

Mines Branch Information Circular IC 155

BIBLIOGRAPHY OF HIGH-TEMPERATURE  
CONDENSED STATES RESEARCH PUBLISHED IN  
CANADA, OCTOBER-DECEMBER, 1963

by

Norman F.H. Bright\*

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SYNOPSIS

This report contains bibliographic information concerning research work on high-temperature condensed states published in Canadian journals during the period October to December, 1963. A short list of compilations of data published in the United States on the high-temperature properties of materials is included. A list of laboratories and research workers in the United Kingdom, active in high-temperature condensed states research, is also included.

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Direction des mines

Circulaire d'information IC 155

BIBLIOGRAPHIE DES RECHERCHES EFFECTUÉES  
DANS LE DOMAINE DES ÉTATS CONDENSÉS AUX  
TEMPÉRATURES ÉLEVÉES, AU CANADA,  
D'OCTOBRE À DÉCEMBRE 1963

par

Norman F.H. Bright\*

RÉSUMÉ

Le présent rapport contient des renseignements bibliographiques sur les recherches effectuées sur les états condensés aux températures élevées, publiées dans les revues scientifiques canadiennes au cours de la période d'octobre à décembre 1963. Une brève énumération des données publiées aux États-Unis sur les propriétés des matériaux à haute température, figure dans le dit rapport. On y trouve également une liste des laboratoires et chercheurs qui travaillent au Royaume-Uni à des recherches dans les états condensés à haute température.

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\*Chef, Section de la chimie physique, Division des sciences minérales, Direction des mines, ministère des Mines et des Relevés techniques, Ottawa, Canada.

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## INTRODUCTION

This report is a further contribution to the series of bibliographic bulletins of information on high-temperature condensed states research that have been published as Mines Branch Information Circulars since March, 1960, on behalf of the Sub-commission on Condensed States of the Commission on High Temperatures and Refractories of the International Union of Pure and Applied Chemistry. The present document covers work published in Canadian scientific and technical journals during the period October to December, 1963, inclusive.

Included in this report is a short list of reference works published by various agencies in the United States that contain compilations of data referring to the high-temperature physical and chemical properties of materials. It was agreed at the London meeting of the above Commission in July, 1963, that this information would be made available to the recipients of the periodic bibliographic bulletins. The information has been supplied by Dr. J. J. Diamond of the National Bureau of Standards, Washington, D.C.

Also included in this report is a list of laboratories in the United Kingdom active in research on condensed phases at high temperature. The list includes the names of the workers involved and their special fields of interest, and was compiled and supplied to the writer by Dr. K. G. McWhirter of Morganite Research and Development, Ltd., Battersea Works, Battersea Church Road, London, S.W. 11, England. It is a revision and

expansion of the list published in Mines Branch Information Circular IC 136, issued in May, 1962, and has been revised up to January 1, 1964.

Any further information concerning these bibliographies can be obtained from the writer of this report at the following address:

Dr. Norman F.H. Bright,  
Mineral Sciences Division,  
Mines Branch,  
Department of Mines and Technical Surveys,  
555 Booth Street,  
Ottawa 4, Ontario, Canada.

Anyone not now receiving these reports who wishes to do so, and anyone who no longer finds them of interest is requested to advise the writer accordingly so that appropriate changes may be made in the mailing list.

The writer would very much appreciate being advised of any work published in Canadian journals and lying within the scope of this bibliography, that has escaped his notice, in order that such work may be mentioned in a subsequent issue of these Information Circulars.

The attention of recipients of this report is drawn to the fact that, on September 2-4, 1964, a Symposium on High-Temperature Inorganic Chemistry will be held as an activity of the Inorganic Chemistry Division of the Chemical Institute of Canada. The Symposium is being held at Carleton University, Ottawa, with the writer of this report acting as Programme Chairman. The following invited speakers have agreed to address the Symposium:

Professor Leo Brewer, University of California.

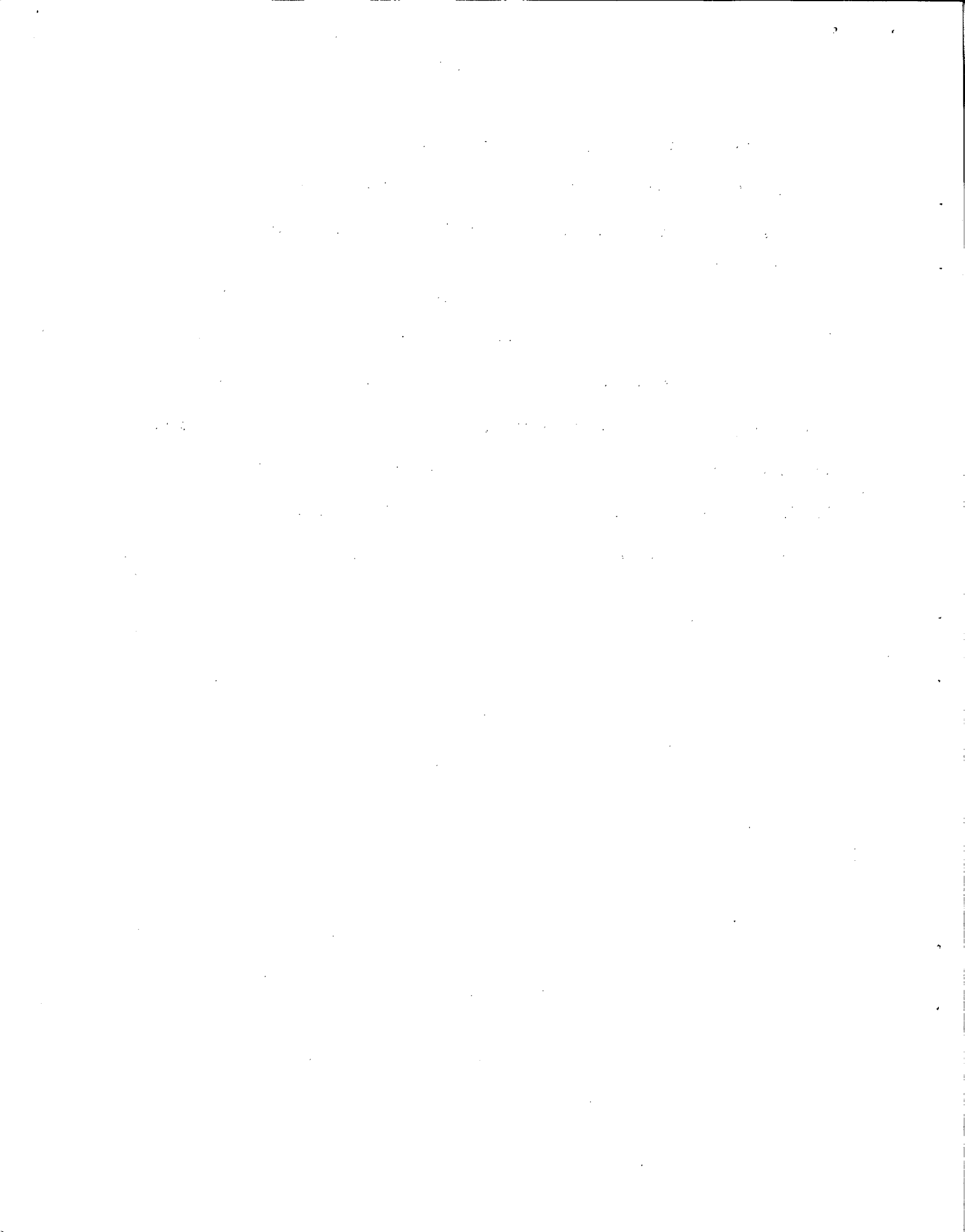
Professor John L. Margrave, Rice University, Houston, Texas.

Professor Rustum Roy, Pennsylvania State University.

Professor Lloyd M. Pidgeon, University of Toronto.

Dr. Charles R. Masson, N.R.C. Atlantic Regional Laboratory,  
Halifax, N.S.

Contributed papers are invited; abstracts and titles should be sent to the writer as soon as possible, and definitely before the end of April, 1964. For the purposes of this Symposium, any reaction occurring above 1000°C is considered as being "high-temperature"; no restriction is being made as to the physical state of the reactants, whether solid, liquid, gaseous or plasma. Further information regarding this Symposium can be obtained from the writer of this report at the address already quoted.



BIBLIOGRAPHY OF WORK ON HIGH-TEMPERATURE  
CONDENSED STATES PUBLISHED IN CANADA,  
OCTOBER-DECEMBER, 1963



International Union of Pure and Applied Chemistry  
Commission on High Temperatures and Refractories  
Sub-commission on Condensed States

Bibliography (October to December, 1963)

for Canada

collected by Dr. Norman F.H. Bright, Mines Branch, Ottawa.

A. Devices for achieving temperatures above 1500°C

Nil

B. Devices for measuring and controlling temperatures above 1500°C

Nil

C. Devices for physical measurements at temperatures above 1000°C

1. The unmatched guard method of measuring thermal conductivity at high temperatures.

M.J. Laubitz (Division of Applied Physics, National Research Council, Ottawa, Ontario).

Canad. Journ. Phys., 41 [10], 1663-1678 (1963).

D. Properties, at temperatures below 1000°C, of materials that melt above 1500°C

a. Metallic materials

1. Infra-red absorption lines in boron-doped silicon.

K. Colbow (University of British Columbia, Vancouver, B.C.)

Canad. Journ. Phys., 41 [11], 1801-1822 (1963).

2. Molybdenum.

V.B. Schneider (Mineral Resources Division, Department of Mines and Technical Surveys, Ottawa, Ontario).

Mineral Report #6, Department of Mines and Technical Surveys, Ottawa, Ontario (1963).

b. Non-metallic materials

1. Evaluation of ceramic tooling.

H.D. Moore and D.R. Kibbey (Ohio State University,  
Columbus, Ohio, U.S.A.).

Canad. Metalworking, 26 [10], 36-38 (1963).

c. Mixed materials

1. The effects of carbides on the mechanical properties of tantalum.

H.R. Ogden, F.F. Schmidt and E.S. Bartlett (Battelle  
Memorial Institute, Columbus, Ohio, U.S.A.).

Canad. Met. Quart., 2 [4], 355-368 (1963).

E. Properties, at temperatures above 1000°C, of materials that melt above 1500°C

a. Metallic materials

1. On the anomalous self-diffusion in body-centred cubic zirconium.

G.V. Kidson (Atomic Energy of Canada Limited, Chalk  
River, Ontario).

Canad. Journ. Phys., 41 [10], 1563-1570 (1963).

2. Rhenium.

L. Sanderson.

Canad. Min. Journ., 84 [12], 54-55 (1963).

3. The spallation of iridium with protons of energies 9-87 Mev.

G.R. Grant and L. Yaffe (McGill University, Montreal, Quebec).

Canad. Journ. Chem., 41 [10], 2533-2543 (1963).

b. Non-metallic materials

Nil

c. Mixed materials

Nil

F. Properties, at temperatures above 1000°C, of materials that melt below 1500°C

a. Metallic materials

1. Silver in Canada.

J.W. Patterson (Mineral Resources Division, Department of Mines and Technical Surveys, Ottawa, Ontario).  
Mineral Surveys #3, Department of Mines and Technical Surveys, Ottawa, Ontario (1963).

2. Some physical and chemical properties of sprayed silver alloy catalysts.

G.L. Osberg, A. Tweddle and W.C. Brennan (Division of Applied Chemistry, National Research Council, Ottawa, Ontario).  
Canad. Journ. Chem. Engg., 41 [6], 260-264 (1963).

b. Non-metallic materials

1. Jet piercing with compressed air.

Anon.  
Canad. Mining Journ., 84 [12], 35 (1963).

c. Mixed materials

Nil

G. Phase equilibria

1. Diffusion in multicomponent metallic systems: VI.

Some thermodynamic properties of the D matrix and the corresponding solution of the diffusion equations.

J.S. Kirkcaldy, D. Weichert and Zia-Ul-Haq (McMaster University, Hamilton, Ontario).  
Canad. Journ. Phys., 41 [12], 2166-2173 (1963).

2. Diffusion in multicomponent metallic systems: VII.

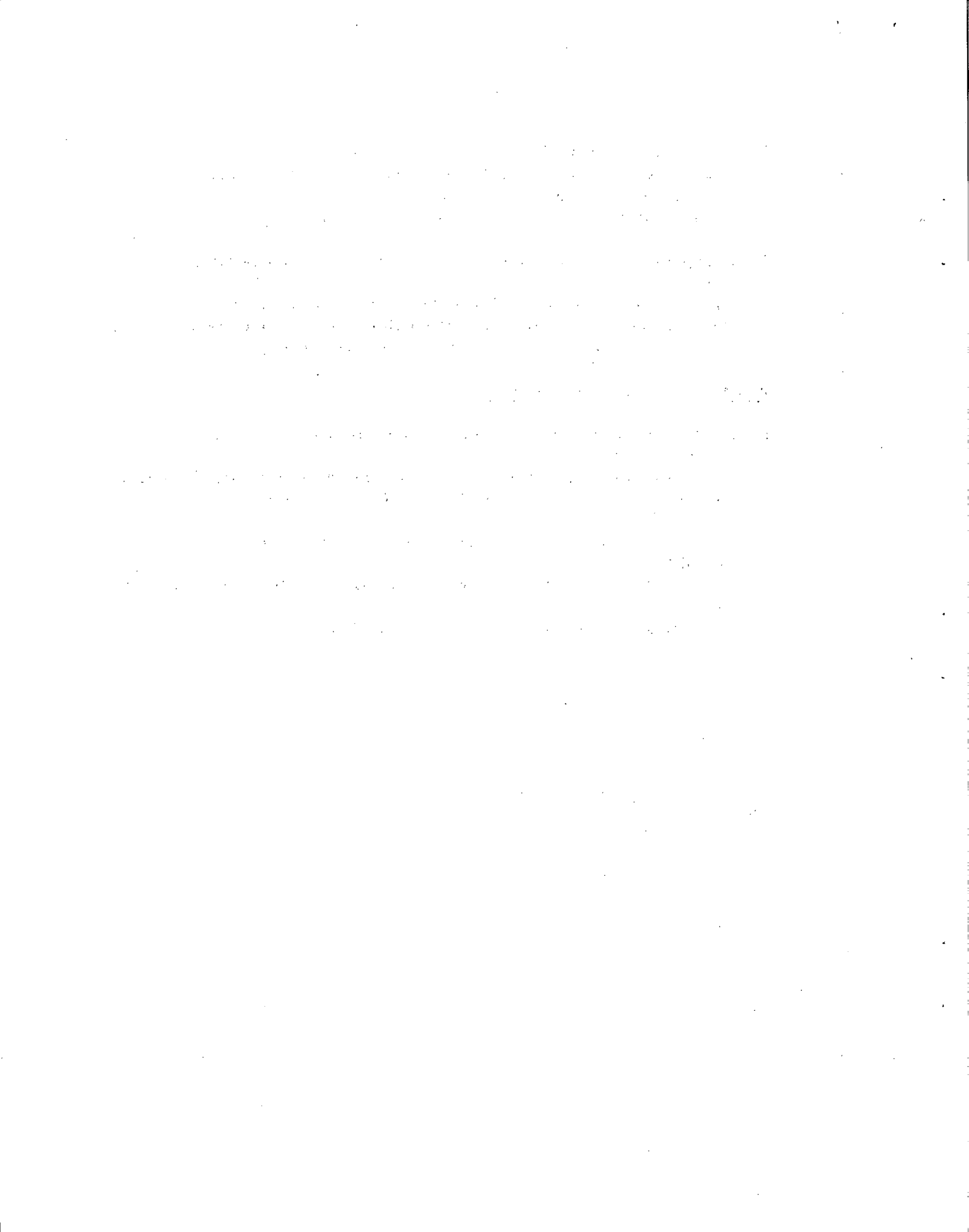
Solutions of the multicomponent diffusion equations with variable coefficients.

J.S. Kirkcaldy, J.E. Lane and G.R. Mason (McMaster University, Hamilton, Ontario).  
Canad. Journ. Phys., 41 [12], 2174-2186 (1963).

3. The InTe-Sb phase diagram.  
R.L. Stegman and E.A. Peretti (U.S. Naval Research Laboratory, Washington, D.C., U.S.A.).  
Canad. Met. Quart., 2 [4], 369-372 (1963).
4. A vapour-pressure study of the alloys of manganese with copper.  
B.F. Peters and D.R. Wiles (Department of Mining and Metallurgy, University of British Columbia, Vancouver, B.C.).  
Canad. Journ. Chem., 41 [10], 2591-2599 (1963).

H. Reactions at temperatures above 1000°C

1. Nuclear reactions induced in tantalum by protons of energy up to 84 Mev.  
C.L. Rao and L. Yaffe (McGill University, Montreal, Quebec).  
Canad. Journ. Chem., 41 [10], 2516-2532 (1963).
2. Reactions produced in erbium by protons of energies between 6 and 87 Mev.  
G.V.S. Rayadu and L. Yaffe (McGill University, Montreal, Quebec).  
Canad. Journ. Chem., 41 [10], 2544-2556 (1963).



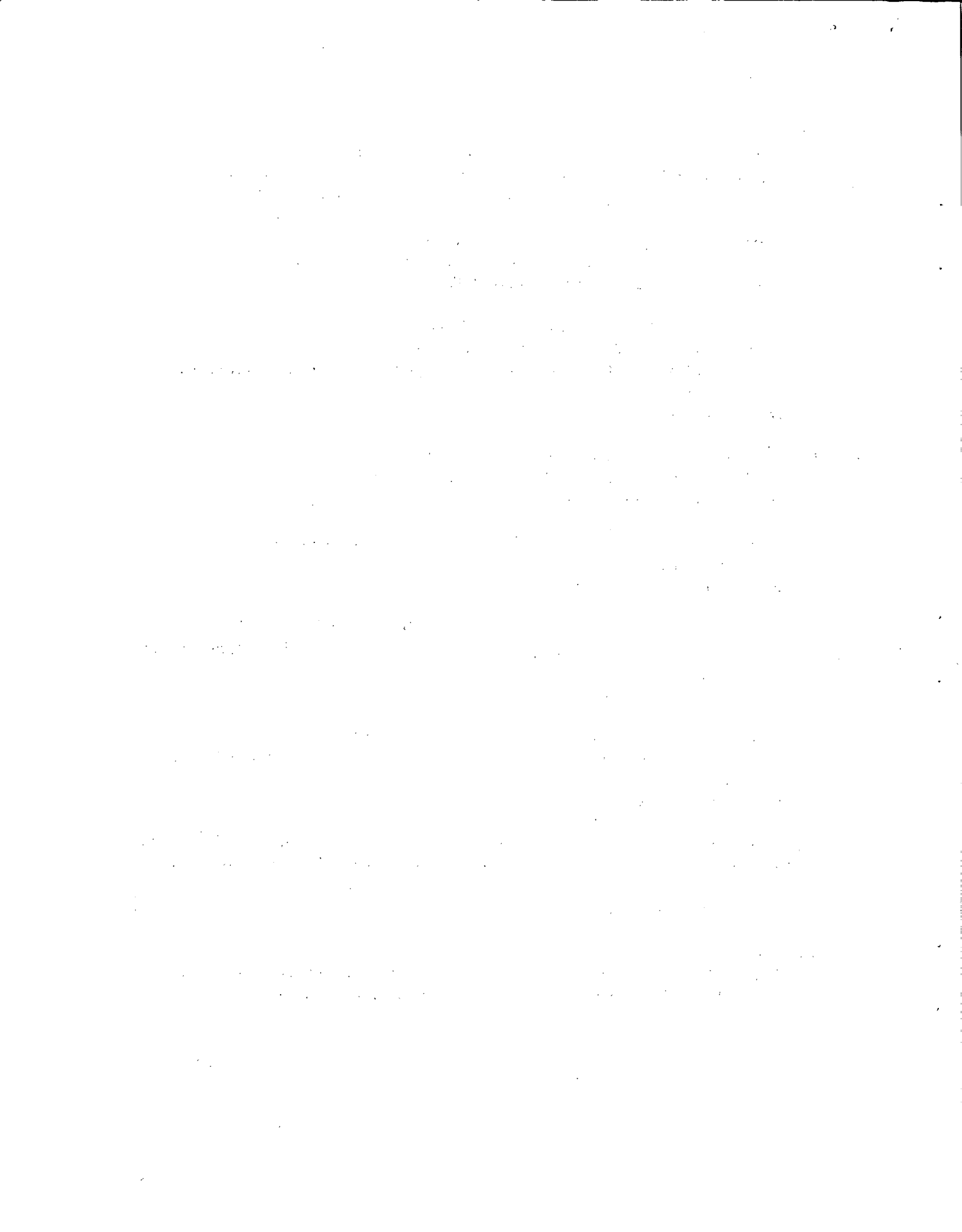
PRELIMINARY LIST OF U.S. COMPILATIONS OF DATA  
THAT INCLUDE INFORMATION ON THE HIGH-TEMPERATURE  
PROPERTIES OF MATERIALS

PRELIMINARY LIST OF U.S. COMPILATIONS OF DATA  
THAT INCLUDE INFORMATION ON THE HIGH-TEMPERATURE  
PROPERTIES OF MATERIALS

1. Handbook of Thermophysical Properties of Solid Materials.  
A. Goldsmith, T.E. Waterman and H.J. Hirschhorn (Armour Research  
Foundation, Chicago, Illinois).  
Macmillan, 5 vol., 4300 pp.
2. JANAF Thermochemical Tables.  
D.R. Stull et al. (Thermal Research Lab., Dow Chemical Co.,  
Midland, Mich.).  
A.R.P.A., Joint Army-Navy-Air Force Thermochemical Panel, Loose-  
leaf (Quarterly supplements).
3. Contributions to the Data on Theoretical Metallurgy:  
XII - Heats and Free Energies of Formation of Inorganic Oxides  
(U.S. Bur. Mines Bull., 542, 1954).  
XIII - High Temperature Heat Content, Heat Capacity, and Entropy  
Data for the Elements and Inorganic Compounds (U.S. Bur. Mines  
Bull., 584, 1960).  
XIV - Entropies of the Elements and Inorganic Compounds (U.S. Bur.  
Mines Bull., 592, 1961).  
K.K. Kelley et al.
4. Selected Values of Thermodynamic Properties of Metals and Alloys.  
R. Hultgren, R.L. Orr, P.D. Anderson and K.K. Kelley (University  
of California, Berkeley).  
John Wiley, Inc., 1963, 963 pp.
5. Thermodynamic Properties of the Elements.  
D.R. Stull and G.C. Sinke (Dow Chemical Co., Midland, Mich.).  
Amer. Chem. Soc., Advances in Chem. Series No. 18, 1956.
6. Mechanical Property Survey of Refractory Nonmetallic Crystalline  
Materials and Intermetallic Compounds.  
W.D. Smiley et al. (Stanford Research Institute).  
Wright Air Development Centre, Technical Report 59-448 (1960).

7. Thermal Properties of Certain Metals, Pt. I and II.  
T.C. Goodwin, Jr. and M.W. Ayton (Library of Congress).  
Wright Air Development Centre, Technical Report 56-423.
8. Emissivity: An Annotated Bibliography.  
A.A. Beltran (Lockheed M S D, Sunnyvale, Calif.).  
Special Bibliography SB-61-38 (1961).
9. Emittance of Cr, Nb, Mo, Ta and W.  
W.D. Wood, H.W. Deem and C.F. Lucks.  
Defense Metals Information Centre, Battelle Memorial Institute,  
Columbus, Ohio.  
DM IC Memo 141 (1961).
10. Thermal Radiation Properties Survey.  
G.G. Gubareff, J.E. Janssen and R.H. Torborg.  
Honeywell Research Centre, Minneapolis, Minn., 1960, 293 pp.
11. Selected Values of Chemical Thermodynamic Properties.  
F.D. Rossini et al.  
National Bureau of Standards Circular 500 (1952).
12. Selected Values of Properties of Chemical Compounds.  
B.J. Zwolenski et al. (Agricultural and Mechanical College of Texas,  
College Station, Texas).  
Manufacturing Chemists Association (Loose-leaf).
13. Consolidated Index of Selected Property Values.  
Office of Critical Tables, National Academy of Sciences - National  
Research Council.  
NAS-NRC Publication 976 (1962).
14. Retrieval Guide to Thermophysical Properties Research Literature.  
Edited by Y.S. Touloukian (Purdue University, Thermophysical  
Properties Research Centre, Lafayette, Indiana).  
McGraw-Hill, 1960.
15. Data Book.  
Edited by Y.S. Touloukian (Thermophysical Properties Research  
Centre, Purdue University, Lafayette, Indiana).





LIST OF LABORATORIES AND RESEARCH WORKERS  
ACTIVE IN RESEARCH ON CONDENSED PHASES  
AT HIGH TEMPERATURES IN THE UNITED KINGDOM

Laboratory

Aberdeen University,  
Department of Chemistry,  
Old Aberdeen, Scotland.

Aberdeen University,  
Department of Natural  
Philosophy,  
Old Aberdeen, Scotland.

Admiralty Materials  
Laboratory,  
Holton Heath, Poole,  
Dorset, England.

Associated Electrical  
Industries, Ltd.  
Research Department,  
Trafford Park,  
Manchester 17, England.

Associated Electrical  
Industries, Ltd.  
Research Department,  
Rugby, Warwickshire,  
England.

Personnel

F.P. Glasser  
L.D. Glasser  
H.F.W. Taylor

R.V. Jones  
D.A. Jones  
R.W.H. Stevenson

T.C.J. Ovenston

L.D. Brownlee  
M.B. Coyle  
G.A. Geach  
A.G. Knapton  
T. Raine

M.A. Cayless  
M.G. Clarke  
J.S. Jackson  
J.J. Matthews  
G.C.E. Olds  
H. Ramsdon  
F.W.G. Rose  
I. Williams

Interests

Phase equilibria and transformations at high temperature. Crystal structures.

Growth of large single crystals of alkali halides, alkali earth fluorides, transition element fluorides and some rare earth fluorides. X-ray scattering and magnetic resonance studies of these crystals. Electronic energy levels of added impurities by absorption and emission spectra.

Development and assessment of new metals and alloys for use under extreme conditions; engineering materials for use at very high temperatures.

Fabrication and applications; alloy constitution diagrams; deformation, defects and impurities; oxidation and corrosion.

Properties and uses of refractory metals and ceramics at high temperatures. Arc and electron beam melting. Thermoelectric materials. Transparent refractories and electron emitters; plasma jets.

Laboratory

The B.S.A. Group Research  
Centre,  
Mackadown Lane,  
Birmingham 33, England.

Battersea College of  
Technology,  
Department of Metallurgy,  
High Temperature  
Materials Section,  
St. John's School, Usk  
Road, London, S.W.11,  
England.

Personnel

A.E. Catherall  
H.J. Goldschmidt  
W.M. Ham  
D.A. Oliver  
R.L. Sands

T.G.J. Glinn  
D.H. Houseman  
N.A. Lockington  
J.C. Measor  
R.L. Samuel  
H.E.N. Stone

Interests

Refractory alloys for  
high-temperature  
applications (in  
particular, those based  
on niobium). Phase-  
equilibrium work (metals  
and compounds).  
Development of heat-  
resisting materials by  
powder metallurgy.  
Dispersion hardening.

Strain-aging and internal  
friction in niobium,  
tantalum and vanadium.  
Kinetics of oxidation of  
iron and nickel alloys.  
Effects of ultrasonics on  
substitutional diffusion  
(to improve diffusion  
coatings, esp. for niobium,  
tantalum, etc.). Sintering  
of tungsten. Effects of  
surface composition and  
atmosphere on creep of  
molybdenum. Thermal  
stability of oxide coatings  
on nickel-base alloys.  
Self-healing of silicide  
coatings on tungsten.  
Reaction between silicon  
carbide and liquid slag.  
Dispersion hardening of  
nickel and nickel alloys.  
Development of refractory  
oxides or cermet coatings  
on niobium. Production  
of metal/oxide composites  
by thermal reduction in  
vacuo.

Laboratory

Personnel

Interests

Birmingham University,  
Department of Industrial  
Metallurgy,  
Birmingham 15, England.

G.W. Rowe  
A.G. Wetton

Friction and wear  
properties of materials.

Birmingham University,  
Department of Physical  
Metallurgy,  
Birmingham 15, England.

A.D. McQuillan  
G.V. Raynor  
R.E. Smallman  
N.B.W. Thompson

Non-stoichiometry and  
nature of defects of  
titanium dioxide.  
Mechanical properties of  
metallic oxides, carbides  
and nitrides to 1300°C.  
Electron-beam zone  
refining of refractory  
metals. Growth of single  
crystals in controlled  
orientations. Focussed-  
arc methods for growing  
single crystals such as  
rutile.

Bristol Aerojet Ltd.,  
Barnwell, Weston-super-  
Mare, Somerset, England.

A. Slingsby

Thermal shock resistance  
and mechanical and/or  
chemical erosion of  
refractory metals,  
graphites and carbides,  
etc., when subjected to  
temperatures of the order  
of 3000°C in hot gases with  
high velocity, seeded with  
various constituents.

The British Aluminium Co.  
Ltd.,  
Chalfont Park, Gerrard's  
Cross, Bucks., England.

D. Ball  
V.J. Hill  
W.T. Hughes  
G.L. Kington

Technology of the carbides  
and borides of the transition  
elements. Alumina and  
materials containing alumina.

British Ceramic Research  
Association,  
Penkhull, Stoke-on-Trent,  
Staffs., England.

N.F. Astbury  
P. Popper  
H.M. Richardson

Special ceramics - electrical,  
aeronautical and nuclear.  
Industrial refractories.

Laboratory

Personnel

Interests

British Coal Utilisation  
Research Association,  
Randalls Road, Leather-  
head, Surrey, England.

R.L. Bond  
P.G.W. Hawksley  
J.D. Watt

High temperature chemistry  
of minerals associated with  
coal, and reactions and  
properties of carbonaceous  
solids at high temperatures.  
Methods of obtaining high  
temperatures and measuring  
them.

British Iron and Steel  
Research Association,  
140, Battersea Park Road,  
London, S.W.11, England.

W.A. Archibald  
S. Klemantaski  
R. Littlewood

Refractories and slags;  
reactions between gases,  
metals and slags; high  
temperature electro-  
chemistry; thermodynamic  
properties.

British Non-Ferrous Metals  
Research Association,  
Euston Street, London,  
N.W.1, England.

R. Eborall  
S. Harper

Structure and properties  
of materials melting at  
more than 1500°C.

The British Oxygen Co.  
Ltd.,  
Deer Park Road,  
London, S.W.19, England.

R.E. Jahn

Measurements of  
temperature distribution  
in arcs and plasma jets.

Building Research Station,  
Garston, Watford,  
Hertfordshire, England.

W.H. Gutt  
A.J. Majumdar

Oxide systems - phase  
equilibria (cements and  
slags). High temperature  
microscopy. High  
temperature X-ray analysis.

Cambridge University,  
Department of Metallurgy,  
Pembroke Street, Cambridge,  
England.

C. Baker  
L.M. Gillin  
A. Kelly  
K. Ogawa  
D.J. Rowcliffe

Plastic properties and  
radiation effects on high-  
temperature materials  
(graphite, magnesium  
oxide, boron nitride, and  
carbides of transition  
metals).

Laboratory

Personnel

Interests

Cambridge University,  
Laboratory for the Physics  
and Chemistry of Solids,  
Free School Lane,  
Cambridge, England.

A.G. Atkins  
F.P. Bowden  
C.A. Brookes  
J.H. Greenwood  
M.J. Murray  
D.I.R. Norris

Physical and mechanical  
properties of solids at  
high temperatures and at  
high pressures.

Cement and Concrete  
Association Research  
Laboratories,  
Materials Department,  
Wexham Springs, Slough,  
Bucks., England.

P.E. Halstead  
A.E. Moore

Multicomponent systems  
of the oxides CaO, SiO<sub>2</sub>,  
Al<sub>2</sub>O<sub>3</sub>, Fe<sub>2</sub>O<sub>3</sub>, SO<sub>3</sub> and  
MgO, and in particular  
the phases which occur in  
portland cement and  
related materials.

Central Electricity  
Research Laboratories,  
High Temperature  
Chemistry Section,  
Cleeve Road, Leatherhead,  
Surrey, England.

A.B. Hart  
E. Raask

Properties and reactions  
of coal-ash slag.  
Corrosion of metals by  
fused salts. Condensation  
of potassium sulphate from  
hot gases from a m.h.d.  
duct, and its thermodynamic  
properties. Molten salt  
electrolytes: gas electrodes,  
and electrochemical  
corrosion of metals.

The College of Aeronautics,  
Department of Materials,  
Cranfield, Bletchley,  
Bucks., England.

A.J. Kennedy  
A. Younger

Physical and mechanical  
properties of graphitic  
material at temperatures  
above 2000°C.

Edinburgh University,  
Department of Chemical  
Engineering,  
Chambers Street,  
Edinburgh 1, Scotland.

G.S.G. Beveridge

Gas-solid reactions at  
high temperatures.  
Oxidation kinetics of zinc  
sulphide, decomposition  
rates of limestone, move-  
ment of reaction zones in  
beds of solids, heat  
transfer at high temperature  
in beds of solids (radiation,  
conduction).

Laboratory

Edinburgh University,  
Department of Natural  
Philosophy,  
Drummond Street,  
Edinburgh 8, Scotland.

The English Electric  
Co. Ltd.,  
Nelson Research Labora-  
tories,  
Stafford, England.

Exeter University,  
Department of Physics,  
The Washington Singer  
Laboratories, Prince of  
Wales Road, Exeter,  
Devon, England.

Fulmer Research Institute  
Ltd.,  
Stoke Poges, Bucks.,  
England.

Personnel

A.F. Brown  
D.I. Kennedy  
H.E. Woodman

G.J.P. Buchi  
W.E.C. Creyke  
H.R. Heap  
P.W. McMillan

J.R. Drabble

E.A. Brandes  
G.B. Brook  
P. Gross  
B. Hatt  
C. Hayman  
G.I. Williams

Interests

Electrolysis in metals:  
ionic motion in the solid  
state at temperatures  
close to the melting point  
(work is mainly on noble  
metals).

High temperature  
properties of metals;  
electron microscopy of  
high-temperature  
materials. Bonding of  
metals to ceramics,  
graphite and other metals.  
Special ceramics, high  
alumina ceramics. Glass  
ceramic with controlled  
coefficient of expansion.

Mixed-valence semi-  
conductors: growth of  
single crystals of nickel  
oxide using arc-image  
furnace. Measurement  
of electrical conductivity  
and Seebeck coefficient  
to 1500°C.

Deposition of solids from  
the vapour phase. Chemical  
transport, purification and  
deposition of solids by inter-  
mediate subhalide vapour  
formation. Phase diagrams,  
transformation equilibria  
and kinetics at high  
temperatures. Oxidation  
of solids with formation of  
solid oxides. High  
temperature, high-vacuum  
X-ray diffraction. De-  
composition pressures of  
solids at high temperature.



<u>Laboratory</u>	<u>Personnel</u>	<u>Interests</u>
General Electric Co. Ltd., Hirst Research Centre, Wembley, Middlesex, England.	D.S. Evans M.F. Grimwade K. Jackson D.J. Jones R.C. McVickers A. Prince S.G. Rogers G.W. Warren	Metals and alloys of tungsten, molybdenum, tantalum, niobium. Sintered alloys of nickel and cobalt, etc. Dispersed-phase alloys.
Hull University, Department of Chemistry, Kingston-upon-Hull, Yorkshire, England.	J.J. Kipling P.V. Shooter	Factors influencing the graphitization of carbons. Properties of graphitic and non-graphitic carbons prepared at up to 3000°C, and of carbons prepared at up to 1000°C, by carbonization of polymers and of polycyclic materials.
Imperial Chemical Industries Ltd., General Chemicals Division, Research Department, Widnes Laboratory, Widnes, Lancashire, England.	A.J. Rudge	Various aspects of high- temperature research.
Imperial Metal Industries, (Kynoch) Ltd., P.O. Box 216, Kynoch Works, Birmingham 6, England.	N.P. Inglis M.K. McQuillan	High temperature alloys based on niobium, tantalum, molybdenum and tungsten.
International Research and Development Co. Ltd., Fossway, Newcastle upon Tyne 6, England.	G. Arthur D.J. Brown R.E.W. Casselton G.W. Michie	Physical properties of oxides at high temperatures. Growth of ceramic single crystals, refractory carbides and borides. Arc- melting and casting of uranium carbide and growth of uranium carbide single crystals by electron-beam heating. Refractory metals.

<u>Laboratory</u>	<u>Personnel</u>	<u>Interests</u>
Leeds University, Department of Inorganic and Structural Chemistry, Leeds 2, England.	R.S. Bradley P. Engel D.C. Munro	Phase studies involving azides and nitrides at high temperatures and pressures. Electrical studies associated with this work.
Leeds University, The Houldsworth School of Applied Science, Leeds 2, England.	T.G. Carruthers A.L. Roberts J.P. Roberts	Structure and properties of refractory oxides etc. up to 2000°C. Mechanism of catalysis by ceramic oxides. Strength and creep of ceramic engineering materials at high temperatures. Basic studies of cermets. High temperature semiconductors. Permeation of gases through oxides. Diffusion in oxides. Mechanical properties of oxides. Catalysis over oxides. Pressing of oxides, clays, etc. up to around 900°C.
Leeds University, The Houldsworth School of Applied Science, Department of Metallurgy, Leeds 2, England.	R.M. Douthwaite P.M. Kelly J. Nutting G. Pollard	Phase transformations in metals using thin foil transmission techniques. Deformation and precipi- tation produced by fatigue and creep at high temperatures in light alloys. Secondary emission electron microscopy up to 1300°C and 5000 X for study of allotropic changes.
Arthur D. Little Research Institute, Inveresk, Midlothian, Scotland.	A. Robertson A.J. Rostron	Kinetics of reaction bet- ween steam and metals up to 2000°C.

Laboratory

Liverpool University,  
Department of Inorganic,  
Physical and Industrial  
Chemistry,  
The Donnan Laboratories,  
Vine Street, Liverpool 7,  
England.

Liverpool University,  
Department of Metallurgy,  
Brownlow Hill, Liverpool 3,  
England.

London University,  
Birkbeck College,  
Department of Chemistry,  
Malet Street, London,  
W.C.1, England.

London University,  
Birkbeck College,  
Department of Physics,  
Malet Street, London,  
W.C.1, England.

Personnel

D. Nicholls

C. Bodsworth  
J. Burke  
G.T. Higgins  
W.S. Owen  
J. Stringer

R.A. Shaw

N.E. Cusack  
R. Ross

Interests

High-temperature  
chemistry of boron  
compounds, especially  
transition metal borides  
and boron suboxides.

Phases in iron alloys;  
iron-nitrogen alloys;  
thermodynamic activities  
of carbon and nitrogen in  
austenitic iron alloys;  
tempering in chromium  
steels;  $\beta$  -  $\alpha$  transformation  
in uranium-chromium  
alloys; transformation  
kinetics in zirconium-  
niobium alloys, oxidation  
of refractory metals.

Thermal condensations  
leading to inorganic  
polymers; thermogravi-  
metric analysis;  
differential thermal  
analysis; thermal stability  
of inorganic polymers;  
study of the interaction at  
elevated temperatures bet-  
ween oligomeric and  
polymeric materials and  
their containers.

Properties of liquid  
mercury at high  
temperatures and  
pressures.

Laboratory

Personnel

Interests

London University,  
Imperial College,  
Department of Chemical  
Engineering and Chemical  
Technology,  
Prince Consort Road,  
London, S.W.7, England.

L.R. Barrett  
K. Bett  
E. Buckle  
J. Rowlinson  
R.F. Strickland-  
Constable  
A.R. Ubbelohde  
K. Weale  
D. Young

Resistance and induction-  
heated furnaces. Physical  
and electrical properties  
of graphite, oxides and  
salts. Oxidation of  
graphites. High pressure  
techniques.

London University,  
Imperial College, Royal  
College of Science,  
Department of Chemistry,  
Imperial Institute Road,  
London, S.W.7, England.

R.M. Barrer  
A.J.E. Welch

Sintering and structure  
of oxide systems. Hydro-  
thermal syntheses.

London University,  
Imperial College, Royal  
School of Mines,  
Department of Metallurgy,  
Prince Consort Road,  
London, S.W.7, England.

C.B. Alcock  
E.H. Baker  
J.H.E. Jeffes  
F.D. Richardson  
P.S. Rogers  
B.C.H. Steele  
J.W. Tomlinson

Slag equilibria at 1000-  
2000°C. Molten salts.  
Reactions between gases  
and solid oxides, sulphides  
and sulphates. Structures  
and thermodynamics of  
molten metals, salts and  
slags, nitrides, oxides,  
silicates, phosphates, etc.  
Kinetics of transport  
processes in liquids,  
vaporisation processes in  
solid + gas reactions.  
Mass transfer in gas +  
liquid and liquid + liquid  
systems relevant to high  
temperatures. Studies  
of fused salts at high  
temperatures and high  
pressures.

London University,  
Queen Mary College,  
Department of Chemistry,  
Mile End Road,  
London, E.1, England.

J. Pritchard  
K.W. Sykes

Carbon-gas reactions.

Laboratory

London University,  
University College,  
Department of Chemical  
Crystallography,  
Gower Street, London,  
W.C.1, England.

Personnel

K. Lonsdale  
H.O.A. Meyer  
H.J. Milledge

Interests

Apparatus for X-ray measurements on single or powdered crystals at high temperatures (to 1000°C) and high pressures (to 30,000 atmospheres) simultaneously. Geochemical problems; origin of diamond and kimberlite minerals. Techniques for examining specimens obtained from HP/HT experiments. Possibility of applying neutron diffraction measurements to these problems.

Manchester University,  
Department of Metallurgy,  
Manchester 13, England.

S. Blairs  
R. Elliott  
G.M. Leak  
R.A.J. Shelton  
C.R. Tottle

Deposition of metals from the vapour phase, for purification or for coating. Thermodynamic studies of metal-halide vapour-phase reactions. Solidification of metals and alloys by study of the solid-liquid interface. Zone refining. Thermal properties of cermets. Effects of high temperature deformation on hardening mechanism. Bonding between metals and oxides. Diffusion at high temperatures.

Laboratory

Personnel

Interests

Manchester College of  
Science and Technology,  
Department of Chemistry,  
Manchester 1, England.

J. Hockey  
G.J. Kakabadse  
S. Lecchini  
R.F. Simmons  
H. Steiner

Heating of tungsten wires  
and tapes in vacuo to 2500°K  
and measurement of these  
temperatures. High-  
temperature reactions  
involving vanadium oxides  
and certain salts. Influence  
of halogen compounds on  
reaction responsible for  
flame propagation. Catalysis  
and chemisorption by the  
oxides of transition metals.  
Properties of silica and  
titania. Surface properties  
of silica-alumina catalysts.

Manchester College of  
Science and Technology,  
Department of Metallurgy,  
Manchester 1, England.

P.E. Evans

Metals and ceramics;  
electron microscopy of  
ceramic materials, metal  
oxides, nitrides and borides;  
grain growth in metals and  
ceramics; structure and prop-  
erties of surfaces; the  
image furnace; ceramic  
nuclear fuels.

Manganese Bronze Holdings  
Ltd.,  
2, London Wall Buildings,  
London. E.C.2, England.

I. Jenkins

Sintered metals. Fibre-  
reinforced plastics. High  
temperature equipment.

Ministry of Aviation,  
National Gas Turbine  
Establishment,  
Pyestock, Farnborough,  
Hampshire, England.

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Mechanical properties of  
materials at high tem-  
peratures, including effects  
of thermal stress.

Morganite Research and  
Development Ltd.,  
Battersea Church Road,  
London, S.W.11, England.

E.S. Bale  
M.J. Bucknell  
C.F. Cooper

See next page.

Laboratory

Personnel

Interests

Morganite Research and  
Development Ltd.,  
Northfields Laboratories,  
London, S.W.18, England.

D.J. Badami  
C.M. George  
E. Greenhalgh  
A.C. McLeod  
J.B. Nelson  
R. Thompson  
B. Wilmshurst

Preparation, reactivity,  
thermodynamic and physical  
properties, and structures  
of refractory materials.

Murex Limited,  
Rainham, Essex, England.

G.L. Miller

Production of tungsten,  
molybdenum, tantalum and  
niobium, from extraction  
to fabricated parts.

National Chemical  
Laboratory,  
Teddington, Middlesex,  
England.

D.A. Everest  
E.F.G. Herington  
G.P. Jones  
R.P. Miller  
K.C. Mills  
E. Napier  
R.A. Wells  
D. Whyman

Fusion and high-temperature  
processes for treating  
refractory minerals.  
Nucleation and growth of  
stable and metastable phases  
from fused (vitreous)  
silicates. High-temperature  
free-energy measurements  
(vapour pressure; solid-state  
electrochemical cells);  
specific heats at high tempera-  
tures.

National Engineering  
Laboratory,  
High Temperature Materials  
Division,  
East Kilbride, Glasgow,  
Scotland.

D. Murray  
C.E. Phillips  
A.I. Smith

Research on mechanical  
properties of engineering  
materials at high tempera-  
tures. Development of  
equipment and techniques for  
mechanical testing of  
materials at high tempera-  
ture.

National Physical  
Laboratory,  
Basic Physics Division,  
Teddington, Middlesex,  
England.

R.W. Powell

Thermal and electrical con-  
ductivities of materials.

<u>Laboratory</u>	<u>Personnel</u>	<u>Interests</u>
National Physical Laboratory, Metallurgy Division, Teddington, Middlesex, England.	W.A. Dench P.L. Harrison B.E. Hopkins O. Kubaschewski	High-temperature calori- metry and equilibria. High temperature oxidation of metals. Strength and oxidation resistance of alloys.
National Physical Laboratory, Standards Division, Teddington, Middlesex, England.	C.R. Barber T.J. Quinn	Visual and photoelectric pyrometry.
Newcastle-upon-Tyne University, Department of Chemical Engineering, Newcastle-upon-Tyne 1, England.	I. Fells J.H. Harker	Combustion and flame systems, including heat transfer, carbon formation, nucleation growth, etc.
Newcastle-upon-Tyne University, Department of Metallurgy, Newcastle-upon-Tyne 1, England.	J. Congleton J.D. Gilchrist D. Hardie D. Maxwell R.N. Parkins N.J. Petch R.F. Tylecote A.E. Wraith	Dislocation theory of the yield and fracture of poly- crystalline metals and ceramics. Stress corrosion.
Northampton College of Advanced Technology, Department of Applied Chemistry, St. John Street, London E.C.1. England.	F.B. Elliott R. Fisher A.M.W. Orr	Physical properties of the interstitial alloys of tantalum to 1200°C. Diffusion between niobium and other refractory metals. Thermo- etching of platinum.
Oxford University, Inorganic Chemistry Laboratory, South Parks Road, Oxford England.	J.S. Anderson P.G. Dickens B.E.F. Fender	Thermodynamics and theory of defect solids. Sintering of doped oxides. High temperature solid state e.m.f. measurements.



<u>Laboratory</u>	<u>Personnel</u>	<u>Interests</u>
Oxford University, Department of Metallurgy, Parks Road, Oxford, England.	W. Hume- Rothery J.W. Martin	Equilibrium diagrams of high-melting-point metallic systems. Crystal structure and mechanical properties at high temperatures.
Oxford University, Department of Physics, Clarendon Laboratory, Parks Road, Oxford, England.	G. Garton B. Wanklyn	Growth of synthetic garnet single crystals and other oxide materials by fluxed- melt method to 1500°C. Growth of crystals by Bridgman-Stockbarger method to 1500°C. Crystal growth at high temperatures (to 3000°C).
The Plessey Co. (U.K.), Ltd., Caswell, Towcester, Northants., England.	D.S. Campbell F.C. Cowlard G.G. Deeley W.A. Elms J.M. Herbert J.B. Huffadine J.C. Lewis G.T.J. Mayo N.C. Moore G. Ord W. Rimmer A.W. Simpson A.G. Thomas A.C. Whitehead	Properties of dense silicon nitride, titanates, ferrites. Preparation and properties of high-purity alumina, magnesium fluoride, magnesia, molybdenum disilicide, niobium alloys. Vapour deposition processes; flame-spray processes; metal-ceramic seals. Preparation and properties of vitreous carbon. Cermets.
Royal Armament Research and Development Establishment, Fort Halstead, Sevenoaks, Kent, England.	-	Arc and electron-beam melting; processing and properties of refractory metals (e.g. molybdenum and tungsten).
Royal College of Advanced Technology, Department of Chemistry and Applied Chemistry, Salford 5, Lancashire, England.	D. Dollimore D.L. Griffiths G.R. Heal K.H. Tonge	Carbonization of selected polymers. Graphitization studies.

<u>Laboratory</u>	<u>Personnel</u>	<u>Interests</u>
Royal College of Science and Technology, Department of Metallurgy, Glasgow, C.1, Scotland.	H.B. Bell J. Taylor	Activities of components in liquid slags and alloys, particularly those of importance in iron-making and steelmaking.
Services Electronics Research Laboratory, Baldock, Hertfordshire, England.	S.J. Bass F.E. Birbeck A. Calverley P. Gurnell W.R. Harding K. Marshall	Semiconductors. Zone refining. High purity refractories. Refractory materials for use in valves.
Sheffield University, Department of Chemistry, Sheffield 10, England.	A.J. Smith	Crystal structures and crystal chemistry of a number of phases, prepared at high temperatures, particularly of mixed metal oxides.
Sheffield University, Department of Fuel Technology and Chemical Engineering, St. George's Square, Sheffield 1, England.	V. Croft I.A. McGrath M.W. Thring J.C. Titus- Glover	Emissivity and electrical conductivity of oxides at temperatures above 2000°C using an arc-image furnace as source of heat.
Sheffield University, Department of Metallurgy, St. George's Square, Sheffield 1, England.	B.B. Argent C.J. Ball J. Beech B.A. Bilby A.R. Entwisle D. Havenhand C.W. Haworth R.W.K. Honeycombe D.A.R. Kay D.H. Kirkwood W.R. Maddocks A. Mitchell W.B. Morrison S.A.F. Murrell H.T. Protheroe A.G. Quarrell C.M. Sellars W.J.M. Tegart D.H. Warrington J.M. West J.A. Whiteman J.H. Woodhead	Metal constitution and structure. Phase trans- formations in steels. Mechanical properties, creep and fatigue. Slag equilibria and constitution. Crystal theory.

Laboratory

Personnel

Interests

Sheffield University,  
Department of Refractories  
Technology,  
St. George's Square,  
Sheffield 1, England.

D.W. Budworth  
D.S. Buist  
W.F. Ford  
J. White

Sintering and bonding at high temperatures. Physical and mechanical properties of refractory materials. Phase relationships in oxide systems, including systems containing elements of variable valency. Phase relationships in U-C-metal and U-N-metal systems.

Southampton University,  
Department of Physical  
Chemistry,  
Highfield, Southampton,  
England.

G.J. Hills  
P.J. Ovenden  
E.O. Sherman

Corrosion of metals in molten salts (especially alkali sulphates). Electrode processes in molten salts. Electrolytic conduction of molten salt systems as a function of temperature and applied hydrostatic pressure.

Steatite and Porcelain  
Products Ltd.,  
Bewdley Road, Stourport-  
on-Severn, Worcs.,  
England.

E.C. Williams

Reactions at high temperatures in ceramic and ceramic-metal systems in relation to sintering and vitrification, and their effects on the physical properties of the resulting products.

Thermal Syndicate Ltd.,  
Wallsend, Northumberland,  
England.

M.A. Hepworth  
G. Hetherington  
K.H. Jack  
G.W. Stephenson  
J.A. Winterburn

High-temperature reactions in flames and plasmas to produce vitreous and uniaxial crystalline refractory materials. Influence of thermal history on properties of vitreous silica. Water-silica and hydrogen-silica high-temperature equilibria. Diffusion and transport studies in vitreous silica. Sintering characteristics of ceramic oxides.

<u>Laboratory</u>	<u>Personnel</u>	<u>Interests</u>
United Kingdom Atomic Energy Authority, Atomic Energy Research Establishment, Chemistry Division, Harwell, Didcot, Berks., England.	M. Allbutt R.M. Dell H.J. de Nordwall R.L. Faircloth J.R. Findlay D.A. Landsman E.J. McIver T.L. Markin M.H. Rand L.E.J. Roberts R.G. Sowden	Thermodynamics of oxide, carbide and nitride systems. High temperature crystallography of ceramic systems. Determination of physical properties to 1500°C. Preparation of high-temperature materials. Diffusion of impurity atoms in condensed phases at high temperatures. Thermodynamic state of impurities in high temperature materials.
United Kingdom Atomic Energy Authority, Atomic Energy Research Establishment, Metallurgy Division, Harwell, Didcot, Berks., England.	R.S. Barnes P. Murray S.F. Pugh M.B. Waldron J. Williams	Fabrication, properties, constitution and structure of alloys, ceramics and cermets. Effects of irradiation on the above materials.
United Kingdom Atomic Energy Authority, Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland.	A.G. Adwick J.A.S. Mowat	High temperature reactions and properties of ceramic materials.
United Kingdom Atomic Energy Authority, Reactor Materials Laboratory, Culcheth, Warrington Lancs., England.	I.P. Bell R.F. Hanstock J.W. Hutcheon R. Lind P.T. Nettley R.W. Nichols C. Tyzack B. Watkins	Development and assessment of graphite, metals, alloys and ceramics for use in nuclear reactors. Effect of irradiation on these materials and their compatibility with reactor coolants and nuclear fuels.

<u>Laboratory</u>	<u>Personnel</u>	<u>Interests</u>
United Steel Companies Ltd., Research and Development Department, Swinden Laboratories, Moorgate, Rotherham, Yorkshire, England.	J.H. Chesters J.R. Lakin J. Mackenzie	Basic refractories (notably magnesia, magnesite- chrome and dolomite) for all-basic furnace roofs and arc furnace sidewalls. Aluminosilicates for blast furnaces, blast furnace stoves, and arc furnace roofs. Carbon for arc furnace electrodes and blast furnace hearths.
Warren Spring Laboratory, Gunnells Wood Road, Stevenage, Hertfordshire, England.	A.W. Fletcher P. Harris D. Jackson	Mineral re-constitution and grain growth studies in ores and mineral concentrates.
The Worcester Royal Porcelain Co. Ltd., Research Department, Worcester, England.	A.A. Philpott P. Rado W. Ryan	Sintering, effect of high temperature and atmosphere, general properties of alumina, calcium fluoride and aluminosilicate systems.

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