spitsure te help.

Mr. President, engineers usually say that councillors talk too much, but I can assure you that their sense of briefness has been demonstrated at this conference.

In conclusion I want to take this opportunity of wishing you a successful year of office.

THE PRESIDENT: Thank you Councilor Blignaut.

Mr. F. A. COTTON (S.A. Institute of Certificated Engineers): Mr. Acting Mayor, Councillor Ross-Spencer, Mr. President, ladies and gentlemen: May I congratulate you, Mr. President on your election, and upon the near-conclusion of a very successful Convention.

You are a past-president of your Insitution, and we know your capabilities. I think we were the first body that conceived the idea of training you as a President, and I think we deserve some credit for that. We know, therefore, that the balance of your term of office will be crowned with success.

As a guest may I express to you and the Council my sincere thanks for the lavish manner in which we have been entertained. Some might say that the entertainment was too lavish, but I think some are in the depths of morning-after depression.

THE PRESIDENT: Thank you Mr. Cotton.

Mr. V. H. WOOD (Vereeniging): Mr. Acting Mayor, Mr. President, it is my pleasant duty to speak on behalf of your Affiliates.

The rapid development which has taken place in recent years in the field of electrical engineering makes it even more necessary for the interchange of knowledge, and ideas, and it is therefore fitting that the high level of debate on such contemporary subjects as atomic energy and the development of amenities for our Native community has typified this, your 33rd Annual Convention.

All who have taken part in debate are to be congratulated on their valuable contributions. It is only by pooling our knowledge and resources that a satisfactory solution can be found to the many problems which lie ahead of us.

The close co-operation which has developed between your affiliates and your Association will, I am sure, contribute greatly to the benefit, not only of your Association, but the community at large, in an age when we are so much dependent on electricity.

We are greatly indebted to you, Mr. Acting-Mayor, and the Corporation of Johannesburg for the kind hospitality which we have so much enjoyed.

To you, Mr. President, on behalf of the Affiliates of your Association, I wish to offer congratulations, and extend to you our very good wishes for a successful year of office, in which I trust your Executive will join.

The high standard which has been set at this conference does, I am sure, augur well for the success of your work in the coming year.

THE PRESIDENT: Thank you Mr. Woods.

Mr. W. MILTON (Escom): Mr. President, Mr. Acting-Mayor, Councillor Ross-Spencer, ladies and gentlemen: It falls to my lot to thank you very much for the invitation extended to Escom to attend this conference. Why Mr. de Villiers is not speaking I am not at all clear, but he seems to assume that I am more or less part of the A.M.E.U.

We do thank you very much for the opportunity given us each year to attend your conferences, and to maintain our contract with our fellow electrical engineers, whose duties are much the same as ours.

I would like to congratulate you on the choice of papers, and join with Mr. Woods in that respect.

I regret that I personally have not been able to attend all the meetings of the convention, but they have been attended by others of my colleagues throughout.

I do wish you a very successful year of office, and look forward to joining you in Durban next year.

THE PRESIDENT: Thank you Mr. Milton.

THE SECRETARY: We have one or two other messages for you this morning.

A telegram has been received from Mr. Nicholas. "Congratulations and best wishes to your convention work. Sorry will not be with you."

Then I was handed a letter yesterday by Mr. Gouws of the Transvaal Provincial Administration, Department of Local Government.

"Mr. President, due to pressure of work in Pretoria I am unable to attend the closing session of your Convention. I would, however, like to place on record my sincere appreciation of being accorded the privilege of attending your Convention. I thought the discussions would be Greek to me, but have understood a great deal more than Municipal Electrical Engineers in the Transvaal will give me credit for."

„Mnr. die President, namens die Transvaal se Provinsiale Administrasie wil ek u bedank vir die uitnodiging om hierdie verrigtinge by the woon. Ek het die lesings en besprekings uiters leersaam gevind en wil van hierdie geleentheid gebruik maak om u Vereniging 'n baie suksesvolle jaar toe te wens."

THE PRESIDENT: Incidentally, the Mayor of Windhoek this morning had to leave before 10 o'clock and he thanked us very much and suggested we go to Windhoek for our convention. Meanwhile they are getting training by having the Town Clerks, and Civil Engineers — then they expect to be able to handle us!

Mr. J. R. MITCHELL (Salisbury): Mr. Acting Mayor, Mr. President, Councillor Ross-Spencer: It is again my very welcome duty to thank our hosts the Council of the City of Johannesburg for the entertainment of our accompanying ladies. Today in this very rapidly developing world, engineers and councillors are continually being faced with new problems, but nature being what she is, she usually gives us a new aid in solving those problems.

Now I am an engineer and an engineer always calls a spade a spade, until of course he falls over one in the dark! And I would say, from my own point of view, that, in

human relations, which are some of the most difficult we have to deal with in both engineering and in council work, the finest aid any engineer or councillor can have is a loving and long-suffering wife.

All an engineer needs from his wife, of course, is affection, admiration, encouragement, and the ability to live grandly on an inadequate income.

Wives of both councillors and engineers, are blessed it seems with having a fortitude and optimism almost in inverse proportions to their husbands increases in responsibilities and pessimism.

When all is said and done, all they really want are two lines — one for their husbands to look at and the other for their husbands to listen to.

I came across the other day, in an American college magazine, a chemical description of Woman. It said as follows: "Thought to be of the human race. Accepted at 120 lbs. but known isotopes are found from 80 lbs. to even twice that mass and considerably above the average figure. Seldom found in the natural state. Usually coated with a solution of paint. Low boiling point. Freezing point varies. Is highly explosive except in qualified hands. Extremely active when in the vicinity of the opposite members of the species. It is illegal to own more than one although a certain amount of interchange is permissible."

The female of the species, Mr. Deputy Mayor have been right royally entertained. They enjoyed the splendid cocktail party on Monday evening; and the delightful tea party at the Zoo Lake with the Deputy Mayoress on Thursday morning. At some factories which they visited on Wednesday some came away with samples — but I did not hear of any samples being obtained at the diamond works. Arguments are still proceeding as to whether Mr. Starkweather was in fact Mr. Macgregor, and the delightful gesture of finding a box of chocolates on their seats was in keeping with the generosity and general kindliness of their hosts in this city.

As you know there are only two periods when a man does not understand his wife: they are before and after marriage; so it was no surprise to hear one wife say at the theatre, "You see you had no need to have wasted your money on buying chocolates" and the other one to say "This is very nice; I suppose *you* never thought of buying *me* one."

Oh well, I suppose it is the variety and unpredictability that contributes so much to their charm and interest.

I must, therefore, on behalf of the male members of the Convention first of all, thank our ladies for contributing so much to the gaiety and social events of the week. And to you and your Council, and I think I should say, your ratepayers, the ladies say a very gracious "Thank you."

Clr. E. R. SNYMAN (Springs): Mnr. die Agerende-Burgermeester, Mnr. die President, ek is nou in 'n heeltemal moeilike posisie hierso. Ek het opgestaan om hier te kom praat en bly my speech agter by die stoel, en hy wil nie saamkom nie.

Dit is vir my 'n baie aangename taak om vandag namens al die afgevaardigdes vir ons Agerende Burgemeester van Johannesburg en sy Raad baie baie dankie te sê vir die aangename konferensie wat ons hier gehad het.

Ek kan u die versekering gee dat ek praat namens al die afgevaardigdes — ons het ons terdeë geniet.

Ek dink net toevallig aan 'n grappie wat Mnr. Kane my vertel het. Hy het my gevra wat sê 'n mens vir 'n elektriese paal as hy verby hom stap. Toe sê ek, „Nee ek weet nie." „Jy sê niks nie, jy stap maar net verby."

Mr. President, it affords me great pleasure on behalf of all the delegates here today to thank the Acting Mayor and his Council for the marvellous time that they gave all the delegates here, in this vast city. I always thought that Johannesburg was a suburb of Springs. As a matter of fact I recall that the name of Springs was mentioned quite often at this conference, but after the cocktail party the other night, I'm afraid I had to change my mind. Johannesburg is not a suburb of Springs.

Mr. President, I had the honour to attend the conference in Salisbury two years ago. Unfortunately I was done out of the Margate

one by another councillor, and then I was very pleased when I was nominated to attend this conference in Johannesburg. I am looking forward to attend the conference in Durban next year, and especially the one in Livingstone the year after; I hope I will not be on the retired list when we come back to Johannesburg again.

Again, I want to thank you very much Mr. Acting Mayor, on behalf of all the delegates for the wonderful time you have given us all, and I want to wish all the delegates God speed and a safe journey back.

THE PRESIDENT: Thank you Councillor Snyman.

I now call on the Acting Mayor to reply.

HIS WORSHIP THE ACTING MAYOR OF JOHANNESBURG, Councillor A. Gorshel: Mnr. die President, Raadslid Ross-Spencer, dames en here: Dit is vir my 'n aangename vooreg en genoë om julle almal geluk te wens met die uitstekende sukes wat u 33ste Konferensie behaal het.

Ek waardeer ook die woorde van dank wat sprekers vanmôre aan my Stadsraad berig het, en ek is ook baie bly dat Mnr. Kastelyn nou uit sy eie ondervinding die burgers van Bloemfontein gaan verseker dat Johannesburg nog 'n deel van die Unie van Suid-Afrika vorm.

Mr. President, Mr. Vice-President, Councillor Ross-Spencer, ladies and gentlemen: I do appreciate very much the kind words that you have directed towards me as representing the City Council of Johannesburg for what you have called the hospitality extended to you.

I can only assure you that as far as my wife and I are concerned, and I am sure as far as all my colleagues who have had the pleasure of being with you at these various functions goes, it has been an extremely interesting and pleasurable experience which we look forward to repeating as soon as possible.

Mr. Mitchell referred to the problem of human relations as regards local authorities, meaning town or city councils, and the councillors themselves, which, of course, indicates that in his opinion councillors are human, since he used that word. I heard as recently as yesterday that in Britain they have a very popular idea of town and city councillors which is expressed in this way, that individually councillors do nothing, and collectively they decide that nothing can be done. Perhaps the best thing we have done this year in the City Council of Johannesburg is to decide that we would do all we could to make your stay in Johannesburg at the conference as happy and successful as possible.

Having regard to the fact that so many of you have come from far afield to see our city and to spend a little time with us, I can only say to you that, far from any thanks being due to the City Council of Johannesburg, I want to thank all of you for coming to this convention, to our city, and for the very kind words of appreciation that I will take back to the Council from you Mr. President, and your colleagues and the ladies here this morning.

I sincerely hope that you will indeed, as has been said, have pleasant recollections of your visit here, and that at the earliest opportunity your Association, sir, will be able to come back again with a conference so that we may once again be able to entertain you in a small way (it only costs us about £50,000 a year to entertain people!) and show that we are more than conscious of the importance of your Association, of the magnificent work that is being done throughout the country by the people in charge of all the Electricity Undertakings, of the courtesy of the people in charge of those undertakings. It is an extraordinary thing that one finds men who are in charge of Power Stations being particularly calm, cool, and collected, and always, regardless of the problem that they have to face, prepared to be polite — which is more than one can say, I am afraid, about all council or local authority departments. There is a certain equanimity among the engineers which is quite remarkable.

So we hope to see you all again soon, and may I join other speakers in wishing you all a safe and happy return to your homes, and all I can say to you on behalf of my wife, and myself, and my colleagues in the Council, "Totsiens."

THE PRESIDENT: Thank you Mr. Acting Mayor.

I believe there is something else going to happen that I know nothing about: the Executive is running me!

Mr. J. C. DOWNEY (Springs): Mr. President, Mr. Acting Mayor, ladies and gentlemen: I should like, on behalf of all the delegates present to propose a vote of thanks to our President for the manner in which he has handled this Convention.

I do know of the excellent and very hard work he has done behind the scenes for our convenience and pleasure, and the tremendous amount of night oil he has used for this purpose.

But there is one thing I want to tell you. The President's forecast that he was going to have a bad time from his Executive. His forecast was correct. His first Executive meeting produced difficulty for himself. So much so, he has never had another Executive meeting during this Convention!

Mr. President, on behalf of the delegates I want to thank you most sincerely for the way you have handled and conducted this Convention.

THE PRESIDENT: Thank you Jack.

This question of having trouble with the Executive, let me put it this way: that they misbehaved themselves so much under Chris Downie on Monday that they started the whole of Monday's proceedings over again on Tuesday morning, trying to make up their minds what they had done the previous day!

Mr. Acting Mayor, ladies and gentlemen: It is with somewhat mixed feelings that I have to now close the proceedings of this, the 33rd Convention of our Association.

I must first of all express my very sincere thanks to you all, every one of you, for the help and encouragement that I have had this week.

First of all to our Executive, may I say that I have deeply appreciated their help — and what was also noticeable their frequent and constant attendance at all sessions.

My thanks are due to the City Council for their active help in many directions, and this includes particularly the Parks Department for the floral decorations, the City Engineers Department for their job of work outside the hotel, and the very many members of the staff, the backroom boys, the typists, the office boys, who have all been involved in this, I hope successful, Convention.

Last but not least there is the staff of your office, Mr. Acting Mayor, who have helped me on the right road on many occasions.

My Chairman, Councillor Ross-Spencer, has been a real friend, and I also wish to thank Mrs. Ross-Spencer for her kindness in many ways. Alan Powell, George Masson and Barney who have helped to make this Convension a real success with the quality and excellence of their papers.

The Gold Refinery, the Master Diamond Cutting Association, the Traffic Department, Transport Department, and the factories some of us visited. They have all helped towards this success.

In the background, for many months, there has been Dick Ewing our Secretary, and his staff, and last but not least his charming wife, to them all a very special expression of appreciation.

The hotel staff to my knowledge, insofar as the Convention is concerned, has been marvellous, and I think most tolerant. Many thanks Mrs. England and Mr. Thomasini.

Finally, Mr. Acting Mayor, my really sincere appreciation to your good lady and yourself, for giving us so much of your time, and having helped us to maintain Johannesburg's reputation for hospitality.

I now declare the 33rd Convention closed, and wish you all God speed.

Baie dankie, dames en here. Totsiens.

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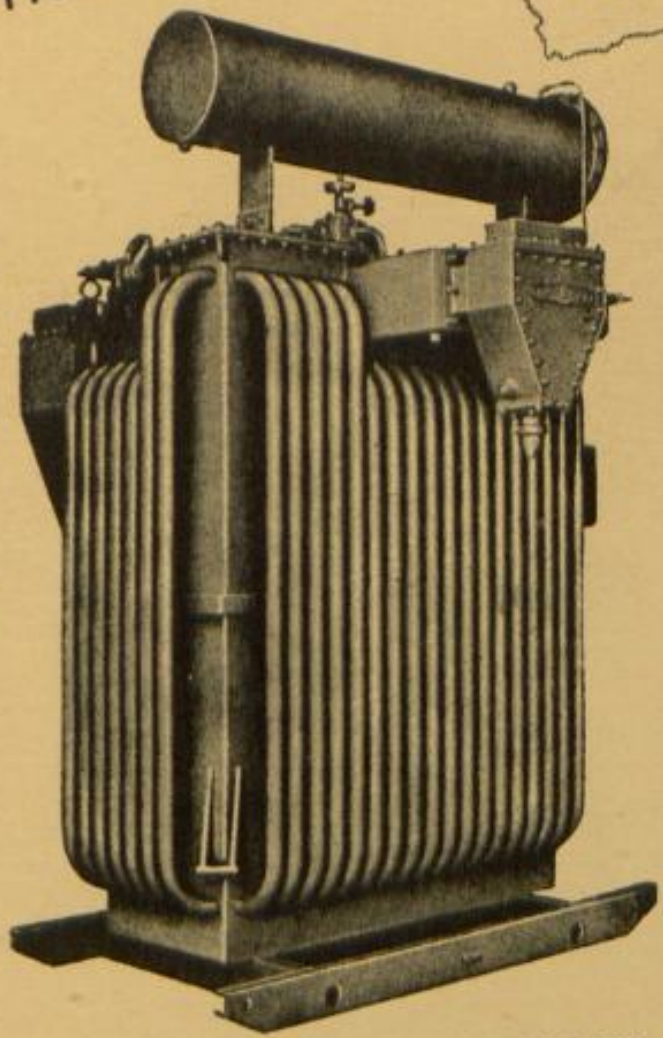

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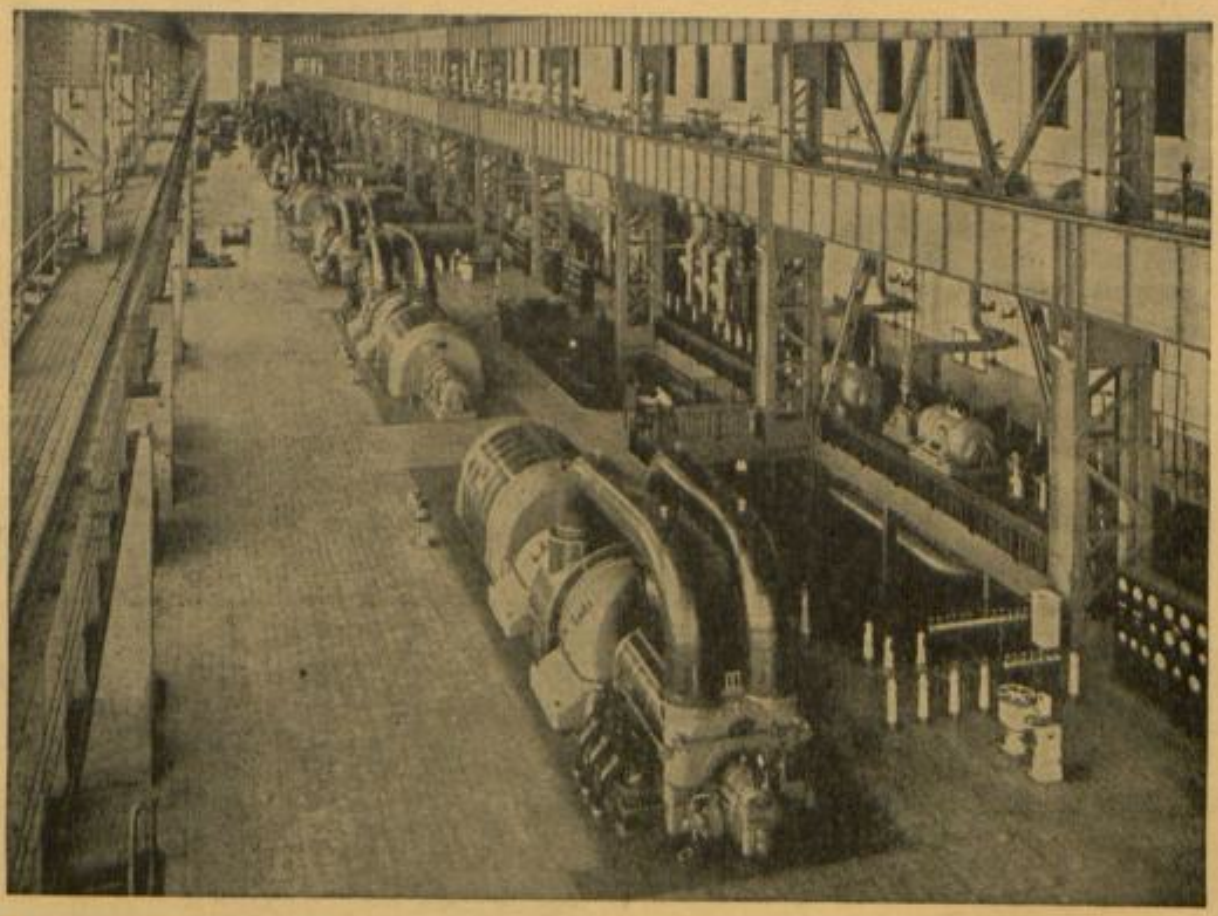

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