# THE JOURNAL

OF THE

# INSTITUTE OF METALS

VOLUME L

# METALLURGICAL ABSTRACTS

AND

INDEX TO VOLUMES XLVIII, XLIX, and L

OF THE

**JOURNAL** 

G. SHAW SCOTT, M.Sc.

SECRETARY

The Right of Publication and of Translation is Reserved



The Institute of Metals is not responsible either for the statements made or for the opinions expressed in the following pages

#### LONDON

PUBLISHED BY THE INSTITUTE OF METALS 36 VICTORIA STREET, LONDON, S.W.1

1933

N	o	•••	• • •	•••	•••	• • • • •	
n	,						

# The INSTITUTE of METALS

36 VICTORIA STREET, LONDON, S.W.1.

Founded 1908. Incorporated 1910.

To the Secretary,	
The Institute of Metals.	
I, the undersigned	
beingyears of age and desirous of becoming a †	
Member of the Institute of Metals, agree that if elected I will l	
the Regulations and Bye-laws of the Institute from time to tin	
observe the obligations imposed on Members under the Articles	
of the Institute, and that I will advance the interests of the Inst may be in my power; and we, the undersigned, from our person	
do hereby recommend the said	
Name of applicant in full.	
Address	
Business or Profession	
Qualification	
Degree and/or honorifie distinctions	************
Dated thisday of	, 19
	Signatures of three
	Members.
The Council, having approved the above recommendation,	
declare the applicant to be duly elected as	To be filled up
Member of the Institute of Metals.	by the
	Council.
36 VICTORIA STREET, Chairman.	
Westminster, London, S.W.1.	
Dated thisday of19	
† For Qualifications of Members, see Rule 6, other	SIDE.
(It would be a convenience if the Candidate's Card were sent with	this form.)
KO.	

### EXTRACTS FROM THE RULES

(MEMORANDUM AND ARTICLES OF ASSOCIATION.)

#### MEMBERS AND MEMBERSHIP

Rule 5 .- Members of the Institute shall be Honorary Members, Fellows, Ordinary Members, or Student Members.

Rule 6.—Ordinary Members shall be of such age (not being less than twenty-one years) as shall be determined from time to time by the Council and/or provided in the Bye-laws. They shall be cither :

(a) persons engaged in the manufacture, working, or use of non-ferrous metals and alloys;

(b) persons of scientific, technical, or literary attainments, connected with or interested in the metal trades or with the application of non-ferrous metals and alloys, or engaged in their scientific investigations

Student Members shall be admitted and retained as Student Members within such limits of age [17-23 years] as shall be determined from time to time by the Council and/or provided in the Byc-laws, and shall be either

(a) Students of Metallurgy; or(b) pupils or assistants of persons qualified for ordinary membership, whether such persons are actually members of the Institute or not.

Student Members shall not be eligible for election on the Council, nor shall they be entitled to vote at the meetings of the Institute, or to nominate candidates for ordinary membership.

Rule 7.—Subject to the foregoing two clauses, and as hereinafter provided, election to member-

ship shall be by the Council, and all applications for membership shall be in writing in the form [overleaf] marked "A," or such other form as may from time to time be authorized by the Council, and such application must be signed by the applicant and not less than three members of the Institute.

Membership shall not begin until the entrance fee and first annual subscription have been paid.

Rule 8.—Application for membership as Ordinary or Student Members shall be submitted to the Council for approval. The names of the approved applicants shall be placed on a list which shall be exhibited in the library of the Institute for at least fifteen days immediately after the Council Meeting at which such names were approved. Copies of such lists shall be supplied to the Secretaries of Local Sections of the Institute for inspection by members, and in any other manner to members as

may from time to time be prescribed by the Council. Any objection to any candidate whose name is so exhibited or notified to members shall be made in writing to the Secretary within twenty-one days of the date when the list shall first he so

exhibited.

At a subsequent Council Meeting the applications for membership of persons whose names shall have been so exhibited shall be further considered, and the Council may, in their absolute discretion, elect or reject such applicants, and may refuse any application although previously approved without giving any reason for such refusal. Non-election shall not necessarily prejudice the candidate for election concerned in any future application for election.

#### SUBSCRIPTIONS

Rule 9.—Unless and until otherwise determined by the Council and/or provided in the Bye-laws the subscription of each Ordinary Member shall be £3 3s. per annum, and of each Student Member £1 1s. per annum. Ordinary Members shall pay an Entrance Fee of £2 2s. each and Student Members an Entrance Fee of £1 1s. each.

Rules and/or regulations may be made by the Council from time to time for the transference of Student Members from that status to that of Ordinary Members, including the fixing of an entrance fee to be payable on any such transfer of such a sum as the Council may from time to time prescribe, and/or the waiver of any such.

The Council may, in fixing such sum, take into consideration the prior payment of entrance fees

by Student Members.

Subscriptions shall be payable on election and subsequently in advance on July 1st in each year, or otherwise as shall be determined from time to time by the Council and/or provided in the Byelaws.

### DUTIES AND OBLIGATIONS OF MEMBERS

Rule 12 .- Every member shall be bound :

- (a) To further to the best of his ability and judgment the objects, purposes, interests, and influence of the Institute.
- (b) To observe the provisions of the Memorandum of Association of the Institute, the Articles. and the Bre-laws.
- (c) To pay at all times, and in the manner prescribed, such entrance fees on election, such fees on transference from one class of membership to another, and such annual subscriptions as shall for the time being be prescribed.

(d) To pay and make good to the Institute any loss or damage to the property of the Institute caused by his wilful act or default.

Rule 13.-Every member, in all his professional relations, shall be guided by the highest principles of bonour, and uphold the dignity of his profession and the reputation of the Institute.

P.99/32/3

P901



Past-Presidents.

Sir WILLIAM HENRY WHITE, K.C.B., LL.D., D.Eng., Sc.D., F.R.S., 1908-1910 (deceased).

Sir GERARD ALBERT MUNTZ, Bart., 1910-1912 (deceased).

Professor William Gowland, A.R.S.M., F.R.S., 1912-1913 (deceased).

Professor Alfred Kirby Huntington, A.R.S.M., 1913-1914 (deceased).

Engineer Vice-Admiral Sir Henry John Oram, K.C.B., F.Inst.Met., F.R.S., 1914-1916.

Sir George Thomas Beilby, LL.D., D.So., F.R.S., 1916-1918 (deceased).

Professor Sir (Henry Cort) Harold Carpenter, M.A., Ph.D., A.R.S.M., F.Inst.Met., F.R.S., 1918-1920.

Engineer Vice-Admiral Sir George Goodwin Goodwin, K.C.B., LL.D., F.Inst.Met., 1920-1922.

LEONARD SUMMER, O.B.E., M.Sc., F.Inst.Met., 1922-1924.

Professor Thomas Turner, M.Sc., A.R.S.M., F.Inst.Met., 1924-1926.

Sir John Dewrance, G.B.E., F.Inst.Met., 1926-1928.

WALTER ROSENHAIN, D.Sc., F.Inst.Met., F.R.S., 1928-1930.

RICHARD SELIGMAN, Ph.nat.D., F.Inst.Met., 1930-1932.

# LIST OF OFFICERS

OF

# THE INSTITUTE OF METALS

1933-1934

#### President.

Sir HENRY FOWLER, K.B.E., LL.D., D.Sc.

#### Past-Presidents.

Professor Sir Harold Carpenter, M.A., Ph.D., A.R.S.M., F.R.S. Sir John Dewrance, G.B.E.

Walter Rosenhain, D.Sc., F.R.S.
RICHARD SELIGMAN, Ph.nat.D.
LEONARD SUMNER, O.B.E., M.Sc.
Professor Thomas Turner, M.Sc., A.R.S.M.

#### Vice-Presidents.

W. R. BARCLAY, O.B.E	London.
C. H. DESCH, D.Sc., Ph.D., F.R.S	Teddington.
A. G. C. GWYER, B.Sc., Ph.D	Warrington.
Professor D. Hanson, D.Sc	Birmingham.
Professor R. S. HUTTON, D.Sc., M.A	Cambridge.
H. MOORE, C.B.E., D.Sc., Ph.D.	London.

#### Honorary Treasurer.

JOHN FRY .	,									London
------------	---	--	--	--	--	--	--	--	--	--------

#### Members of Council.

S. L. ARCHBUTT (Representing t	the Local Sections.)
H. W. Brownsdon, M.Sc., Ph.D	Birmingham.
Engineer Vice-Admiral Sir Robert Dixon, K.C.B., D.Eng.	London.
M. S. GIBB, C.B.E., J.P	West Hartlepool.
R. LLOYD GIBBINS	Birmingham.
Kenneth Gray	Sheffield.
H. H. A. GREER, J.P	Glasgow.
J. L. HAUGHTON, D.Sc	Teddington.
Wesley Lambert, C.B.E., A.K.C	London.
H. C. LANCASTER	London.
E. L. MORGOM, M.A	Birmingham.
A. H. MUNDEY	London.
A. J. G. SMOUT	Birmingham.
James Steven	Glasgow.
F. Tomlinson	Manchester.
H. B. WEEKS	London.

#### Secretary and Editor. G. Shaw Scott, M.Sc., F.C.I.S.

### Assistant Secretary.

S. C. GUILLAN.

Telegraphic Address—" Victoria 2320, London."
INSTITUTE OF METALS,

TITUTE OF METALS, 36 VICTORIA STREET, LONDON, S.W.I. Telephone-Victoria 2320.

# ABSTRACTORS AND REVIEWERS

N. AGEEW, Met. Eng.

B. BLUMENTHAL, Dr.-Ing.

Captain B. BRANDT.

J. C. CHASTON, B.Sc., A.R.S.M.

R. B. DEELEY, B.Sc., A.R.S.M.

J. W. Donaldson, D.Sc., A.I.C.

W. ENGEL, Dr.-phil.

U. R. EVANS, M.A., D.Sc.

S. FIELD, A.R.C.S.

R. GENDERS, M.B.E., D.Met., F.I.C.

H. F. GILLBE, Ph.D., B.Sc.

Frhr. v. Göler, Dr.-Ing.

H. J. Gough, M.B.E., D.Sc., Ph.D., F.R.S.

Roosevelt GRIFFITHS, M.Sc.

J. D. GROGAN, B.A.

Dott. G. GUZZONI.

M. A. K. HANSEN, Dr.-phil.

E. S. HEDGES, D.Sc., Ph.D., A.I.C.

H. W. G. HIGNETT, B.Sc.Eng., A.I.C.

O. F. HUDSON, D.Sc., A.R.C.S.

W. HUME-ROTHERY, M.A., Ph.D.

Z. Jasiewicz, M.S.

F. Johnson, D.Sc.

J. L. LEQUERICA Y LIAS.

Professor Dr. L. LOSANA.

Professor W. MISANGYI, Dr.-techn.

W. A. C. NEWMAN, B.Sc., A.R.S.M., A.R.C.S., F.I.C.

E. ÖHMAN.

Ing. R. Pospisil.

A. R. POWELL.

G. D. PRESTON, B.A.

W. P. REES, M.Sc.

Miss P. M. C. ROUTH, B.Sc.

D. N. SHOYKET, Chem. Eng.

Professor J. F. SPENCER, D.Sc., Ph.D., F.I.C.

H. SUTTON, M.Sc.

J. S. G. THOMAS, D.Sc.

J. H. Watson, M.C., B.Sc., A.R.S.M.

J. WEERTS, Dr.-Ing.

S. WERNICK, Ph.D., M.Sc.

S. V. WILLIAMS, B.Sc.

A. B. WINTERBOTTOM, M.Sc.Tech., F.I.C.

M. ZVEGINTZOV, B.A., B.Sc.

### CONTENTS

## METALLURGICAL ABSTRACTS

- I. Properties of Metals, 1, 65, 145, 209, 289, 337, 417, 465, 529, 593, 657, 721.
- II. Properties of Alloys, 10, 76, 151, 221, 294, 346, 424, 471, 534, 600, 660, 726.
- III. Corrosion and Protection, 24, 82, 160, 228, 300, 354, 432, 479, 543, 608, 666, 737.
- IV. Structure: Metallography; Macrography; Crystal Structure, 32, 86, 164, 237, 306, 362, 439, 485, 552, 614, 671, 744.
  - V. Analysis, 39, 86, 166, 238, 309, 364, 441, 487, 553, 618, 673, 748.
- VI. Laboratory Apparatus, Instruments, &c., 40, 91, 170, 242, 311, 367, 445, 489, 556, 621, 677, 749.
- VII. Physical and Mechanical Testing and Radiology, 41, 91, 174, 243, 312, 368, 446, 490, 557, 625, 679, 750.
- VIII. Pyrometry, 44, 94, 175, 246, 313, 370, 492, 561, 628, 680, 756.
  - IX. Electrometallurgy and Electrochemistry, 45, 95, 176, 246, 314, 370, 448, 492, 562, 629, 681, 758.
  - X. Industrial Uses and Applications, 50, 101, 179, 253, 319, 373, 453, 495, 566, 638, 685, 762.
- XI. Heat-Treatment, 53, 110, 185, 256, 323, 382, 456, 499, 570, 694, 764
- XII. Joining, 53, 110, 186, 256, 324, 383, 499, 570, 695, 765.
- XIII. Working, 55, 116, 189, 259, 326, 386, 502, 573, 701, 766.
- XIV. Finishing, 119, 192, 262, 328, 388, 504, 577, 705, 768.
- XV. Foundry Practice and Appliances, 122, 194, 263, 329, 389, 506, 580, 641, 708, 769.
- XVI. Furnaces and Fuels, 129, 197, 269, 331, 392, 510, 582, 642, 776.
- XVII. Refractories and Furnace Materials, 198, 273, 395, 513, 584, 644, 778.
- XVIII. Miscellaneous, 202, 275, 398, 518, 647, 778.
  - XIX. Bibliography, 59, 132, 205, 280, 333, 403, 457, 524, 587, 649, 714, 781.
  - XX. Book Reviews, 63, 140, 284, 335, 408, 460, 528, 589, 652, 719, 784.

# INDEX TO VOLS. XLVIII, XLXIX, AND L OF THE JOURNAL

						PAGE
Subject Index						785
Name Index						885

#### CORRIGENDA

```
For "Lowanke" read "Lowance."
Page
      75, line 1 from bottom of page.
                                            For "VI" read "X."
       78
           ,, 5.
 33
       86, lines 24 & 37,
                                            For "Steuzel" read "Stenzel."
 31
                                            For "Kova" read "Kota."
       88, line 21.
                                            For "K. V. Frolich" read "K. W.
                2 from bottom of page.
 33
                                               Frohlich."
                                            For "Cu,O" read "Cu,I,"
For "1931, 51-71" read "1931, 31-50."
     166, ,,
                6.
 33
     184,
               33.
           ,,
 33
                                            For "1931, 52, 117-118" read "1931,
     196,
                8 from bottom of page.
                                               52, 113-114, 117-118."
                                            For "J. N. Chesters" read "J. H.
     201, "
               11.
                                               Chesters."
     208, ,,
                                            For "Shlougin" read "Shoulgin.
               12.
                                            For "More than 72% silver" read "Less than 72% silver."
     239, ,,
               23.
 93
     240, ,,
               22.
                                            For "1932, 207, 114-124," read "1932,
                                               270, 114-124.
                                            For "1931, 7, 78-82," read "1931, 7, 150-154."
     316, ,,
               13.
     320, ,,
                                            For "See this J., 1931, 47, 202," read
               20.
                                               "See this J., 1931, 47, 292."
                                            For "Beverley L. Clarke" read "Beverly
     364, ,,
               16.
                                               L. Clarke."
     372,
                9.
                                            For "Heimrood" read "Heimrod."
 89
                                            For "Cf. J., this volume, p. 155" read
     385,
               15.
           11
 33
                                            "Cf. J., this volume, p. 55."
For "Grummell" read "Grumell."
     394, ,,
                8 from bottom of page.
     423, ,,
              23 from bottom of page.
                                            For "Bridgeman" read "Bridgman."
                                            For "Clarke, Beverley L." read "Clarke,
     457, ,,
              13 from bottom of page.
                                               Beverly L.
     465, ,,
                2,
                                             For "Cf. J., this volume, p. 213" read
                                               " Cf. J., this volume, p. 210."
                                            For "at 120° C." read "with a core
     465, ,, 15 from bottom of page.
                                            angle of 120°."
For "VI" read "IV."
     478, ,,
               28.
                                            For "M. Magnani" read "U. Magnani." For "Jerzillo" read "Verzillo."
     500, ,,
                8.
     501,
               10.
           22
 97
                                            For "1932, 7, 145-152" read "1932, 5, 145-152."
                2 from bottom of page.
     535,
           ,,
 13
     538, ,, 28.
                                            For "1930, 3, 31" read "1930, 3, 181-183."
 99
     541, " 21.
                                            For "nickel 79%" read "nickel 29%."
                                            For "Ultimate Strength" read " Break-
     541, top of column 3 of table.
                                               ing Strength."
                                                  T. Lombardo" read "D. Lombardo."
     555, line 16 from bottom of page.
                                            For "Alluminio, 1, (1), 15-35" read
     567, ,, 14 from bottom of page.
                                               " Alluminio, 1932, 1, 15-35.
                                            For "1931, 2, 55-56" read "1932, 3,
     575, ,,
              7 from bottom of page.
                                               55-56."
                                            For "1929, 2, 7" read "1929, 2, (20), 7."
     582, lines 17 & 18.
                                            For "M. G. H. Meigh (Rev. Mét., 1932, 29, 209-214)" read "G. H. Meigh
     602, line 9.
                                            (Rev. Met., 1932, 29, 208-214)."
For "A. L. White" read "A. E. White."
     658, ...
               25 from bottom of page.
                                            For "Copper-Tin-Antimony System"
     662, "
               18.
                                              read "Copper-Tin-Lead System."
               23 from bottom of page.
                                            For "See J., this volume, p. 345" read
     668, ,,
                                               "See J., this volume, p. 545.
                                            For "Nickel Bulletin, 1932, 7" read
"Nickel Bulletin, 1932, 5."
For "F. E. Basir" read "F. E. Bash."
     692, "
                6.
     693, "
               10.
                                            For "Thum, A., and Buchanan, W." read
               27.
     719, "
                                            "Thum, A., and Buchmann, W."
For "Seager" read "Saeger."
For "T. A. Wolfe," read "R. A. Wolfe."
                8.
     731,
     748.
              10.
                                            For "W. A. Dunlap" read "W. M.
```

Dunlap."

765 ,, 27 from bottom of page.