

# METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

VOLUME 3

(*New Series*)

EDITED BY

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

1936

Copyright]

[Entered at Stationers' Hall

~~7066/402~~

Form A.

(Membership Application)

No.....

Recd.....

# 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\* .....

being.....years of age and desirous of becoming a †.....

Member of the INSTITUTE OF METALS, agree that if elected I will be governed by the Regulations and Bye-laws of the Institute from time to time extant and observe the obligations imposed on Members under the Articles of Association of the Institute, and that I will advance the interests of the Institute so far as may be in my power; and we, the undersigned, from our personal knowledge, do hereby recommend the said.....for election.

\*Name of applicant in full .....

Address.....

†Business or Profession .....

Qualification.....

Degrees and/or honorific distinctions.....

Dated this.....day of....., 19.....

.....  
.....  
.....

Signatures  
of three  
Members.

The Council, having approved the above recommendation,  
declare the applicant to be duly elected as.....  
Member of the INSTITUTE OF METALS.

To be filled up  
by the  
Council.

36 VICTORIA STREET,

Chairman.

WESTMINSTER, LONDON, S.W.1.

Dated this.....day of.....19.....

† For Qualifications of Members, see Rule 6, other side.

‡ Name and address of firm (or other body) should be stated, as well as position held.

(It would be a convenience if the candidate's card were sent with this form.)

# 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 either:

- (a) persons engaged in the manufacture, working, or use of non-ferrous metals and alloys;  
or
- (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 [17–26 years] as shall be determined from time to time by the Council and/or provided in the Bye-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 membership 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 be 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. (Entrance Fee for Students has been temporarily suspended.)

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 Bye-laws.

## 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 Bye-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 honour, and uphold the dignity of his profession and the reputation of the Institute.



P.101/36

## ABSTRACTORS AND REVIEWERS

N. AGEW, Dr.-chem., Met.Eng.  
W. E. ALKINS, D.Sc.  
Professor J. H. ANDREW, D.Sc.  
W. E. BALLARD.  
Professor C. O. BANNISTER, M.Eng., A.R.S.M.  
B. BLUMENTHAL, Dr.-Ing.  
B. CHALMERS, B.Sc., Ph.D.  
J. C. CHASTON, B.Sc., A.R.S.M.  
J. W. DONALDSON, D.Sc.  
A. G. DOWSON, B.A., Ph.D.  
W. ENGEL, Dr.-phil.  
S. FIELD, A.R.C.S.  
R. GENDERS, M.B.E., D.Met.  
Frhr. v. GÖLER, Dr.-Ing.  
ROOSEVELT GRIFFITHS, M.Sc.  
G. A. HANKINS, D.Sc., A.R.C.S.  
E. S. HEDGES, D.Sc., Ph.D.  
H. W. G. HIGNETT, B.Sc.Eng.  
A. W. HOTHERSALL, M.Sc.Tech.  
W. HUME-ROTHERY, M.A., Ph.D., F.R.S.  
N. C. HYPPIER, B.A., B.Sc.  
Z. JASIEWICZ, M.S.  
I. JENKINS, B.Sc.  
F. JOHNSON, D.Sc.  
W. D. JONES, M.Eng., Ph.D.  
J. KAISERMAN.  
Professor W. MISÁNOYI, Dr.-techn.  
W. A. C. NEWMAN, B.Sc., A.R.S.M., A.R.C.S.  
J. E. NEWSON, M.Met.  
H. O'NEILL, M.Met., D.Sc.  
A. R. PEARSON, M.Sc., LL.B.  
H. W. L. PHILLIPS, B.A.  
A. R. POWELL.  
Professor Dr. O. QUADRAT.  
J. T. RANDALL, D.Sc.  
C. E. RANSLEY, B.Sc.  
P. W. REYNOLDS, B.A., B.Sc.  
A. G. ROBIETTE, B.Sc.  
PHOEBE M. C. ROUTH, B.Sc.  
D. N. SHOYKHET, Chem.Eng.  
H. S. VAN SOMEREN, B.Sc.  
Professor J. F. SPENCER, D.Sc., Ph.D.  
D. STOCKDALE, M.A., Ph.D.  
H. SUTTON, D.Sc.  
N. SWINDELLS, B.A.  
C. SYKES, D.Sc., Ph.D.  
R. TAYLOR, Ph.D.  
G. J. THOMAS, B.Sc.  
J. S. G. THOMAS, D.Sc.  
E. V. WALKER, B.Sc., A.R.S.M.  
J. H. WATSON, M.C., B.Sc., Ph.D., A.R.S.M.  
S. V. WILLIAMS, B.Sc.  
M. ZVEGINZOV, B.A., B.Sc.

## SYMBOLS AND ABBREVIATIONS USED IN TEXT.

A.	Ångström units.	km. <sup>2</sup>	square kilometre.
abs.	absolute.	kv.	kilovolt(s).
a.c.	alternating current(s).	kva.	kilovolt-ampère(s).
amp.	ampère(s).	kw.	kilowatt(s).
amp.-hr.	ampère-hour(s).	kw.-hr.	kilowatt-hour(s).
A.W.G.	American wire-gauge.	lb.	pound(s).
Bé.	Baumé.	L.-F.	low-frequency.
B. & S.	Brown & Sharpe (gauge).	m.	metre(s).
B.H.P.	brake horse-power.	m. <sup>2</sup>	square metre(s).
B.O.T.	Board of Trade.	m. <sup>3</sup>	cubic metre(s).
B.th.u.	British thermal units.	m.amp.	milliampère(s).
B.T.U.	Board of Trade unit.	max.	maximum.
B.W.G.	Birmingham wire-gauge.	mg.	milligramme(s).
C.	centigrade.	mm.	millimetre(s).
cal.	caloric(s).	mm. <sup>2</sup>	square millimetre(s).
c.c.	cubic centimetre(s).	mm. <sup>3</sup>	cubic millimetre(s).
cg.	centigramme(s).	m.m.f.	magnetomotive force(s).
c.g.s.	centimetre-gramme-second.	mμ	millimicron.
cm.	centimetre(s).	m.v.	millivolt(s).
cm. <sup>2</sup>	square centimetre(s).	N.	normal.
cm. <sup>3</sup>	cubic centimetre(s).	N.T.P.	normal temperature and pressure.
coeff.	coefficient(s).	oz.	ounce(s).
const.	constant(s).	P.C.E.	pyrometric cone equivalent.
c.p.	candle-power.	p.d.	potential difference.
C.T.U.	centigrade thermal units.	p.p.m.	parts per million.
cwt.	hundredweight(s).	R.	Réaumur.
d	density.	r.p.m.	revolutions per minute.
d.c.	direct current(s).	sp. gr.	specific gravity.
dg.	decigramme(s).	sq.	square.
diam.	diameter(s).	v.	volt(s).
dm.	decimetre(s).	va.	volt-ampère(s).
dm. <sup>2</sup>	square decimetre(s).	w.	watt(s).
dm. <sup>3</sup>	cubic decimetre(s).	w.-hr.	watt-hour(s).
e.m.f.	electromotive force(s).	w.p.c.	watts per candle.
F.	Fahrenheit.	°	degree(s) (arc or temperature).
ft.	foot; feet.	%	per cent.
ft. <sup>2</sup>	square foot.	λ	wave-length.
ft. <sup>3</sup>	cubic foot.	μ	micron.
ft.-lb.	foot-pound(s).	μμ	1 millionth micron = 0.1 Å.
gall.	gallon(s).	Ω	ohm.
gm.	gramme(s).	'	minute of the arc.
H.-F.	high-frequency.	"	second of the arc.
H-ion.	hydrogen ion.	<	A < B denotes that A is less than B.
H.P.	horse-power.	>	A > B denotes that A is greater than B.
H.P.-hr.	horse-power hour(s).	≠	negative of <; A ≠ B denotes that A is not less than B.
hr.	hour.	≡	combination of < and =; A ≡ B denotes that A is equal to or less than B.
hrs.	hours.	≡	is not equal to.
in.	inch; inches.	≡	identically equal to.
in. <sup>2</sup>	square inch.	≈	approximately (or essentially) equal to.
in. <sup>3</sup>	cubic inch.		
in.-lb.	inch-pound(s).		
I.S.W.G.	Imperial standard wire-gauge.		
K.	absolute temperature (scale).		
K.C.U.	kilogramme-degree-centigrade heat unit (= 3.97 B.th.u.).		
kg.	kilogramme(s).		
kg.m.	kilogramme-metre(s).		
km.	kilometre(s).		

# CONTENTS

I.	Properties of Metals, 1, 29, 69, 109, 141, 193, 237, 289, 337, 385, 439, 487, 629.	
II.	Properties of Alloys, 3, 36, 73, 113, 146, 198, 246, 295, 346, 389, 450, 503, 648.	
III.	Structure (Metallography ; Macrography ; Crystal Structure), 7, 39, 75, 116, 153, 202, 250, 303, 357, 396, 457, 525, 662.	
IV.	Corrosion, 8, 42, 78, 120, 155, 203, 256, 307, 361, 397, 459, 533, 667.	
V.	Protection (other than Electrodeposition), 10, 43, 80, 122, 159, 206, 259, 310, 363, 402, 460, 545, 680.	
VI.	Electrodeposition, 12, 43, 81, 123, 161, 208, 261, 311, 366, 404, 462, 550, 684.	
VII.	Electrometallurgy and Electrochemistry (other than Electrodeposition), 13, 45, 84, 164, 210, 264, 311, 368, 407, 464, 556, 690.	
VIII.	Refining, 14, 165, 210, 265, 408, 557, 692.	
IX.	Analysis, 14, 45, 84, 125, 165, 211, 265, 312, 368, 408, 465, 558, 692.	
X.	Laboratory Apparatus, Instruments, &c., 16, 49, 85, 126, 167, 213, 266, 314, 370, 409, 468, 565, 697.	
XI.	Physical and Mechanical Testing, Inspection and Radiology, 17, 49, 86, 127, 167, 213, 267, 315, 370, 411, 469, 567, 697.	
XII.	Temperature Measurement and Control, 51, 87, 128, 170, 269, 316, 373, 413, 471, 570, 705.	
XIII.	Foundry Practice and Appliances, 18, 52, 88, 128, 170, 214, 270, 317, 374, 413, 471, 572, 706.	
XIV.	Secondary Metals : Scrap, Residues, &c., 53, 90, 128, 273, 375, 415, 473, 580, 712.	
XV.	Furnaces and Fuels, 19, 54, 91, 129, 172, 216, 273, 320, 375, 415, 473, 580, 712.	
XVI.	Refractories and Furnace Materials, 19, 55, 92, 129, 172, 273, 321, 376, 416, 474, 582, 716.	
XVII.	Heat-Treatment, 20, 55, 130, 174, 274, 321, 583, 718.	
XVIII.	Working, 20, 56, 92, 130, 174, 217, 275, 322, 377, 417, 475, 585, 719.	
XIX.	Cleaning and Finishing, 21, 93, 130, 176, 219, 276, 323, 377, 418, 477, 592, 721.	
XX.	Joining, 21, 56, 94, 131, 177, 219, 277, 325, 378, 419, 478, 594, 723.	
XXI.	Industrial Uses and Applications, 21, 58, 95, 132, 178, 222, 279, 327, 378, 422, 480, 598, 731.	
XXII.	Miscellaneous, 23, 63, 98, 135, 182, 227, 283, 331, 380, 425, 483, 607, 747.	
XXIII.	Bibliography, 24, 63, 99, 135, 183, 227, 284, 382, 426, 483, 610.	
XXIV.	Book Reviews, 67, 105, 139, 187, 234, 286, 333, 434, 485, 618, 749.	

	PAGE
Name Index . . . . .	751
Subject Index . . . . .	824

## CORRIGENDA

Page	14, line	14.*	For "Laboratories" read "Industries."
"	26, "	4.	For "Hedges, Ernest H.," read "Hedges, Ernest S."
"	41, "	4.*	For "John J. Norton," read "John T. Norton."
"	53, "	6.	For "Present" read "Pressure."
"	57, "	9.	For "R. Sallèles," read "R. Salclles."
"	96, "	11.	For "C. F. Geiger" read "G. F. Geiger."
"	123, "	23.	For "Metallizer, 1936, 4, (6)," read "Metallizer, 1936, 4, (1)."
"	128, lines	6*, 17*	} For "Found. Trade J., 1936, 54, (2)," read "Found. Trade J., 1936, 54, (1012)."
"	129, line	10*	
"	146, "	16.	Delete "(16), 491-494."
"	149, "	13.*	For "G. Nehlet" read "G. Nehlep."
"	166, "	26.*	Before "Thomas E. Hillis" add "William R. Crowell."
"	196, "	20.*	For "Yoshio Fujii," read "Yoshiro Fujii."
"	203, "	24.*	For "206-213" read "213-218."
"	211, "	4.	For "so opposed" read "as opposed."
"	215, "	25.*	For "Rails" read "Rolls."
"	230, "	12.*	For "Haringhausen" read "Haringhuizen."
"	241, "	27.	For "Bernardiner," read "Bernadiner."
"	264, "	18.*	For "325-327" read "319-330."
"	277, "	17.*	Before "(8), 391-396" add "(6), 270-271."
"	310, "	28.*	For "N. Nakata" read "H. Nakata."
"	349, "	27.*	For "Souder," read "Souden."
"	351, "	9.	For "Rudolph Krulla" read "Rudolf Krulla."
"	368, "	5.	For "Serris" read "Servis."
"	369, lines	19, 20.	For "Alizarin. S.A.P. Mussakin" read "Alizarin-S. A. P. Mussakin."
"	373, line	8.	For "Hubert Plant," read "C. Hubert Plant."
"	375, "	11.	For "Earl" read "Carl."
"	402, "	13.	For "130-131" read "129-130."
"	466, "	13.	For "Arsenic" read "Aluminium."
"	466, "	22.*	For "544-566" read "544-546."
"	491, "	8.*	For "G. Zopf" read "G. Zapf."
"	508, "	25.	For "572-574" read "512-514."
"	514, "	9.*	For "Mg <sub>2</sub> Cd" read "Mg <sub>3</sub> Cd."
"	524, "	3.	For "is subjected" read "is not subjected."
"	534, "	10.	For "S. M. Gelman" read "S. P. Gelman."
"	538, "	27.	For "Shaibman" read "Shraibman."
"	541, "	23.	After "U.R.S.S." add "Série chim."
"	541, "	6.*	For "O. I. Vehr" read "O. I. Vher."
"	546, "	17.	For "R. Gire" read "G. Gire."
"	567, "	3.*	For "A 23-25" read "A 15-22."
"	596, "	4.*	For "Fr. Egglesmann" read "Fr. Eggelsmann."

\* From bottom of page.

Corrigendum to *Metallurgical Abstracts*, 1935, volume 2.

Page 336, line 28. For "Indian Acad. Sci., 1934, 1" read "Indian Acad. Sci., 1934, [A], 1."