

DEPARTMENT OF  
MINES AND TECHNICAL SURVEYS

**MINES BRANCH**

SCIENTIFIC AND TECHNICAL PAPERS  
PUBLISHED BY THE STAFF IN 1963

OTTAWA

INFORMATION CIRCULAR IC 162

Price 50 cents

© Crown Copyrights reserved

Available by mail from the Queen's Printer, Ottawa,  
and at the following Canadian Government bookshops:

OTTAWA

*Daly Building, Corner Mackenzie and Rideau*

TORONTO

*Mackenzie Building, 36 Adelaide St. East*

MONTREAL

*Aeterna-Vie Building, 1182 St. Catherine St. West*

or through your bookseller

A deposit copy of this publication is also available  
for reference in public libraries across Canada

Price 50 cents      Catalogue No. M38-3/162

*Price subject to change without notice*

ROGER DUHAMEL, F.R.S.C.

Queen's Printer and Controller of Stationery

Ottawa, Canada

1963

## FOREWORD

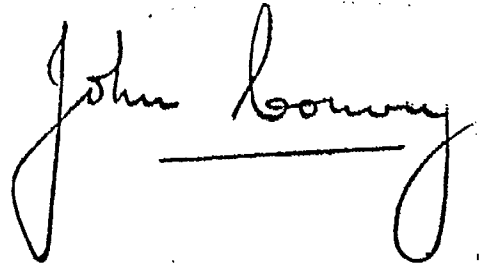
Information Circular IC 151 (June, 1963) was the first in a series of annual reviews of the scientific and technical papers published by the staff of the Mines Branch. This Information Circular is the first supplement to IC 151 and is divided into three sections.

Section 1 consists of the titles of papers published during 1963 in the Mines Branch Series (Monographs, Research Reports, Technical Bulletins, and Information Circulars) together with an abstract or summary of each paper. These reports are available from the Queen's Printer, Ottawa, at the prices indicated and may be ordered by the catalogue number given for each report. (Pre-1962 reports are listed in Canadian Government Sectional Catalogue No. 12, July 1962).

Section 2 lists the titles of all papers published in scientific and technical journals during 1963 by the Mines Branch staff. An abstract or summary again accompanies each title in order to inform the reader of the main content of the paper. The periodicals containing these papers are available in many technical libraries.

Section 3 contains a list of the titles available in the Investigation Report Series from the beginning of the series in 1958 up to and including 1963. This series includes the results of investigations carried out by the Mines Branch at the request of industry and of other government agencies and also of investigations initiated by the Mines Branch of specific materials and processes. Many Investigation Reports are not available because they are either confidential or of very limited interest. Those that are listed in this Information Circular are available for reference in the divisional files, but in most cases there are no additional copies for distribution. However, it is felt that even this limited availability will be of value to many individuals or companies with specific interests and will help prevent unnecessary duplication of investigations already made by the Branch.

I hope that this supplementary index will be as well received as the first in this series and that it will provide the reader with a more complete view of the work of the Mines Branch in aiding Canada's mineral and metallurgical industries.



John Convey,  
Director.

June, 1964

## AVANT-PROPOS

La circulaire d'information IC 151 (juin 1963) était la première d'une série de revues annuelles des travaux scientifiques et techniques publiés par le personnel de la Direction des mines. La présente circulaire, qui comprend trois sections, est le premier supplément à IC 151.

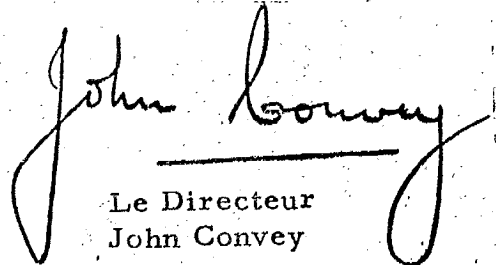
La première section comprend les titres des travaux publiés en 1963 dans les séries de la Direction des mines (monographies, rapports de recherches, bulletins techniques, et circulaires d'information) ainsi qu'un résumé de chaque étude. On peut obtenir ces différents rapports chez l'imprimeur de la Reine, à Ottawa, aux prix indiqués, en les commandant d'après le numéro de catalogue assigné à chaque rapport. (Pour ce qui est des rapports antérieurs à 1962, la liste en est donnée dans le Catalogue du gouvernement canadien n° 12, juillet 1962.)

La section 2 comprend les titres de tous les travaux publiés par la Direction des mines en 1963 dans les revues scientifiques et techniques. Encore ici, un résumé de l'étude accompagne chaque titre, afin de donner au lecteur un aperçu de la teneur. Les périodiques où paraissent ces travaux sont à la disposition du public dans plusieurs bibliothèques techniques.

La section 3 énumère les titres des travaux qui ont paru dans la série des Rapports d'Investigations depuis le début de la série en 1958 jusqu'à 1963 inclusivement. Cette série comprend les résultats des recherches effectuées par la Direction des mines à la demande de l'industrie et d'autres services officiels, ainsi que les résultats des recherches entreprises par la Direction des mines sur des matériaux et procédés déterminés. Plusieurs de ces Rapports d'Investigations ne peuvent être consultés à cause de leur nature confidentielle ou du peu d'intérêt qu'ils présentent. Ceux qui sont énumérés dans la présente circulaire d'information peuvent être consultés dans les archives des diverses divisions, mais, dans la plupart des cas, il n'existe pas d'exemplaires pour la distribution au public. Cependant, on estime que même cette disponibilité limitée est de nature à favoriser de nombreux particuliers ou des sociétés qui s'intéressent à des domaines très précis et contribuera à éliminer le double emploi inutile en ce qui concerne les recherches déjà effectuées par la Direction.

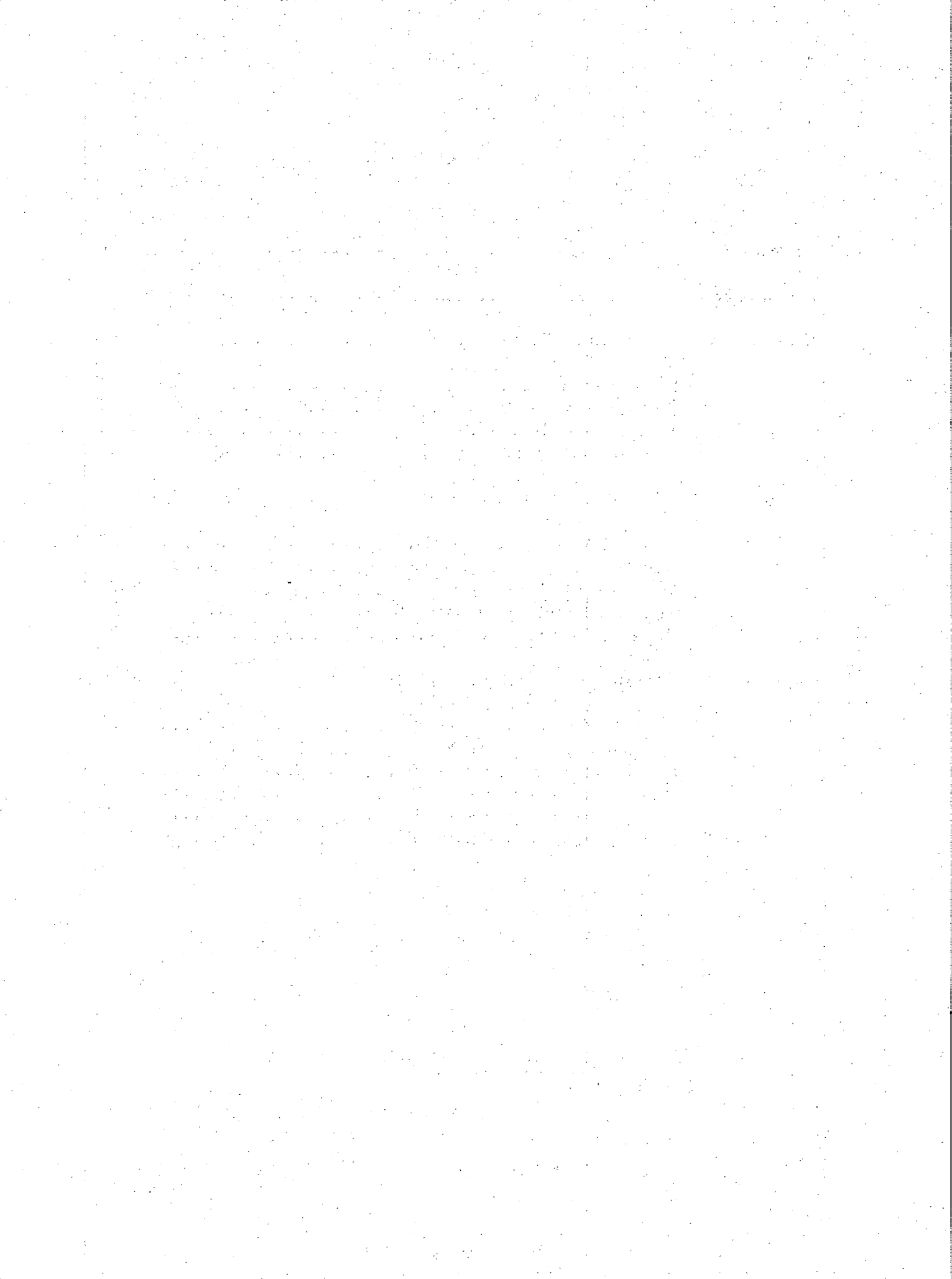
J'espère que cet index supplémentaire sera aussi bien accueilli que le premier dans cette série et qu'il présentera au lecteur un inventaire plus complet des travaux effectués par la Direction des mines à l'intention des industries minérales et métallurgiques.

juin 1964

  
Le Directeur  
John Convey

## CONTENTS

	<u>Page</u>
Foreword .....	i
Avant-Propos .....	ii
<b>Section 1 - Mines Branch Series .....</b>	
Monographs .....	1
Research Reports .....	3
Technical Bulletins .....	15
Information Circulars .....	21
<b>Section 2 - Papers Published in Periodicals</b>	
Mineral Processing Division .....	29
Extraction Metallurgy Division .....	35
Mineral Sciences Division .....	37
Fuels and Mining Practice Division .....	45
Physical Metallurgy Division .....	51
<b>Section 3 - Available Investigation Reports</b>	
Investigation Reports 1958 .....	59
Investigation Reports 1959 .....	65
Investigation Reports 1960 .....	69
Investigation Reports 1961 .....	73
Investigation Reports 1962 .....	79
Investigation Reports 1963 .....	83



*SECTION 1 - MINES BRANCH SERIES*

## MONOGRAPHS

Mines Branch Monograph No. 870. In preparation.

Water Survey Report No. 14

Mines Branch Monograph No. 871. In preparation.

Water Survey Report No. 15

Mines Branch Monograph No. 872. Industrial Water Resources of Canada

Supplement to

Water Survey Report No. 12

Water Quality at Some Canadian Military Establishments, 1959-1962.  
by J.F.J. Thomas\*. 1963, 57p. table.

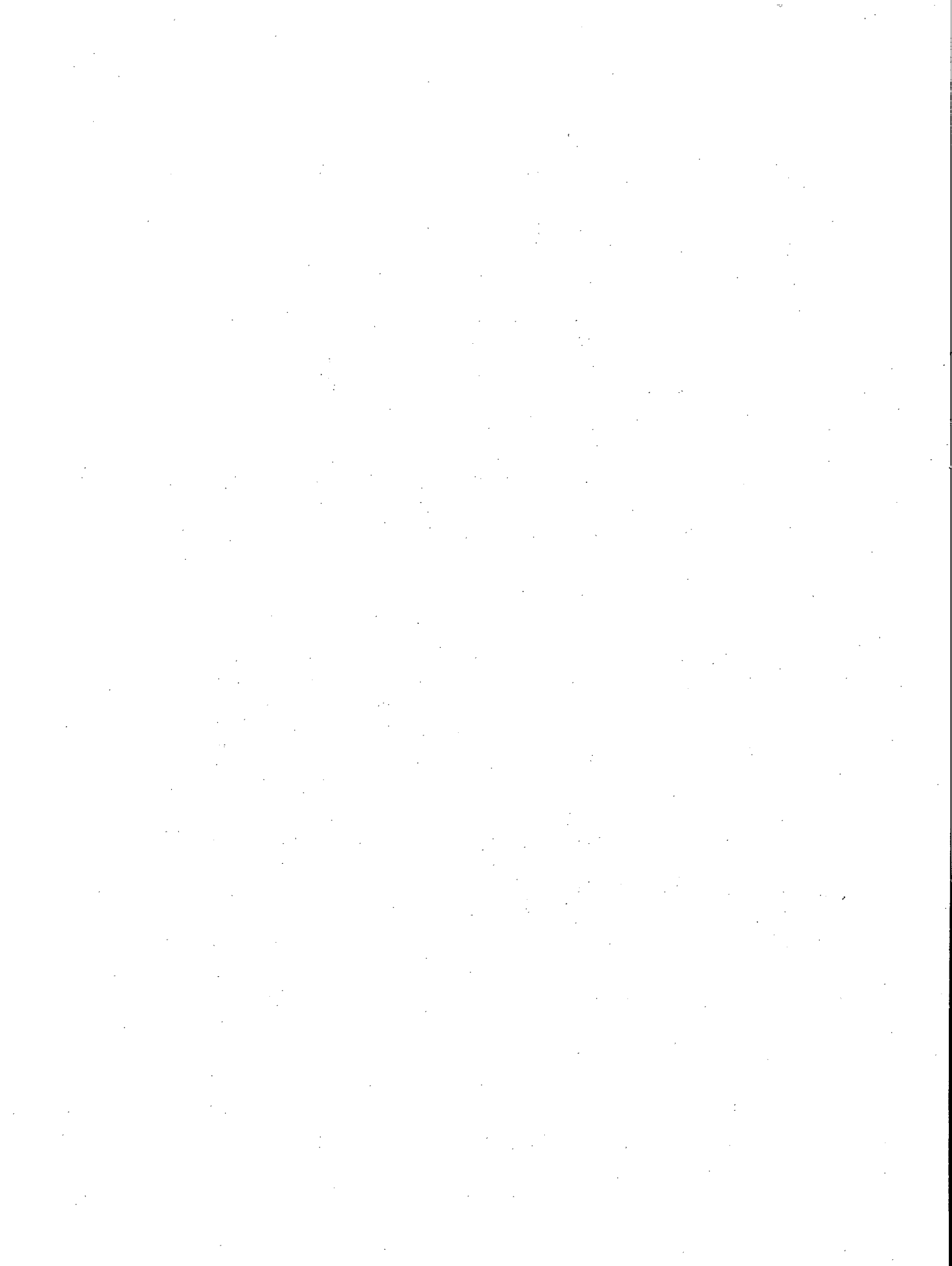
At the request of the Department of National Defence (Army) a survey of the chemical quality of waters supplied to a large number of army establishments in Canada was initiated in 1956. Water quality is very important to the efficient operation in peace and war of both small and large military camps. Besides meeting health standards, these supply waters must be suitable for a variety of domestic and industrial uses; in a number of establishments they must also meet special requirements for use in hospitals, laboratories and shops.

In the 1956-57 survey, reported in Water Survey Report No. 12,<sup>1</sup> the chemical quality of waters supplied to 135 establishments was studied. Although some information on seasonal variations in water quality was obtained on most of these waters, further studies on seasonal and yearly variations were continued at the request of the Department of National Defence at 15 establishments over the period 1958 to 1961 inclusive; some data were also obtained at a few camps in 1962. The information obtained during 1958 at these 15 establishments was included as an addendum to Table II in Water Survey Report No. 12. This Supplement details the information obtained at the same 15 camps for the period 1959 to 1962.

---

\* Head, Industrial Waters Section, Mineral Processing Division, Mines Branch.





## RESEARCH REPORTS

### R 100. *Electromechanical Properties of Three Experimental Lead Zirconate-Lead Titanate Ceramic Compositions*

by T.B. Weston\*. July 1962. 32p. Illus., tables.

Three experimental piezoelectric compositions in the lead titanate-lead zirconate series have been produced, using conventional ceramic fabrication techniques. Long-period grinding of the constituents in ball mills made it possible to employ sintering temperatures lower than those previously reported, but there was some loss of lead oxide during fabrication and impurity pickup during grinding was substantial. The finished ceramic samples proved difficult to pole, but development of a suitable poling technique yielded piezoelectric properties only slightly poorer than the best values reported in the literature for similar compositions, generally produced by more elaborate methods. Although some unexpected changes of composition during fabrication were observed, it was possible to draw some conclusions regarding the effect of minor chemical modification, including the addition of niobia, on the electromechanical properties.

---

\* Scientific Officer, Mineral Processing Division, Mines Branch.

75¢.

Cat. No. M38-1/100

### R 101. I. *The Binary System Nb<sub>2</sub>O<sub>5</sub>-SiO<sub>2</sub>*

by Mohammad Ibrahim and N. F. H. Bright

The binary system Nb<sub>2</sub>O<sub>5</sub>-SiO<sub>2</sub> has been shown to include an extensive two-liquid region over the range 5 to 80% Nb<sub>2</sub>O<sub>5</sub>. The minimum temperature of the two-liquid area is 1695°C. A eutectic composition occurs at 95% Nb<sub>2</sub>O<sub>5</sub> and 1448°C and another at approximately 5% Nb<sub>2</sub>O<sub>5</sub> and 1695°C. The experimental results were obtained by the cone-fusion method.

### II. *The Binary System CaO-Nb<sub>2</sub>O<sub>5</sub>*

by Mohammad Ibrahim\*, N. F. H. Bright\*\* and J. F. Rowland\*\*\*.  
July 1962. 9p. Illus., tables.

The binary system CaO-Nb<sub>2</sub>O<sub>5</sub> has been shown to include three compounds: CaO-Nb<sub>2</sub>O<sub>5</sub>, which melts congruently at 1560°C; 2CaO-Nb<sub>2</sub>O<sub>5</sub>, which melts congruently at 1576°C; and 3CaO-Nb<sub>2</sub>O<sub>5</sub>, which melts incongruently at 1560°C. Three eutectic compositions occur at 6% CaO (1362°C), 23% CaO (1492°C), and 34% CaO (1535°C). These results were obtained by the cone-fusion technique. The compound 3CaO-Nb<sub>2</sub>O<sub>5</sub> has been shown to exist in two forms: type I, face-centered cubic with a = 7.978 Å, having a superlattice with a = 23.934 Å, and type II, orthorhombic (pseudotetragonal, distorted cubic) with a = 11.51 Å,

b = 11.10 A, c = 15.98 A, having a pseudocell with a = 5.754 A, b = 5.551 A, and c = 7.990 A. The conditions controlling the formation of these two forms were not determinable from the experiments conducted.

Published as a paper in the Jour. of the Amer. Cer. Soc.,

I. Vol. 45 (5), pp. 221-222 (1962).

II. Vol. 45 (7), pp. 329-334 (1962).

- \* Postdoctorate Research Fellow with the National Research Council of Canada, \*\*Head and \*\*\*Senior Scientific Officer, Physical Chemistry Section, Mineral Sciences Division, Mines Branch.

25¢.

Cat. No. M38-1/101

R 102. *In preparation.*

- R 103. *Resolution of the Operating Variables of a Small Hydrocyclone?*  
by R. F. Pilgrim\* and T. R. Ingraham\*\*. August 1962. 4p. Illus., tables.

Application of dimensional analysis and experiment to the operation of a hydrocyclone yielded an equation of the form:

$$Q = K_1 P^{(n-1)/2} \delta^{(n-1)/2} \mu^{(2-n)}$$

This equation shows that the volume throughput Q is a function of the pressure differential P, the density  $\delta$  and the viscosity  $\mu$  of the medium. The constant  $K_1$  and the coefficients of the pressure differential, density and viscosity were shown by statistical analysis to be relatively simple functions of the dimensions of the body and orifices of small glass hydrocyclones used with liquid media.

Published as a paper in the Can. Jour. of Chem. Eng., August 1962. pp. 169-172.

- \* Senior Scientific Officer and \*\*Head, Research Section, Extraction Metallurgy Division, Mines Branch.

25¢.

Cat. No. M38-1/103

- R 104. *A Study of the Athabasca Bitumen from the Abasand Quarry, Alberta, Canada - Part III: Chromatographic Separation of the Oil Fraction, and Properties and Structure of the Oil Components.*  
by M. L. Boyd\* and D. S. Montgomery\*\*. November 1962. 73p. Illus., tables.

The oil component, which constituted 33.1 per cent of the Abasand bitumen, was resolved into a series of fractions by elution chromatography on silica gel. The saturated fraction was further resolved on activated carbon, and the most aromatic portion on both activated carbon and alumina. The following properties were determined for most of the

fractions thus prepared: elementary analysis, molecular weight, density (20°C), refractive index ( $n_D^{20}$ ), dispersion, the aniline point, the ultra-violet spectrum and the infrared spectrum. Quantitative estimates of the number of methyl, methylene and aromatic carbon atoms have been made from the infrared spectra. The major fractions were then characterized by the application of three groups of structural analysis methods: (1) a representative group of methods designed for lubricating oils, (2) densimetric methods of van Krevelen, and (3) a method developed by the authors. It was possible to separate out about one-third of the oil component as totally saturated material. The remainder of the material was separated into a series of fractions which contained increasing proportions of aromatic carbon atoms up to about 35 per cent. On the average, the oil fractions would appear to contain three rings per molecule.

\* Senior Scientific Officer and \*\*Senior Scientist, Fuels and Mining Practice Division, Mines Branch.

75¢.

Cat. No. M38-1/104

- R 105. *Radiation Effects on p- and n- Type Catalysts Used in the Thermal Dissociation of Ethyl Alcohol*  
by Matteo Donato\*. August 1962. 28p. Illus., tables.

The dissociation of anhydrous ethyl alcohol has been studied over the temperature range 330°-430°C with the employment of catalysts that had been exposed to a range of estimated "integrated" neutron doses of up to  $96.6 \times 10^{18}$  n/cm<sup>2</sup>. The catalysts are ZnO, an n-type semiconductor, prepared by decomposition of the carbonate, and Cr<sub>2</sub>O<sub>3</sub>, a p-type semiconductor, prepared by dehydration of the hydroxide. Measurable changes in yield and decomposition mechanism have been observed as compared with the unirradiated catalysts.

The variation in the behaviour of the catalysts has been related to the various neutron doses received, and the results are discussed in the framework of the electronic theory of catalysis on semiconductors.

\* National Research Council Postdoctorate Fellow, Physics and Radio-tracer Subdivision, Mineral Sciences Division, Mines Branch.

50¢.

Cat. No. M38-1/105

- R 106. *Infra-Red Absorption by Colouring Matter in Natural Waters*  
by J. Ungar\*. November 1962. 14p. Illus., tables.

A type of ion exchange chromatography was employed to extract organic colouring matter from natural waters. Infra-red spectroscopy of the extracts in KBr discs showed them to be markedly similar to organic matter studied by other workers using different extraction procedures. Such groups as hydroxyl, C=C, C=O, carboxyl and CH were

present. Further studies using the described extraction technique as well as the direct measurement of infra-red spectra of aqueous direct solutions are recommended.

- \* Former Scientific Officer, Industrial Waters Section, Mineral Processing Division, Mines Branch, now Manager of Technical Services (Laboratories), Ionac Chemical Company, a division of Pfaudler-Permutit, Inc., Birmingham, N. J., U. S. A.

50¢.

Cat. No. M38-1/106

R 107. *Kinetic Studies of the Thermal Decomposition of Ferric Sulphate and Aluminum Sulphate*

by N. A. Warner\* and T. R. Ingraham\*\*. June 1962. 5p. Illus., tables.

Kinetic studies were made of the thermal decompositions of ferric sulphate and aluminum sulphate. The reaction product gases were swept from the samples. Cylindrical pellets prepared from chemically pure anhydrous powders were used, and mathematical corrections were made to relate the reaction rate to the area of the interface between the undecomposed sulphate and the oxide product. The interface is the local of the reaction. The rate of the decomposition reaction is proportional to the area of this interface. Studies on ferric sulphate have shown that the rate of decomposition is also directly proportional to the difference between the equilibrium pressure of sulphur dioxide (or oxygen) over the sample and the partial pressure of sulphur dioxide (or oxygen) in the gas stream. The activation energies are 19.9 kcal. and 64.0 kcal. respectively for the ferric sulphate and aluminum sulphate decompositions. No oxysulphates were detected as intermediates in the transition from the normal sulphates to the oxides.

Published as a paper in the Can. Jour. of Chem. Eng., Dec. 1962, pp. 263-267.

- \* National Research Council of Canada Postdoctorate Fellow and \*\*Head, Research Section, Extraction Metallurgy Division, Mines Branch.

25¢.

Cat. No. M38-1/107

R 108. *Competitive Adsorption of C<sup>14</sup>-Labelled Oleic Acid by Quartz and Hematite Flotation Processes*

by C. M. Lapointe\*. January 1963. 37p. Illus., tables.

The adsorption of C<sup>14</sup>-labelled oleic acid on quartz and hematite has been studied in benzene for surface area measurements, and in water for flotation purposes. Although the results on surface areas for hematite agree with the expected values, those for quartz are but a fraction of the values of a monolayer.

Contact and flotation tests in aqueous emulsions of oleic acid showed a definite effect of even a small amount of quartz on the adsorption of oleic acid by hematite, at near-neutral pH.

Improved techniques of radiometric measurements are described for solutions, emulsions and films of oleic acid adsorbed on solids. A new method for extracting the oleic acid from water with the liquid scintillator and measuring its activity in a two-phase liquid system is described.

\* Senior Scientific Officer, Physics and Radiotracer Subdivision, Mineral Sciences Division, Mines Branch.

75¢.

Cat. No. M38-1/108

R 109. *High-Temperature Behaviour of Aluminous Cement Concretes Containing Different Aggregates*

by N.G. Zoldners\*, V.M. Malhotra\*\* and H.S. Wilson\*\*\*. July 1963. 57p. Illus., tables.

Changes in physical properties of about 400 concrete test specimens, made with aluminous cement and expanded shale, anorthosite, ilmenite and phonolite aggregates, were studied after exposure to temperatures ranging from 100 to 1100°C. It was found that the aluminous cement concrete loses its strength rapidly in the range of temperatures investigated. Expanded shale aggregate concrete showed the greatest stability, retaining about 20 per cent of its original compressive strength after firing at 1000°C, whereas concrete made with phonolite aggregate was the least heat-resistant of the four types investigated.

The fired concrete specimens were tested for strength and examined petrographically. Probable causes of reduction in strength due to exposure to elevated temperatures are discussed briefly.

\* Head, \*\*Scientific Officer, and \*\*\*Senior Scientific Officer, Construction Materials Section, Mineral Processing Division, Mines Branch.

\$1

Cat. No. M38-1/109

R 110. *In preparation.*

R 111. *Determination of Copper in High-Purity Niobium, Tantalum, Molybdenum and Tungsten Metals With Bathocuproine.*

by Elsie M. Penner\* and W.R. Inman\*\*. June 1963. 6p. tables.

A spectrophotometric method for determining 0.0005-0.125% of copper in high-purity niobium, tantalum, molybdenum and tungsten metals is described. After sample dissolution and reduction of copper to the univalent state with ascorbic acid, the yellow complex formed by copper and bathocuproine (2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline) is extracted into n-amyl alcohol and the absorbance of the resulting

extract is determined at 476 m $\mu$ . Other impurities present in the four high-purity metals described do not interfere in the proposed method.

Published as a paper in the *Talanta*, Vol. 10, 1963. pp. 407-412.

\* Scientific Officer and \*\*Head, Analytical Chemistry Subdivision,  
Mineral Sciences Division, Mines Branch.

50¢.

Cat. No. M38-1/111

R 112. *Wodginite--A New Tin-Manganese Tantalate from Wodgina, Australia and Bernic Lake, Manitoba*

by E. H. Nickel\*, J. F. Rowland\* and R. C. McAdam\*. June 1963. 13p.  
Illus., tables.

The name wodginite is proposed for a mineral found at two widely separated localities--Wodgina, Australia and Bernic Lake, Manitoba. The mineral is monoclinic, space group C2/c or Cc, with cell parameters of  $a = 9.52 \text{ \AA}$ ,  $b = 11.47 \text{ \AA}$ ,  $c = 5.10 \text{ \AA}$  and  $\beta = 91^\circ 18'$  (Wodgina) and  $a = 9.47 \text{ \AA}$ ,  $b = 11.42 \text{ \AA}$ ,  $c = 5.09 \text{ \AA}$  and  $\beta = 91^\circ 02'$  (Bernic Lake). Its composition is expressed by the formula  $A_{16}O_{32}$ , where A represents chiefly Ta, Sn and Mn, with lesser amounts of Nb, Fe and Ti. The relationship of wodginite to columbite-tantalite, ixiolite and olovotantalite is discussed.

Published as a paper in the *Can. Mineral.*, Vol. 7, Part 3, 1963,  
pp. 390-402.

\* Senior Scientific Officers, Mineral Sciences Division, Mines Branch.

25¢.

Cat. No. M38-1/112

R 113. *Hot Workability of Alpha Brasses*

by R. Thomson\* and J. O. Edwards\*\*, January 1963. 4p. Illus., tables.

Both lead and bismuth have a deleterious effect on the hot working properties of alpha brasses. The work reported in this article shows that the element uranium, when present in the alloy in such proportions as to form stable high melting point intermetallic compounds with all of the bismuth or lead, is a highly effective agent in removing the characteristic hot shortness in hot-rolled contaminated alpha brass. It is suggested that melt treatment by uranium may thus afford considerable production economies in terms of scrap utilization, casting shop practice, hot fabrication, etc. The principle may be extended to other alloys susceptible to impurity effects during hot working, and, indeed, to other problems where the fixation of one constituent is desirable for any reason.

Published as a paper in *Metal Industry*, January 1963. pp. 85-88.

- \* Research Metallurgist, Canadian Uranium Research Foundation, and  
\*\* Head, Non-Ferrous Metals Section, Physical Metallurgy Division,  
Mines Branch.

25¢.

Cat. No. M38-1/113

R 114. *A Study of Sedimented Organic Matter and its Natural  
Derivatives*

by L.H. King\*, Frances E. Goodspeed\* and D.S. Montgomery\*\* (with  
Appendix by M.F. Millson\*). June 1963. 74p. Illus., tables.

The need for a classification covering the entire spectrum of organic matter in geological formations has been recognized for some time, but owing to the lack of sufficient data the formulation of such a classification has been held back.

In this report, techniques are described for the preparation of samples of organic matter from geological formations whereby ash contents can be lowered to a level where reliable property measurements can usually be obtained. Property measurements were made on a wide variety of samples which vary in structure from aliphatic to graphitic types. The properties measured include: elemental analysis, volatile matter content, refractive index, density, solubility in carbon disulphide, and infrared spectra.

Structural parameters derived from these properties include aromaticity, reduced molar volume, ring condensation index, an estimate of aromatic cluster size, and quantitative structural group data obtained from the infrared spectra of solid materials mounted in KBr. The correlation of these parameters, as well as of the measured properties, with atom percent carbon delineated structural trends and development tracks for the materials under consideration. These results are compared with the structural and metamorphic trends in coal.

The problem of classification is discussed in terms of genesis and chemical structure. The samples are divided into two major groups on the basis of their origin: sedimented organic matter (syngenetic), and natural derivatives of sedimented organic matter (epigenetic). It appears that further geological qualification is required before the material of syngenetic origin can be properly classified according to its inherent chemical properties, but the study shows that the epigenetic material can be effectively classified in terms of atom percent carbon, volatile matter content, and solubility.

- 
- \* Senior Scientific Officers and \*\*Senior Scientist, Fuels and Mining  
Practice Division, Mines Branch.

\$1

Cat. No. M38-1/114



R 115. *Origin of the Albert Mines Oil Shale (New Brunswick) and its Associated Albertite*

by Lewis H. King\*. June 1963. 28p. Illus., tables.

The Albert Mines oil shale is part of the Albert formation of the Moncton basin of New Brunswick, and is of Mississippian age. The deposit is a varved dolomitic, organic marlstone, and is probably of planktonic algal origin. It bears a striking resemblance to certain facies of the Green River formation.

The oil shale is associated with the type vein of albertite, and the unique occurrence is considered as evidence that the albertite had its origin in the organic matter of the shale. However, the albertite properties are different from those of the organic matter of the shale; the former is more highly aromatic in structure. It is suggested that the albertite developed as a chemical fraction of the shale, possibly from a fraction of degraded aquatic humus. It probably migrated in aqueous solution, assisted by dissociating functional groups that are still in evidence in the infrared spectra. Precipitation of the albertite from the migrating solutions probably resulted from a change in environment pH.

Various other origins for albertite are discussed.

\* Senior Scientific Officer, Fuels and Mining Practice Division, Mines Branch.

50¢.

Cat. No. M38-1/115

R 116. *On the Origin of Anthraxolite and Impsonite*

by Lewis H. King\*. June 1963. 12p. Illus.

Anthraxolites and impsonites are of secondary origin, but it is difficult to ascertain their point of entry in the secondary development track. They are normally described as being homogeneous and structureless; however, six of the twelve samples examined during this study possess a fine crystalline structure. The presence of crystalline material provides a basis for further speculation on their origin, as the conditions for crystallization in organic materials limit the various possibilities. It is thought that the material must have been quite aromatic in composition during deposition and that it probably migrated in an aqueous environment. It is also suggested that the migrating fraction originated as an alteration product of primary sedimented organic matter.

\* Senior Scientific Officer, Fuels and Mining Practice Division, Mines Branch.

50¢.

Cat. No. M38-1/116

- R 117. *Electrical Resistivity Measurements on Western Canadian Coals*  
by Lewis H. King\*. July 1963. 38p. Illus., tables.

Field resistivity measurements were made in advance of a coal face to determine the probability of encountering outbursts as the coal was mined. This field work led to the measuring of resistivity on laboratory specimens in order to ascertain the influence of adsorbed methane, carbon dioxide, and moisture. The laboratory work shows that moisture, but not adsorbed gases, can account for the large resistivity fluctuations encountered in the field. The field measurements apparently detect fracturing in the coal ahead of an advancing face when the fractures are saturated with moisture, but outbursts cannot be predicted from the measurements.

---

\* Senior Scientific Officer, Fuels and Mining Practice Division, Mines Branch.

50¢.

Cat. No. M38-1/117

- R 118. *Kinetic Studies on the Thermal Decomposition of Calcium Carbonate*

by T.R. Ingraham\* and P. Marier\*\*. August 1963. 4p. Illus.

Kinetic studies have been made of the thermal decomposition of precipitated calcium carbonate, powdered calcite, and regular fragments of calcite crystals. The powdered materials were examined in the form of pellets, which were prepared by compacting the powder to about 70% of its theoretical density. The work was done at one atmosphere of pressure in a flow of air containing various amounts of carbon dioxide. It was observed that the decomposition of the pellets, which were prepared in a variety of shapes, was characterized by the same advancing interface mechanism as that observed for single specimens of crystal fragments. When the rates of decomposition were normalized for the change in interfacial area accompanying decomposition, it was possible to correlate the observed rates of decomposition for a variety of pellet shapes, and to relate these rates, as a function of particle size and pellet roughness, to the rates of decomposition of large fragments of calcite crystals. The activation energy for the decomposition reaction was found to be 40.6 kcal./mole. At a constant temperature, the decrease in reaction rate with increasing carbon dioxide pressure was found to be proportional to the difference between the equilibrium dissociation pressure and the back pressure of carbon dioxide. A reaction mechanism based on diffusion through a constant thickness of active calcium oxide is suggested.

Published as a paper in the Can. Jour. of Chem. Eng.,  
Aug. 1963. pp. 170-173.

---

\* Head, Research Section and \*\*Scientific Officer, Extraction Metallurgy Division, Mines Branch.

25¢.

Cat. No. M38-1/118

**R 119. Dense Lithium Fluoride for Gamma-Ray-Free Neutron Shielding**  
by V.D. Svikis\*. February 1964. 35p. Illus., tables.

A simple method of processing powdered LiF into dense and strong LiF, suitable for self-supporting neutron shielding, was developed. The processing was carried out in two stages. In the first stage, chemically pure LiF powder was slip-cast and sintered for periods of from 1 to 5 hours at temperatures ranging from 500° to 840°C, in order to establish the best conditions for making dense and volume-stable LiF aggregate. Aggregates were prepared with densities in the range 52 to 92% of theoretical, depending on sintering temperature and time. Maximum density was achieved by sintering at 700°C for 3 hours. In the second stage, dense and stabilized LiF aggregate was graded, pressed into shapes at 4000, 6000 and 8000 psi, and heated at 600° and 800°C, to find the best conditions for making dense compacts. LiF compacts, as large as 8-3/4 by 4-1/2 by 3 in., with densities in the range 78 to 85% of theoretical, were prepared. Maximum density and good mechanical strength were attained when the graded aggregate was pressed into at 800°C. The material can be cut and machined to close dimensional tolerances.

---

\* Senior Scientific Officer, Mineral Processing Division, Mines Branch.

75¢.

Cat. No. M38-1/119

**R 120. Ageing Behaviour of Al-10% Mg Casting Alloys at Room Temperature and up to 150°C (300°F)**  
by W.A. Pollard\*. November 1963. 42p. Illus., tables.

The ageing and related phenomena of the Al-10% Mg casting alloy, at room temperature and up to 150°C (300°F), have been studied by tensile testing and metallographic examination over periods of up to six years.

In alloys containing more than about 10.2% Mg aged at room temperature, a slow but continuous increase in strength occurs at least up to five years. However, at 50°C (122°F) and above, this age-hardening does not occur, but precipitation is observed first at grain boundaries, with no change in properties, and then in Widmanstaetten form within grains, accompanied by rapid embrittlement. Reversion of the room temperature aged material occurs above 50°C (122°F).

The results are discussed in terms of recent work on the Al-Mg alloys and of recent theories of age-hardening.

---

\* Senior Scientific Officer, Non-Ferrous Metals Section, Physical Metallurgy Division, Mines Branch.

75¢.

Cat. No. M38-1/120

- R 121. *The Galvanizing Behaviour of Commercial Steel Sheet Materials* by J. J. Sebisty\* and R. H. Palmer\*\*, November 1963. 36p. Illus., tables.

A statistically designed investigation has been made of the hot-dip galvanizing characteristics and behaviour of several commercially produced steel sheet materials, comprising a series of low-carbon mild steels. Both continuous strip and general galvanizing practice were considered in selection of the laboratory galvanizing conditions.

Coating formation of the mild steels in aluminum-free zinc baths was largely influenced by the physical roughness of the steel surface, whereas in baths alloyed with aluminum and under conditions approximating to continuous strip practice effective inhibition of the iron-zinc reaction was more dependent on the inherent chemical activity of the steel surface. As this increased, the beneficial effect of aluminum was lessened and especially so in the case of heavily-worked mild steel sheet.

The galvanizing response of low-alloy high-strength type steels in aluminum-free baths varied according to steel composition. High-silicon materials showed an extremely aggressive, linear rate of attack with time which was reflected in the formation of very thick coatings having an unsatisfactory surface appearance. In aluminum-alloyed baths, suppression of zinc attack of the alloy steels was somewhat less effective than with mild steels, except under certain conditions where the effect of aluminum was enhanced with the high-silicon type steels. Coatings on the latter were prone to the development of bare or uncoated spots when the aluminum concentration in the bath was high. Tensile properties of the alloy steels were affected in varying degrees by galvanizing and most significantly in the case of yield strength.

- \* Senior Scientific Officer, Physical Metallurgy Division, Mines Branch,  
\*\* Research Metallurgist, Canadian Zinc and Lead Research Committee.

75¢.

Cat. No. M38-1/121

- R 122. *Thermodynamic Properties of Zinc Sulfate, Zinc Basic Sulfate, and the System Zn-S-O* by T. R. Ingraham\* and H. H. Kellogg\*\*, December 1963. 8p. Illus., tables.

Three anhydrous zinc sulfates have been identified. They are:  $ZnSO_4 (\alpha)$ , stable below  $1007^\circ K$ ;  $ZnSO_4 (\beta)$ , stable above  $1007^\circ K$ ; and  $ZnO \cdot 2ZnSO_4$ . The decomposition pressure of each sulfate has been measured and the following relations calculated from the results:

$$3\text{ZnSO}_4(\alpha) = \text{ZnO} \cdot 2\text{ZnSO}_4 + \text{SO}_3, \quad -R \ln P_{\text{SO}_3}$$

$$= 53,733/T - 45.21 \text{ (298}^\circ \text{ to } 1007.5^\circ \text{K)}$$

$$3\text{ZnSO}_4(\beta) = \text{ZnO} \cdot 2\text{ZnSO}_4 + \text{SO}_3, \quad -R \ln P_{\text{SO}_3}$$

$$= 39,281/T - 30.866 \text{ (1007.5}^\circ \text{ to } 1122^\circ \text{K)}$$

$$1/2 (\text{ZnO} \cdot 2\text{ZnSO}_4) = 3/2 \text{ZnO} + \text{SO}_3, \quad -R \ln P_{\text{SO}_3}$$

$$= 57,189/T + 3.3 \ln T$$

$$- 65.629 \text{ (298}^\circ \text{ to } 1208^\circ \text{K)}$$

The measured data have been combined with the known thermodynamic properties of ZnS, ZnO, Zn,  $\text{SO}_2$ , and  $\text{SO}_3$  to yield univariant and bivariant phase diagrams for the system Zn-S-O. The application of these diagrams to problems of roasting zinc concentrates is discussed.

Published as a paper in Trans. AIME, 227, Dec. 1963. pp. 1419-1426.

\* Head, Research Section, Extraction Metallurgy Division, Mines Branch.

\*\* Professor of Mineral Engineering, Henry Krumb School of Mines, Columbia University, New York, N. Y.

25¢.

Cat. No. M38-1/122

R 123. Kinetics of the Reaction of Niobium Pentachloride With Water Vapor

by T.R. Ingraham\* and B.J.P. Whalley\*\*. December 1963. 4p. Illus.

When niobium pentachloride is exposed to moist air, hydrogen chloride is liberated and hydrated niobium pentoxide or niobic acid remains. It is believed that the rate of the reaction is controlled by the rate of diffusion of water across a layer of unidentified intermediate product of constant thickness (about 0.2 mm). The constant thickness of the layer is maintained by the spalling and cracking of the product after it exceeds a critical thickness. Since the reaction takes place at an interface between the niobium pentachloride and the layer of intermediate, it is necessary to normalize the results for the decrease in interfacial area as the reaction proceeds. When this is done, the rate of the reaction, expressed in terms of grams of niobium pentachloride reacting per square centimetre of interface per hour, is:

$$\text{Rate} = (7.7 \pm 0.4) \times 10^4 (p/p) \exp \{ (-8.1 \pm 0.6) \times 10^4 / RT \}$$

Published as a paper in the Can. Jour. Chem. Eng., Dec. 1963. pp. 265-268.

\* Head, Research Section and \*\*Senior Scientific Officer, Extraction Metallurgy Division, Mines Branch.

25¢.

Cat. No. M38-1/123

## TECHNICAL BULLETINS

### TB 41. *Low-Silica Hematite Concentrates*

by P.D.R. Maltby\* and D.E. Pickett\*\*, December 1962. 12p. tables.

Using three samples of specular hematite concentrates from the Labrador-Quebec area, high-grade hematite concentrates with silica contents of less than 0.5 per cent have been produced by fine grinding followed by high-intensity wet magnetic separation and by flotation of the silica. The product has many potential uses in pigment manufacture and in direct reduction, amply justifying the moderate cost of the process.

\* Scientific Officer and \*\*Head, Ferrous and Less Common Minerals Section, Mineral Processing Division, Mines Branch.

50¢.

Cat. No. M34-20/41

### TB 42. *Effects and Control of Nickel and Iron Impurities in Cyanide Zinc Plating Baths*

by Wilfred Dingley\*, June 1962. 6p. Illus., tables.

In 1956 the Canadian Department of National Defence agreed to accept drawn-steel cartridge cases of the 3 inch, 70 calibre type for the Navy, and of the 105 mm type for the Army. Each case was to be zinc-plated in accordance with Federal Specification QQ-Z-325a of the U. S. A., the exterior surface being plated with a Type II, Class 2 coating and the interior surface with a Type II, Class 3 coating.

By the early part of 1958 cases of both types were being produced, inspected, placed in cardboard cartons and shipped to the filling division for storage until required. This storage was in unheated buildings where, due to the temperature fluctuations, a certain amount of moisture condensation must have taken place. In other words, for at least part of the time, the zinc coatings on the cartridge cases must have been covered with a thin film of condensed water which somewhat resembled distilled water except that it doubtless contained carbon dioxide dissolved from the atmosphere.

In December 1958, tiny dark spots were observed on the surfaces of several cases of each type. The manufacturer then made certain process changes which he believed would improve the zinc coatings and prevent the development of spots on future cases. However, inspection during the following months revealed that spots had developed on some of the newer cases soon after they had been placed in storage; also that there had been an increase in the number of older cases with spots, and in the number and size of the spots on each case. This corrosion would not have been considered particularly serious in wartime when the cartridges probably would have been used a few months after they had been manufactured. However, under present-day conditions they might

remain in storage for many years. Also at some time in the future the plated cartridge cases might require storage under tropical conditions which would be much more corrosive than the present ones.

The Mines Branch, Department of Mines and Technical Surveys, Ottawa, Canada, was requested by both the manufacturer and the user of the cases to make a thorough investigation of the causes of this deterioration and to recommend a remedy.

The investigation is described under the main headings:  
1) Examination of materials involved in the problem, 2) Laboratory corrosion testing, 3) Improvement of the zinc plating procedure.

Published as a paper in the 49th Annual Tech. Proc. of the Amer. Electrochem. Soc., June, 1962. pp 155-160.

\* Technical Officer, Pyrometallurgy and Corrosion Subdivision, Extraction Metallurgy Division, Mines Branch.

35¢.

Cat. No. M34-20/42

**TB 43. A Semi-Automatic Monitor of Cyanide Solution Strength for Gold Ore Dissolution**

by G.G. Eichholz\* and C.A. Josling\*\*. March 1963. 16p. Illus.

A semi-automatic device has been constructed that can be used to check the solution strength of cyanide solutions. It consists of a wheel on which a gold-foil bearing glass slide is mounted. The wheel moves the gold foil through the solution under test and intercepts a light beam. As the gold foil is attacked by the cyanide solution its light absorption diminishes. The successive increase in transmitted light intensity is recorded and gives a measure of gold dissolution rate. Curves have been obtained to show the effect of cyanide concentration and oxygen content on dissolution rates.

Details are presented of the construction of the unit, and some practical operating procedures are outlined.

\* Head and \*\*Technician, Physics and Radiotracer Subdivision, Mineral Sciences Division, Mines Branch.

75¢.

Cat. No. M34-20/43

**TB 44. Laboratory Development of Corrosion-Inhibiting Coatings for Mine Hoist Wire Rope**

by W. Dingley\*. February 1963. 13p. Illus., tables.

Results of laboratory tests are given on a compound designed to protect zinc-coated steel wire mine hoist rope. In a preliminary screening test it was learned that a combination of a road-construction asphalt,

zinc chromate and trichlorethylene gave better results than a number of compounds presently used for wire rope protection.

A second series of tests on zinc-coated wire from mine hoist rope, using various proportions of asphalt, zinc chromate and trichlorethylene, showed that coatings having an asphalt to zinc chromate ratio of about 1:1 gave best results. The asphalt-zinc chromate-trichlorethylene coating is recommended for both used and unused ropes.

\* Technical Officer, Pyrometallurgy and Corrosion Subdivision, Extraction Metallurgy Division, Mines Branch.

25¢.

Cat. No. M34-20/44

TB 45. *Porosimetry by Mercury Injection*

by G. T. Shaw\*, B. I. Parsons\* and D. S. Montgomery\*\*. May 1963. 32p. Illus., tables.

Apparatus and techniques are described for quick routine determinations of the pore size distribution by mercury injection. In porosimetry by mercury injection, the amount of mercury that can be forced into a porous solid is measured as a function of the applied pressure. Details of apparatus for measurements at low pressures (1 to 15 psia) and high pressures (up to 60,000 psi) are given. The range of pore radii measurable with the equipment is 100 microns to 17A in materials, such as alumina, silica and activated clays, which have a low compressibility. Pore size distributions determined by the mercury method are compared with pore size distributions calculated from nitrogen desorption isotherms. A discussion is also given on the application of mercury porosimetry to porous bodies containing non-cylindrical pores.

\* Senior Scientific Officers and \*\*Senior Scientist, Fuels and Mining Practice Division, Mines Branch.

75¢.

Cat. No. M34-20/45

TB 46. *Control of Zinc Electrodeposition to Decrease Hydrogen Embrittlement in Steel*

by W. Dingley\* and J. Bednar\*\*. June 1963. 9p. Illus., tables.

The number of failures in zinc-plated high strength steels attributed to hydrogen embrittlement is causing concern particularly in view of the increase in the number of applications for steels of this type. Normally, the hydrogen absorbed by the steel during plating is removed by a baking treatment; this is time-consuming, however, and not always successful. This paper describes a zinc plating process designed to decrease greatly the amount of hydrogen that is absorbed by the steel during plating.



The new method involves modifications of the standard methods of preparing the surface of the steel, preparing the plating bath and applying the current. A procedure for maintaining the purity of the bath also is referred to. Steel specimens plated by the new method retained their original bending ductility without baking. The bend test used to measure the extent of the embrittlement of the specimens is described, and typical results obtained with it are given.

Published as a paper in the 50th Annual Tech. Proc. of the Amer. Electrochem. Soc., June, 1963. pp 71-77.

\* Technical Officer and \*\*Technician, Pyrometallurgy and Corrosion Subdivision, Extraction Metallurgy Division, Mines Branch.

25¢.

Cat. No. M34-20/46

TB 47. Not Used.

TB 48. *Lightweight Concrete Aggregates from Clays and Shales in Quebec* by H. S. Wilson\*. July 1963. 41p. Illus.

The first half of the report includes a description of the types of lightweight aggregates, the properties of lightweight concrete, the history of the expanded-clay and shale industry, and the methods of production. Also, various theories on the causes of bloating are outlined and discussed. It is concluded that in most materials indicates whether the liquid phase formed on heating will be of the proper viscosity. The compounds that release bloating gases may be carbonates, organic material, sulphates, sulphides, hydrous minerals, or ferric oxide. The laboratory equipment and test procedures are described, and a brief account of the Palaeozoic and Pleistocene geology of Quebec and Ontario is given.

In the second half of the report, the 68 locations from where 91 samples were taken are briefly described, and the results of the tests are given. Twenty-one samples from 18 locations show promise of being suitable for production by the rotary kiln. Some of the other materials might be used for sintering.

\* Senior Scientific Officer, Mineral Processing Division, Mines Branch.

75¢.

Cat. No. M34-20/48

TB 49. *Determination of Nickel by Spectrophotometric Measurement of the Chloroform Extract of Nickel<sup>II</sup>-Dimethylglyoximate-Application to Brasses, Bronzes, Magnesium and Aluminum Metals and Their Alloys*

by Elsie M. Penner\* and W.R. Inman\*\*. September 1963. 19p. tables.

A spectrophotometric procedure involving chloroform extraction of nickel<sup>II</sup>-dimethylglyoximate and direct photometric measurement of the extract at 370 m $\mu$  has been applied to the determination of 0.0005 to 1%

nickel in brasses and bronzes and in magnesium and aluminum metals and their alloys. Copper and zinc are complexed with sodium thiosulphate prior to extraction of the nickel complex from an ammonium tartarate medium pH 6.5. Manganese and other elements present in the materials described do not interfere in the proposed method.

---

\* Scientific Officer and \*\*Head, Analytical Chemistry Subdivision, Mineral Sciences Division, Mines Branch.

50¢.

Cat. No. M34-20/49

**TB 50. *Development of a Chemical Process for Production of Cesium Chloride from a Canadian Pollucite Ore***

by H. W. Parsons\*, J. A. Vezina\*, R. Simard\*\* and H. W. Smith\*\*\*, March 1963. 14p. Illus., tables.

A chemical process has been developed for the production of a high-purity cesium chloride from a pollucite (cesium aluminum silicate) ore from the Manitoba deposit of Chemalloy Minerals Ltd. The history of the deposit, and the present and possible future uses of cesium are briefly reviewed. Laboratory and pilot plant investigations on this ore have shown that a cyclic sulphuric acid leach followed by fractional crystallization will produce a rubidium-free cesium alum, which can be converted to cesium chloride by thermal decomposition and ion exchange. On the basis of these findings it is concluded that the process is applicable to the tonnage production of cesium chloride. Reagent consumption was found to be 3.3 lb sulphuric acid and 0.3 lb hydrochloric acid per pound of cesium extracted. Overall extraction of cesium was 95 to 96%.

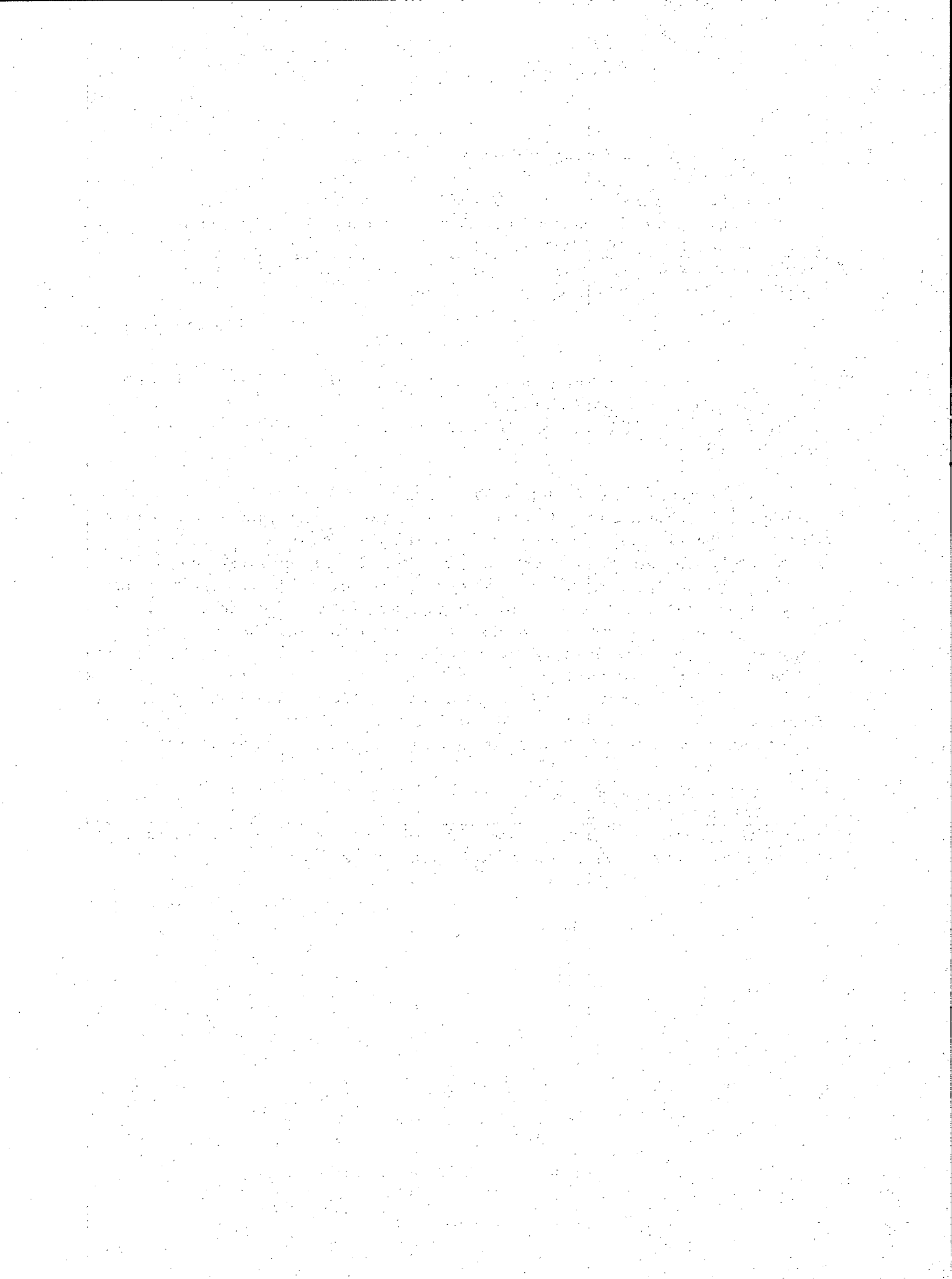
Published as a paper in the Can. Met. Quart. Vol. 2, No. 1, Jan-Mar, 1963, pp. 1-13.

---

\* Scientific Officers, \*\*Senior Scientific Officer and \*\*\*Division Planning Officer, Extraction Metallurgy Division, Mines Branch.

25¢.

Cat. No. M34-20/50



## INFORMATION CIRCULARS

IC 143. *Alphabetical Index to V. I. Mikheev's "X-ray Determination of Minerals"*

by E. H. Nickel\*. December 1962. 26p.

"Rentgenometricheskii Opredelitel' Mineralov" (X-ray Determination of Minerals) by V. I. Mikheev (1957) is a Russian volume containing X-ray powder diffraction data for about 900 minerals. The English alphabetical index has been prepared to assist the worker, unfamiliar with the Russian alphabet or the Russian rendering of mineral names, to gain access to the X-ray diffraction data in the volume.

\* Senior Scientific Officer, Mineralogy Section, Mineral Sciences Division, Mines Branch.

50¢.

Cat. No. M38-3/143

IC 144. *Stockage Souterrain du Gaz Naturel dans le Sud de L'Ontario et du Québec*

by R. P. Charbonnier\*. January 1963. 34p. tables.

Après l'achèvement récent du gazoduc transcanadien, la consommation de gaz naturel devrait s'accroître très rapidement dans le Sud de l'Ontario et du Québec, tout comme la chose s'est produite ces dernières années dans l'Est des États-Unis.

Les données relatives aux États-Unis démontrent l'importance du stockage souterrain du gaz naturel à titre de solution aux problèmes que posent la consommation irrégulière et les périodes de pointe en hiver. La situation est probablement analogue au Canada.

La présente étude tient compte des divers aspects du stockage souterrain du gaz; elle comprend un exemple de l'évaluation des besoins du marché dans le Sud ontarien, un examen de l'agencement et de l'utilisation de champs partiellement épuisés et de réservoirs aquifères, de même que certaines données quant aux coûts.

Les réservoirs actuellement utilisés et d'autres qu'on pourrait utiliser à l'avenir pour y stocker du gaz dans le Sud de l'Ontario et du Québec donnent également lieu à un examen, et l'auteur montre qu'il est souhaitable de pour-suivre les recherches relativement aux endroits où l'on pourrait stocker du gaz dans la région en cause.

This is a French translation of IC 121.

\* Chef, Section du génie des gisements d'hydrocarbures, Division des combustibles et du génie minier, Direction des mines.

50¢.

Cat. No. M38-3/144

IC 145. *Cyanide Recovery from Gold-Barren Waste Solutions:  
A Literature Review*

by A. J. Gilmore\* and W. A. Gow\*\*. April 1963. 13p. Illus., tables.

The literature has been reviewed to assess the possibilities of economically recovering cyanide from alkaline waste solutions from Canadian gold-milling operations.

The literature cites two possible processes. In one process, now in use in a Canadian plant, the alkaline waste solution is acidified with sulphuric acid to convert the free and combined cyanide to hydrocyanic acid, which is absorbed in a lime slurry. The other process was developed to the pilot plant stage in South Africa. It involves an ion exchange technique. By the use of both anion and cation exchangers, both the cyanide and the base metals, present as metal cyanide complexes, are recovered.

Cyanide recovery by these two processes would be uneconomic in most Canadian operations, mainly because of the small tonnages of cyanide discarded

---

\* Senior Scientific Officer and \*\*Head, Hydrometallurgy Subdivision, Extraction Metallurgy Division, Mines Branch.

50¢.

Cat. No. M38-3/145

IC 146. *Bibliography of High Temperature Condensed States Research  
in Canada, October-December, 1962*

by Norman F. H. Bright\*. January 1963. 7p.

This report contains bibliographic information concerning research work on high-temperature condensed states published in Canadian journals during the period October, November and December, 1962.

---

\* Head, Physical Chemistry Section, Mineral Sciences Division, Mines Branch.

50¢.

Cat. No. M38-3/146

IC 147. *Analyses of Coal and Coke During 1962*

by W. J. Montgomery\* and G. C. Behnke\*\*. April 1963. 24p.

The Solid Fuels Analysis Section of the Fuels and Mining Practice Division is responsible for all analytical work on coal and coke, including that reported in the official "Analysis Directory of Canadian Coals", which is published by the Mines Branch (but only at intervals of five or more years). This information circular, issued as the third of an annual series, tabulates the analyses of commercial and special samples of coal and coke received by the Division during 1962.

It must be clearly understood that no responsibility is taken by the Division for the accuracy of the sampling procedures adopted for procuring the samples for which analyses are reported in this circular, excepting those taken by Divisional officers.

Proximate analysis and sulphur values are reported on the "as received" basis only, whereas calorific values are reported on the "dry" basis. Ash fusibility determinations, where made, are reported in most instances using the four-point fusion system following the latest ASTM revision; however, some three-point fusions are also reported. Free Swelling Index and Grindability Index (Hardgrove) are reported on a large number of samples. The authors gratefully acknowledge the assistance of C.H. Glaude in supplying the ASTM Free Swelling Index data reported. As an easy reference, the analyses are arranged by province and state.

\* Head, Solid Fuels Analysis Section, and \*\*Technician, Fuels and Mining Practice Division, Mines Branch.

50¢.

Cat. No. M38-3/147

- IC 148. Bibliography and Directory of High Temperature Condensed States Research in Canada and Elsewhere, January-March, 1963  
by Norman F.H. Bright\*. April 1963. 14p.

This report contains bibliographic information concerning research work on high-temperature condensed states published in Canadian journals during the period January, February, March, 1963.

A list is given of laboratories and personnel engaged in high-temperature condensed states research in Germany, Austria and Switzerland.

\* Head, Physical Chemistry Section, Mineral Sciences Division, Mines Branch.

50¢.

Cat. No. M38-3/148.

- IC 149. Mines Branch Contributions to the United Nations Conference on the Application of Science and Technology for the Less Developed Areas, Geneva, February 4-20, 1963  
by Mines Branch Staff. May 1963. 51p. Illus.

Seven papers were prepared by the Department of Mines and Technical Surveys for the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, which was held at Geneva, February 4-20, 1963. The titles of these papers are listed on the last page of this report.

Since the United Nations does not plan to publish the papers from this conference, the department decided that its contributions should be

reprinted in the usual departmental reports series. Four of the Mines Branch papers are published collectively in this Information Circular. A fifth paper, Mineral Information Bulletin MR 66, is a joint contribution by the Mineral Resources Division and the Mines Branch.

Paper 1 - Analytical Chemistry and Spectrography as Essential Controls for Development and Production in the Mineral and Metal Industries

by W. R. Inman\* and A. H. Gillieson\*\*.

\* Head, Analytical Chemistry Subdivision and \*\*Head, Spectrographic Laboratory, Mineral Sciences Division, Mines Branch.

Paper 2 - Developments in the Production, Casting and Fabrication of Iron and Steel in Relation to Small Tonnage Steel Plants

by G. P. Contractor\* and W. A. Morgan\*\*.

\* Senior Scientific Officer and \*\*Head, Ferrous Metals Section, Physical Metallurgy Division, Mines Branch.

Paper 3 - Ore Microscopy as a Guide to Ore Dressing Procedure  
by M. H. Haycock\*.

\* Head, Mineralogy Section, Mineral Sciences Division, Mines Branch.

Paper 4 - The Use of Radioisotopes and Special Instrumentation for Process Control and Development in the Mineral and Metal Industries

by G. G. Eichholz\*.

\* Head, Physics and Radiotracer Subdivision, Mineral Sciences Division, Mines Branch.

75¢.

Cat. No. M38-3/149

IC 150. The Physics and Radiotracer Subdivision of the Mines Branch, 1959-1963

by G. G. Eichholz\*. May 1963. 53p. Illus.

The work of the Physics and Radiotracer Subdivision of the Mines Branch during 1959-1963 is reviewed. Particular attention is drawn to the close link between industry and government laboratories in this field, which is rapidly growing in importance and is inadequately served by private facilities. A survey is provided of the major projects in radiochemistry, tracer applications, activation analysis, and the development of specialized control instrumentation. A detailed bibliography is appended.

\* Head, Physics and Radiotracer Subdivision, Mineral Sciences Division, Mines Branch.

\$1

Cat. No. M38-3/150

IC 151. *An Index of Scientific and Technical Papers Published by the Staff in 1962*

50¢.

Cat. No. M38-3/151

IC 152. *Iron Ore Pelletizing - A Literature Survey*  
by G.N. Banks\*, R.A. Campbell\*\* and G.E. Viens\*\*. August 1963. 27p.

A survey of the literature reveals wide differences in the procedures used in making iron ore pellets, and in the properties of the pellets obtained. In this paper the methods of production and the properties of pellets, as reported in the literature, are examined in an effort to determine what correlations exist between them. An attempt also is made to determine the levels of the properties of pellets which are considered acceptable and desirable in modern practice. A few cost data are included.

---

\* Scientific Officer, and \*\*Senior Scientific Officers, Pyrometallurgy and Corrosion Section, Extraction Metallurgy Division, Mines Branch.

50¢.

Cat. No. M38-3/152

IC 153. *A Survey of Niobium Alloys and Their Strengthening Mechanisms*  
by D.C. Briggs\*. July 1963. 30p. tables.

Data are listed on the composition, tensile properties, stress-rupture strengths and recrystallization temperatures of niobium and current niobium alloys. Strengthening mechanisms are reviewed with attention to the possibility of improving the high-temperature mechanical properties of niobium and niobium-base alloys. Areas of investigation are indicated in which increased knowledge would greatly aid niobium alloy development.

Present efforts in niobium alloy development are directed toward achievement of good fabrication response and high elevated-temperature strength. Coatings are being developed to provide the necessary oxidation protection. Solid solution strengthening and dispersion strengthening are the principal strengthening mechanisms operative in current alloys. Tungsten, molybdenum and vanadium are the main solution-strengthening elements, while zirconium is the chief dispersion-strengthening agent. Dispersion strengthening is considered to have high potential for future alloy development.

---

\* Scientific Officer, Refractory Metals Section, Physical Metallurgy Division, Mines Branch.

75¢.

Cat. No. M38-3/153



IC 154. Bibliography of High Temperature Condensed States Research  
in Canada, April-September, 1963

by Norman F.H. Bright\*. October 1963. 10p.

This report contains bibliographic information concerning research work on high-temperature condensed states published in Canadian journals during the period April to September, 1963.

\* Head, Physical Chemistry Section, Mineral Sciences Division, Mines Branch.

50¢.

Cat. No. M38-3/154

*SECTION 2 - PAPERS PUBLISHED IN  
PERIODICALS*

THE UNIVERSITY OF CHICAGO  
LIBRARY

## MINERAL PROCESSING DIVISION

### *Silica Sand - Canadian Sources of Interest to the Domestic Glass Industry*

by R. K. Collings, Jour. Can. Ceram. Soc., 32, p. 39-45 (1963).

There are few deposits of naturally occurring, high-purity, silica sand in Canada. However, natural sand and sandstone or friable quartzite deposits from which sand can be produced occur at numerous locations. Investigation has shown that material from many of these deposits can be upgraded to silica-sand quality. Glass sand, an extremely pure form of silica sand, produced from two Canadian deposits is being utilized by the Canadian glass industry; however, most of this industry's sand requirements continue to be imported from the United States.

This paper outlines the present trend in the consumption of glass sand in Canada, indicates present sources of silica sand, and describes several Canadian deposits that are of interest as potential sources of silica for the Canadian glass industry.

### *Industrial Minerals*

by H. M. Woodrooffe, Can. Min. Jour., p. 39-43 (Feb. 1963).

Canada's production of industrial minerals in 1962 established a new record for the fourth year in succession. Shipments of non-metallic minerals, clay products and other structural materials increased by 4 1/2 per cent to \$558,181,380 or 20 per cent of the nation's total mineral production. New production records were established for magnesium minerals, nepheline syenite, salt, elemental sulphur and cement.

### *Asbestos*

by H. M. Woodrooffe, Can. Min. Jour., p. 43-44 (Feb. 1963).

During 1962, the Canadian asbestos industry shipped 1,223,509 tons of commercial fibre valued at \$132,060,710, establishing a new record for the third successive year. All three producing provinces contributed to the increase, and for the first time British Columbia's output exceeded \$10 million in value. Although shipments of most of the principal grades showed little change from 1961, sales of Group 7 fibre increased by 10 per cent to keep pace with the growing demand from the consuming industry for short fibre.

**Durability of Concrete in Service**

discussion by N.G. Zoldners and V.M. Malhotra, Jour. Amer. Concrete Instit., Part 2, p. 2077-2080 (June 1963)

**Correlation Between Tensile Splitting Strength and Flexural Strength of Concrete**

discussion by V.M. Malhotra, Jour. Amer. Concrete Instit., p. 1268-1270 (Sept. 1963).

**Accelerated Testing of Concrete Cylinders**

discussion by V.M. Malhotra, ASTM Proc., 63, p. 1101-1103 (1963).

**Time of Set Studies**

discussion by N.G. Zoldners and V.M. Malhotra, ASTM Proc., 63, p. 901-903 (1963).

**Predicting Compressive Strength from Properties of the Fresh Concrete**

by V.M. Malhotra, Materials Research and Standards, 3, p. 483-485 (June 1963).

A statistical analysis was made of 28-day compressive strength test data from 1176 field-manufactured cylinders made with different water-cement ratios and using different size aggregate. Various properties of fresh concrete and 28-day compressive strengths were correlated, and linear regression equations were developed to predict the compressive strength of concrete. The analysis shows that 28-day compressive strength can be predicted just as accurately by selecting 50 results at random from the test data as by analyzing 1176 results.

**High-Temperature Behaviour of Aluminous Cement Concretes Containing Different Aggregates**

by N.G. Zoldners, V.M. Malhotra and H.S. Wilson, ASTM Proc., 63, p. 966-992 (1963).

For Abstract see Research Report R 109.

**Statistical Evaluation of Concrete Strength Tests**

discussion by V.M. Malhotra, Jour. of Construction Division, Proc. of Amer. Soc. Civil Engineers, 89, p. 133 (Sept. 1963).

*Technical Advances in Milling and Process Metallurgy in Canada During 1962*

by D.E. Pickett, Can. Min. Jour., p. 146-152 (Feb. 1963).

Although precious and base metal producers were assisted by the increased price realized for exported metals, the iron industry was faced by reduced prices, and the "direct ore" shippers in particular by the competition of pelletized iron ores. Marketing of "direct shipping ore" is a serious problem and research into methods of economically producing a more desirable product has top priority.

In this problem, as well as in the general problem of keeping operating costs down in the face of increasing prices of equipment and labour, the economics of old and new plants were helped greatly by the application of instrumental control. Fortunately, the last few years have seen rapid advances in this field, and the development and use of instruments for control of processing, sometimes called automation, was the distinguishing feature in milling progress in 1962.

In process metallurgy the trend was toward increasing use of gaseous and liquid fuels, particularly natural gas, instead of the conventional coke and electric power. Substitution of natural gas is meeting with success in non-ferrous reduction.

*Studies in the Preparation and Properties of Lead Zirconate-Lead Titanate Ceramics*

by T.B. Weston, Jour. Can. Ceram. Soc., 32, p. 100-115 (1963).

An investigation of the preparation and properties of piezoelectric ceramics made from lead zirconate-titanate is described. It was found possible to make reasonably good ceramics of this type from commercially-available oxide raw materials using comparatively simple procedures, but the compositional reproducibility achieved was poor, and the properties of the ceramics suffered from the presence of substantial amounts of impurities introduced during ball-milling of the constituents. Pneumatic milling greatly reduced impurity pickup, but the reproducibility achieved with oxides as starting materials was not improved. Ceramics made from powders produced by a chemical precipitation method exhibited improved properties, in some cases better than those reported in the literature for similar compositions.

### *Ceramics Today and Tomorrow*

by J.G. Brady, *Clay Products News and Ceramic Record*, 36, p. 19-20 (Nov. 1963) and 36, p. 13-14, 22 (Dec. 1963).

The materials concept has arisen from our modern approach to the study of ceramic materials where solid state theories play an important role. Examination of the properties of various ceramic materials indicates that only a fraction of the possible performance of some materials has been achieved. Properties such as refractoriness, strength, color, shape, texture, flexibility, and durability will continue to be important. Fibres, refractories, composites and oxide ceramics, which have been developed for special purposes in missiles, nuclear reactors, space vehicles, etc, may well have wide application in such fields as construction, mechanical design, and chemical equipment, etc. While little work on investigation or production of materials of this type takes place in Canadian industry at present, future developments probably will involve establishment of new plants or modifications to existing plants. It is certain that ceramic materials will be developed in the immediate future for purposes at the moment just being dreamed about.

### *Field Trip to the Gatineau Area, Quebec, Canada, Held in Conjunction With the Eleventh Clay Conference*

by J.G. Brady, J.E. Brydon, C.B. Crawford, D.D. Hogarth and P.C. Stobbe, *Clays and Clay Minerals - Proceedings of the Eleventh National Conference on Clays and Clay Minerals*, MacMillan, New York (1963).

### *Ceramic Materials in the Construction Industry*

by J.G. Brady, *CIMM Trans.*, 66, p. 325-333 (1963).

This paper discusses the ceramic products used in the construction industry in Canada, as well as the main raw materials used in their manufacture.

The products include the following: (1) clay products -- such as facing brick (glazed and unglazed), common brick, facing tile (glazed and unglazed), terra cotta, load-bearing tile, non-load-bearing tile, structural clay floor tile, quarry tile, drain tile, sewer pipe, conduits and flue liners -- which are made mainly from domestic common clays and shales and from domestic or imported stoneware clays and low-grade fire clays; (2) floor and wall tiles of the whiteware type, which are produced from ingredients such as kaolin, ball clay, feldspar, nepheline syenite, talc, pyrophyllite and wollastonite; (3) glass products -- the major ones being sheet glass, plate glass and mineral wool (glass wool, and rock or slag wool) -- which are made from such

materials as silica sand, soda ash, salt cake, feldspar, nepheline syenite, dolomitic limestone, high-calcium limestone, borax and (for rock and slag wool) various rocks or slags; (4) architectural porcelain enamels -- fired on sheet steel, aluminum or aluminum alloys -- which utilize such raw materials as quartz, feldspar, nepheline syenite, borax, titania, soda ash, soda nitre, various fluorides, lithium compounds, lead oxides, potash and many other minor ingredients.

Typical batch compositions are shown for glass, enamels, floor tile and wall tile. The value and quantity of the various products used in Canada are briefly discussed where pertinent information is available. The sources of raw materials, and their availability in Canada, are dealt with briefly.

#### *The Ceramic Industry in Canada.*

by J.G. Brady, *Ceramic Industry*, 81, p. 72 (1963).

#### *Ceramic Clays and Shales of British Columbia*

by J.G. Brady and R.S. Dean, *Jour. Can. Ceram. Soc.*, 32, p. 46-70 (1963).

For purposes of this report, twenty-two samples were selected as being typical of B.C. clays and shales available to the ceramic industry of that province. The samples include common clays or shales, stoneware clays, and fire clays. Some of these materials are being used commercially, and all can probably be used for the manufacture of ceramic products, some with difficulty.

In the present study, ceramic properties and mineralogical composition are investigated, problems associated with processing are discussed, and the results of differential thermal analysis and X-ray diffraction analyses are correlated with ceramic properties.

#### *Dense Lithium Fluoride for Gamma-Ray-Free Neutron Shielding.*

by V.D. Svikis, *Nuclear Instruments and Methods*, 25, p. 93-105 (1963).

A simple method of processing powdered LiF into dense and strong LiF, suitable for self-supporting neutron shielding, was developed. The processing was carried out in two stages. In the first stage, chemically pure LiF powder was slip-cast and sintered for periods from 1 to 5 hours at temperatures ranging from 500° to 840°C, in order to establish the best conditions for making dense and volume-stable LiF aggregate. Aggregates were prepared with densities in the range 52 to 92% of theoretical, depending on sintering temperature and time. Maximum density was achieved by sintering at 700°C for 3 hours.



In the second stage, dense and stabilized LiF aggregate was graded, pressed into shapes at 4000, 6000 and 8000 psi, and heated at 600° and 800°C to find the best conditions for making dense compacts. LiF compacts, as large as 8 3/4 by 4 1/2 by 3 in., with densities in the range 78 to 85% of theoretical, were prepared. Maximum density and good mechanical strength was attained when the graded aggregate was pressed into shapes at a pressure of 8000 psi and the shapes were heated for five hours at 800°C. The material can be cut and machined to close, dimensional tolerances.

### *A Study of the Condensation of Binary Vapors of Miscible Liquids.*

#### *Part 2: Heat Transfer Co-efficients for Filmwise and Non-Filmwise Condensation*

by V. V. Mirkovich and R. W. Missen, *Can. Jour. Chem. Eng.*, 41, p. 73-78 (April 1963).

Heat transfer coefficients for total condensation at 750 mm. Hg of saturated, binary vapors have been measured for the four systems n-pentane + n-hexane, methanol + methylene dichloride, n-pentane + methanol, and n-pentane + methylene dichloride. Condensation was entirely filmwise for the first two systems, but was non-filmwise (dropwise in the extreme) for the last two at low temperature differences for solutions dilute in n-pentane. In the non-filmwise cases the heat transfer coefficients are greater than expected for filmwise condensation, but the difference is not nearly as great as occurs for steam condensation. This indicates the existence of a resistance in the vapor film for mixtures, as postulated by Colburn and Drew in 1937. Dropwise condensation of vapor mixtures does not require a promoter, and indicates that interfacial tension forces may not always be neglected in considering the stability of homogeneous condensate films for mixtures.

### *A Comparative Method and Choice of Standards for Thermal Conductivity Determinations*

by V. V. Mirkovich, *Proc. Third Thermal Conductivity Conference (USAEC), Gatlinburg, Tenn.*, 1, p. 342-352 (Oct 16-18, 1963).

An improved version of the comparative method thermal conductivity apparatus was designed. The accuracy of measurement was determined by measuring the conductivity of alumina with standards made of the same alumina, and by cross-checking the conductivities of alumina, forsterite, Pyroceram Code 9606 and zirconia. The thermal stability of Pyroceram Code 9606 and zirconia was examined in order to establish their value as thermal conductivity reference materials. It was concluded that: (1) with this apparatus, accurate thermal conductivity data can be obtained; and (2) Pyroceram Code 9606 can be recommended for use as a primary standard for the low thermal conductivity range.

## EXTRACTION METALLURGY DIVISION

### *Development of a Chemical Process for Production of Cesium Chloride from a Canadian Pollucite Ore.*

by H. W. Parsons, J. A. Vezina, R. Simard, and H. W. Smith, *Can. Met. Quart.*, 2, p. 1-13 (Jan-Mar, 1963).

A chemical process have been developed for the production of a high-purity cesium chloride from a pollucite (cesium aluminum silicate) ore from the Manitoba deposit of Chemalloy Minerals Ltd. The history of the deposit, and the present and possible future uses of cesium are briefly reviewed. Laboratory and pilot plant investigations on this ore have shown that a cyclic sulphuric acid leach followed by fractional crystallization will produce a rubidium-free cesium alum, which can be converted to cesium chloride by thermal decomposition and ion exchange. On the basis of these findings it is concluded that the process is applicable to the tonnage production of cesium chloride. Reagent consumption was found to be 3.3 lb sulphuric acid and 0.3 lb hydrochloric acid per pound of cesium extracted. Overall extraction of cesium was 95 to 96%.

### *Two-Stage Flotation Treatment of Uranium Ore from Faraday Uranium Mines Limited*

by W. R. Honeywell and V. F. Harrison, *CIMM Trans.*, 66, p. 280-284 (1963).

Two series of laboratory flotation tests were carried out to study the treatment of Faraday ore by two-stage flotation. First the acid-consumers and then the uranium minerals were floated.

On ore ground in the Faraday mill grinding circuit, and using Faraday mill water in the flotation step, a recovery in the flotation concentrate of from 91 to 93 per cent of the uranium was obtained in 45 to 50 per cent of the weight at a grade of 0.24 per cent  $U_3O_8$ . The saving of acid in leaching the uranium-bearing flotation concentrate, as compared to leaching the whole ore, ranged from 30 to 46 per cent. The average over-all extraction resulting from flotation and leaching of the flotation concentrate was 88.1 per cent.

The best collector for the acid-consumers was sodium oleate. Acintol FA-1 emulsion was the best collector for the uranium minerals, and, in the uranium flotation step, an acid pH in the slurry was found to be necessary. The reagent costs were estimated to be 22 to 26 cents per ton of ore.

**Gold Mines Seek to Improve the Cyanidation Process**

by K. W. Downes, Northern Miner, Annual Review Number, p. 23 (Nov. 28, 1963).

Although much has been written about the cyanidation process, the operator of a gold mill will still look in vain for a simple handbook telling him how to run a cyanide circuit. The complexities of the process chemistry are sufficient to have puzzled some very experienced metallurgists, and it is too much to expect that the individual mill superintendent, occupied as he is with the day-to-day operation of a plant, and with the very limited laboratory facilities generally available in a gold mill, will be able to solve all the problems that can arise.

It was in recognition of this fact the Mines Branch proposed to a number of gold mine managers that detailed examinations of some gold milling circuits be made. The object of these examinations was to determine exactly what was going on in some representative cyanide circuits by using both conventional analytical methods and in addition some new techniques which had been developed at the Mines Branch.

**Kinetic Studies on the Thermal Decomposition of Calcium Carbonate**

by T.R. Ingraham and P. Marier, Can. Jour. Chem. Eng., p. 170-173 (August, 1963).

For Abstract see R 118, page 11.

**Thermodynamic Properties of Zinc Sulfate, Zinc Basic Sulfate, and the System Zn-S-O**

by T.R. Ingraham and H.H. Kellogg, Trans. AIME, 227, p. 1419-1425 (December, 1963).

For Abstract see R 122, page 13.

**Kinetics of the Reaction of Niobium Pentachloride With Water Vapor**

by T.R. Ingraham and B.J.P. Whalley, Can. Jour. Chem. Eng., p. 265-268 (December, 1963).

For Abstract see R 123, page 14.

## MINERAL SCIENCES DIVISION

### *The Use of a Pulse-Height Analyser as a Curve Plotter*

by J.D. Keys, Jour. Sci. Inst., 40, p. 44, January, 1963.

The determination of diffusion coefficients, even with the aid of a computer, is a rather tedious process in those cases where the boundary conditions result in error function complement curves and when the surface concentration  $C_0$  is not known. It is the purpose of this note to draw attention to a simple analogue method of plotting a series of error function complement curves from which, in a particular experiment, both  $C_0$  and the diffusion coefficient  $D$  can be obtained by curve matching. Results can be obtained to any desired accuracy by producing a sufficiently large number of the curves, and may be used to provide starting values for computer programming.

### *Fluorescence Effects in Ion Exchange Resins*

by T.R. Flint and G.G. Eichholz, Can. Jour. Chem. Eng., 41, p. 33-37, February, 1963.

Fluorescence under ultraviolet illumination has been observed in anion and cation exchange resins when in the unloaded state. This fluorescence decreases rapidly in intensity as the resin is loaded and this process has been shown to offer a practical method for controlling the loading and elution cycles in ion exchange operations.

The relative effectiveness of different resins and various ions on this fluorescence quenching process has been determined and some correlation has been found between quenching efficiency and ionization potential of the elements. The measurements have shown adequate stability and reproducibility for industrial control applications.

### *The Use of Radioisotopes and Special Instrumentation for Process Control and Development in the Mineral and Metal Industries*

by G.G. Eichholz, United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, Paper D/26, February, 1963. See Information Circular IC 149.

The opening up of the mineral resources of less-developed areas can be broken down into the usual three phases through which any industrial development must pass: exploration, process development, and routine processing. To these should perhaps be added long-term research as a fourth phase usually associated only with more advanced technologies. Each of these phases has its own specialized requirements for equipment, some of which depend heavily on the available

personnel and their relevant skills. It is this interplay of improved process efficiency by semi-automatic controls and its requirements for skilled personnel that will be discussed here as it applies to resources development in underdeveloped areas.

*Radiation Effects on p- and n- Type Catalysts Used in the Thermal Dissociation of Ethyl Alcohol*

by Matteo Donato, Jour. Phys. Chem., 67, p. 773 (1963).

The dissociation of anhydrous ethyl alcohol has been studied over the temperature range 330-430° with the employment of catalysts that had been exposed to a range of estimated "integrated" neutron doses of up to  $96.6 \times 10^{18}$  n./cm. <sup>2</sup>. The catalysts are ZnO, an n-type semiconductor, prepared by decomposition of the carbonate, and Cr<sub>2</sub>O<sub>3</sub>, a p-type semiconductor, prepared by dehydration of the hydroxide. Measurable changes in yield and decomposition mechanism have been observed as compared with the unirradiated catalysts. The variation in the behavior of the catalysts has been related to the various neutron doses received and the results are discussed in the framework of the electronic theory of catalysis on semiconductors.

*Magnetic Assay Unit for Iron Ore and Concentrates*

by G.E. Alexander and G.G. Eichholz, Can. Met. Quart., 2, p. 187-196 (Apr. - June, 1963).

A simple and inexpensive unit for the assaying of magnetic iron ore and concentrates has been designed by modifying a commercial "Q-meter" impedance bridge. This unit permits the rapid examination of wet or dry samples of standard volume for magnetic iron content, and this appears to meet requirements for a simple system for immediate control of ore feed and of magnetic roaster products. Tests have been conducted that show good correlation with the results obtained with other conventional magnetic determinations, such as the Davis tube. The advantages of speed and simplicity of sample preparation seem to offset any likely loss in accuracy. Units of this general type appear to be suitable for adaptation for control of ore feed or kiln products.

**Diffusion and Solid Solubility of Silver in Single-Crystal Bismuth Telluride**

by J.D. Keys and H.M. Dutton, *J. Phys. Chem. Solids*, 24, p. 563-571 (1963)

The anisotropic diffusion and the solid solubility of silver in single-crystal bismuth telluride have been measured by radioactive tracer techniques employing silver-110 and silver-111. The diffusion coefficient perpendicular to the cleavage planes is given by

$$D_{\perp} = 5.1_{-1.0}^{+2.1} \times 10^{-8} \exp\left(\frac{-0.92 \text{ eV}}{kT}\right)$$

and that parallel to the cleavage planes by

$$D_{\parallel} = 5.4_{-1.7}^{+2.0} \times 10^{-8} \exp\left(\frac{-0.45 \text{ eV}}{kT}\right)$$

The solid solubility has a maximum of  $1.5 \times 10^{20}$  atoms/cm<sup>3</sup> (2.5 atom per cent) and the variation of solid solubility with temperature is shown to be consistent with the existing knowledge of the silver-bismuth-tellurium system.

**Diffusion and Solid Solubility of Gold in Single-Crystal Bismuth Telluride**

by J.D. Keys and H.M. Dutton, *J. Appl. Physics*, 34, p. 1830-1831 (June, 1963).

Radioactive gold-198 has been used to measure the solid solubility and anisotropic diffusion of gold in single-crystal bismuth telluride. Although agreement between authors is not complete, there now exist results for the diffusion of all group IB elements in this compound.

**Tartrate Complexes of the Rare-Earth Elements - I. The d-, dl-, and meso-Tartrate Complexes of Tb and Eu**

by P.G. Manning, *Can. Jour. Chem.*, 41, p. 2557-2565 (1963).

Solvent extraction and radiotracer techniques have been applied to the study of metal-tartrate ion association in water at 25°C. Trace concentrations of the radioisotopes Tb 160 and Eu 152/154 were equilibrated between aqueous sodium tartrate solutions and organic phases of thenoyltrifluoroacetone in toluene. The ionic strength (0.0597) and the pH (4.53) of the aqueous phase were kept constant by means of sodium perchlorate and sodium acetate.

Metal complexing with the d-, dl-, and meso isomers of the ligand was examined. For all isomers two complex species were

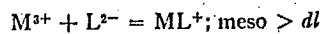
identified with metal:ligand ratios of 1:1 and 1:2, and stability constants for both stages of ion association have been estimated. No third (1:3) complex was detected.

Metal coordination numbers and the formation of tartrate-tartrate hydrogen bridges in the 1:2 complex are discussed.

**Tartrate Complexes of the Rare-Earth Elements - II. The dl- and meso-Tartrate Complexes of La, Ce, Pm, Tm, and Y**  
by P.G. Manning, Can. Jour. Chem., 41, p. 2566-2574 (1963).

The liquid-liquid distribution method has been used to measure the stability constants of the dl-tartrate complexes of La<sup>3+</sup>, Ce<sup>3+</sup>, Pm<sup>3+</sup>, Tm<sup>3+</sup>, and Y<sup>3+</sup>, and the meso-tartrate complexes of Ce<sup>3+</sup> and Tm<sup>3+</sup>. Thenoyltrifluoroacetone was the organic phase extractant, and the aqueous phase, acetate buffered (pH = 4.53), was maintained at a constant ionic strength (0.0597) by means of sodium perchlorate.

The order of stabilities for the two stages of ion association are



The  $b_1/b_2$  values, where  $b$  is a stepwise stability constant defined as

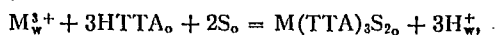
$$b_n = [ML_n^{(3-2n)+}] / [ML_{n-1}^{(3-2n)+}][L^{2-}]$$

are lower (by factors of 4-8) for the dl-tartrates than for the meso-tartrate complexes. The  $b_1/b_2$  ratios decrease as the ionic radius of the metal ion decreases, and for the dl-tartrates of Tb<sup>3+</sup>, Y<sup>3+</sup>, and Tm<sup>3+</sup>, the  $b_1/b_2$  values are 5.3, 5.0, and 4.3 respectively. The enhanced stabilities of the 1:2 ( $ML_2^-$ ) dl-tartrate chelates have been interpreted in terms of ligand-ligand hydrogen bridging in the 1:2 complex.

**Steric Effects in the Synergic Extraction of the Lanthanides, Yttrium, and Scandium**  
by P.G. Manning, Can. Jour. Chem., 41, p. 658-666 (1963).

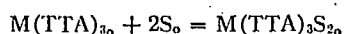
From a study of the partitioning of the carrier-free radioisotopes Tm<sup>170</sup>, Ce<sup>144</sup>, Eu<sup>152/154</sup>, Tb<sup>160</sup>, Lu<sup>177</sup>, and Y<sup>91</sup> between nitric acid and organic solutions containing various proportions of thenoyltrifluoroacetone (HTTA) and dialkyl alkyl phosphonates (S) in

odorless kerosene, concentration equilibrium constants ( $k_2$ ) have been computed for the reaction



where M represents a metal ion, and "w" and "o" are aqueous and organic species respectively.

When used in conjunction with the data of Bronaugh and Suttle, the equilibrium constants determined in this study yielded comparative equilibrium constants ( $k_3$ ) for the solvation process



for the rare-earth metals listed.

In the extraction of Sc<sup>46</sup>, however, the species extracted is dependent on the alkyl groups of the phosphonates, the butyl and 2-ethylhexyl derivatives giving mono- and di-solvates respectively.

It is concluded that steric effects are dominant in these synergic systems.

#### **Corrosion Resistance of Type 329 Stainless Steel in Nitric Acid Containing Chloride Ion**

by Irvine I. Tingley, *Corrosion*, 19, p. 408t-413t (December, 1963).

Type 329 stainless steel, previously found to have a corrosion resistance markedly greater than that of Types 316, 304L and 309SCb in the condensing vapors from solutions of 7.5N HNO<sub>3</sub> and 0.2N HCl, has been found resistant in similar solutions with Cl contents up to 0.38N. Welded specimens of Type 329 must be fully annealed to prevent severe intergranular attack in the heat-affected zone when immersed in boiling solutions of the above-mentioned compositions. The mechanism of the attack and the influence of accumulated chromic and ferric ions are discussed. The behavior of severely stressed specimens of this steel in these solutions was also investigated and compared with that of Type 316 specimens.

#### **A Scheme for the Separation of Platinum, Palladium, Rhodium, and Iridium by Solvent Extraction**

by G. H. Faye and W. R. Inman, *Anal. Chem.*, 35, p. 985-988 (July, 1963).

A new scheme is described for the fractionation of solutions containing microgram or milligram quantities of platinum, palladium, rhodium, and iridium by solvent extraction procedures. The iodide



complexes of platinum and palladium are extracted with tributyl phosphate, and thereby separated from rhodium and iridium. Modifications and extensions of existing methods are used for the separation of palladium from platinum and for the separation of iridium from rhodium. The addition of phosphoric acid improves the precision of the stannous chloride-hydrobromic acid method for the spectrophotometric determination of iridium.

#### ***Ixiolite - A Columbite Substructure***

by E. H. Nickel, J. F. Rowland and R. C. McAdam, *Amer. Mineral.*, 48, p. 961-979 (1963).

Ixiolite, first described in 1857 and mentioned in the literature only a few times since then, has generally been regarded as a discredited mineral species. A re-examination of samples from the type locality in Finland, however, has provided significant new information indicating that ixiolite is a valid species with distinctive characteristics. X-ray diffraction studies show that ixiolite is orthorhombic with  $a = 5.73$ ,  $b = 4.74$  and  $c = 5.16\text{Å}$ , space group Pcan. The unit-cell content is  $(\text{Ta}, \text{Fe}, \text{Sn}, \text{Nb}, \text{Mn})_4\text{O}_8$ . The ixiolite unit-cell is a sub-cell of columbite, with similar parameters except for  $b$ , which is one-third of the columbite  $b$  parameter. Structurally, ixiolite can be regarded as a disordered form of columbite.

#### ***Wodginite - A New Tin-Manganese Tantalate from Wodgina, Australia and Bernic Lake, Manitoba***

by E. H. Nickel, J. F. Rowland and R. C. McAdam, *Can. Mineral.*, 7, p. 390-402 (1963).

The name wodginite is proposed for a mineral found at two widely separated localities -- Wodgina, Australia and Bernic Lake, Manitoba. The mineral is monoclinic, space group  $C2/c$  or  $Cc$ , with cell parameters of  $a = 9.52\text{Å}$ ,  $b = 11.47\text{Å}$ ,  $c = 5.10\text{Å}$  and  $\beta = 91^\circ 18'$  (Wodgina) and  $a = 9.47\text{Å}$ ,  $b = 11.42\text{Å}$ ,  $c = 5.09\text{Å}$  and  $\beta = 91^\circ 02'$  (Bernic Lake). Its composition is expressed by the formula  $A_{16}\text{O}_{32}$ , where  $A$  represents chiefly Ta, Sn and Mn, with lesser amounts of Nb, Fe and Ti. The relationship of wodginite to columbite-tantalite, ixiolite and olovotantalite is discussed.

#### ***Eudidymite from Seal Lake, Labrador, Newfoundland***

by E. H. Nickel, *Can. Mineral.*, 7, p. 643-649 (1963).

Eudidymite is an accessory mineral in the soda-rich paragneiss at Seal Lake, Labrador. Its chemical composition is as follows:  
 $\text{Na}_2\text{O}$  12.20%,  $\text{K}_2\text{O}$  0.39%,  $\text{BeO}$  10.15%,  $\text{SiO}_2$  73.56%, and  $\text{H}_2\text{O}$  3.62%;

total 99.92%. The unit cell is slightly smaller than that of the Langesundfjord eudidymite; other physical and optical properties also show minor differences. These differences are believed to be related to variation in the Be:Si ratio in eudidymite.

**A Manganese Occurrence on Queen Charlotte Islands, B.C.**  
by W. Petruk, *Can. Mineral.*, 7, p. 670-673 (1963).

The deposit occurs on Klashwun Point on the north side of Graham Island. According to H. R. Morris, who very briefly examined the property in company with W. H. Myres, the manganese occurs along a shear zone that varies from 5 to 10 feet in width, and consists essentially of gouge and breccia. Manganite and pyrolusite occur as a cementing medium in the breccia, forming pods of manganese-bearing material up to 30 feet in length.

**Niobian Perovskite from Oka, Quebec; A New Classification for Minerals of the Perovskite Group.**

by E. H. Nickel and R. C. McAdam, *Can. Mineral.*, 7, p. 683-697 (1963).

Niobian perovskite from the southwestern portion of the Oka complex has been found to contain from 14.5 to 44.9%  $Nb_2O_5$ . A chemical analysis of one perovskite sample gave the following results: CaO 25.95%;  $Na_2O$  4.03%; rare earth oxides 2.03%;  $K_2O$  0.03%;  $Nb_2O_5$  43.90%;  $TiO_2$  10.05%;  $Fe_2O_3$  8.74%; MgO 2.20%; MnO 0.77%;  $SiO_2$  0.45%; S 0.90%; and L.O.I. 0.65%. X-ray powder diffraction data indicate that this perovskite is orthorhombic with cell parameters  $a = 5.448$ ,  $b = 7.777$  and  $c = 5.553 \text{ \AA}$ , and space group Pcmn. The unit-cell size of the perovskite decreases with decreasing niobium content.

A classification scheme based on the valency of the A cation is proposed. According to this classification, minerals of the perovskite group are classified as lueshite, perovskite and loparite, respectively, depending on whether the A cation is monovalent (Na), divalent (Ca) or trivalent (Ce). The modifier niobian is used to designate varieties containing a substantial amount of niobium.

**Determination of Copper in High-Purity Niobium, Tantalum, Molybdenum and Tungsten Metals With Bathocuproïne**

by Elsie M. Penner and W.R. Inman, *Talanta*, 10, p. 407-412 (1963)

A spectrophotometric method for determining 0.0005-0.125% of copper in high-purity niobium, tantalum, molybdenum and tungsten metals is described. After sample dissolution and reduction of copper to the univalent state with ascorbic acid, the yellow complex formed by copper and bathocuproïne (2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline) is extracted into n-amyl alcohol and the absorbance of the resulting extract is determined at 476 m $\mu$ . Other impurities present in the four high-purity metals described do not interfere in the proposed method.

**Determination of Nickel in High-Purity Niobium, Tantalum, Molybdenum and Tungsten Metals by Chloroform Extraction of Nickel Dimethylglyoximate**

by Elsie M. Penner and W.R. Inman, *Talanta*, 10, 997-1003 (1963).

A spectrophotometric method for determining 0.0005-0.10% of nickel in high-purity niobium, tantalum, molybdenum and tungsten metals is described. After sample dissolution and pH adjustment to 6.0, nickel dimethylglyoximate is extracted with chloroform from an ammonium tartrate-boric acid medium. The chloroform extract is washed with dilute ammonia solution to remove interfering impurities, and nickel is determined spectrophotometrically at 370 m $\mu$  directly in the extract.

## FUELS AND MINING PRACTICE DIVISION

### *Comparative Costs of Handling Coal and Residual Oil in Large Steam Plant*

by C. E. Baltzer, Proc. Fifteenth Dominion-Provincial Conference on Coal, Halifax, N. S. (Sept. 19-20, 1963).

The main purpose of this paper - "Comparative Costs of Handling Coal and Residual Oil" - is to discuss the charges applying to the handling of the two fuels from the point of receipt at the plant to the boiler burners in large steam generating equipment such as is used in the electric utility industry. As will be realized, this is only one small segment of the overall costs applying to the operation of a modern steam-electric generating station and the system or systems with which it is interconnected.

Since there are no published statistical data applicable to Canadian generating stations covering the elements associated with these particular charges (or, for that matter, costs of any kind associated with the production of electrical energy), recourse must be made to American data that are freely available on a continuing basis from several sources.

### *Composition of Athabasca Bitumen Fractions as Determined by Structural-Group Analysis Methods*

by M. L. Boyd and D. S. Montgomery, K. A. Clark Volume, A Collection of Papers on the Athabaska Oil Sands, Research Council of Alberta Information Series 45, p. 101-108 (Oct. 1963).

The bitumen contained in an 11-kilogram sample of Abasand bituminous sand was separated into a series of fractions by solvent extraction, and subsequent elution chromatography on fuller's earth and silica gel. The chemical structure of twelve of these fractions has been studied. A quantitative estimate of the number of methyl and methylene groups has been made from the infrared spectrum. The aromaticity has been determined by van Krevelen's graphical densimetric method for the asphaltene and resin components and by the n-d-M method for the oil components. A method of structural-group analysis developed by the authors has also been applied. In this case, the composition has been expressed in terms of five hydrocarbon groups. This method consisted of a correlation of the following properties: the elementary composition, molecular weight, density (20°C), refractive index ( $n_D^{20}$ ), and the aromaticity. It has been shown that the composition of these fractions varies from a colourless, saturated oil of molecular weight 360 containing three rings per average molecule, to a black-brown solid of molecular weight 2500, in which half of the carbon atoms were aromatic and whose average molecule contained 23.6 rings.

**A Study of the Oil Component of the Athabasca Bitumen**

by M. L. Boyd and D. S. Montgomery, Jour. Instit. of Petroleum 49, No. 479, p. 345-352 (November, 1963).

The oil component, which constituted 33 per cent of the Abasand bitumen, was resolved into a series of fractions by elution chromatography on silica gel. The saturated fraction, as well as the most aromatic portion, were further resolved on activated carbon. The following properties were determined for most of the fractions thus prepared: elementary analysis, molecular weight, density (20°C), refractive index ( $n_D^{20}$ ) dispersion, aniline point, the ultra-violet spectrum, and the infra-red spectrum. Quantitative estimates of the number of methyl and methylene groups have been made from the infra-red spectra. The major fractions were characterized by the application of a representative group of structural analysis methods which determine the percentage of carbon atoms in aromatic rings, naphthenic rings, and paraffinic side chains. The hydrocarbon skeletal structure expressed in terms of five hydrocarbon groups was also determined by a method developed by the authors. It was possible to separate out about one-third of the oil component as totally saturated material. The remainder of the material was separated into a series of fractions that contained increasing proportions of aromatic carbon atoms up to about 35 per cent. On the average, the oil fractions would appear to contain three rings per molecule.

**Methods for Measuring the Dynamic Properties of Rock:**

by Paul LeComte, Proc. Rock Mechanics Symposium, Queen's University, Kingston, Ontario, December 6-7, 1963, p. 15-26. (Published by Mines Branch, Dept. of Mines and Technical Surveys, Ottawa).

The methods used in the laboratory for determining the mechanical properties of rocks have been arbitrarily divided into static and dynamic methods, the division being based primarily on the rate of loading of the specimen. If the loading of the specimen is slow, as in uniaxial or triaxial compression tests, the method is called a static one; but if the rate of loading is rapid, as in vibration tests, it is called dynamic.

Although dynamic methods of testing rocks are numerous, there are only two principles on which these methods are based and this naturally leads to a twofold grouping. These are a) the methods based on the theory of vibrations, or resonance methods, and b) those based on the theory of wave propagation, or pulse methods.

The purpose of this paper is to review briefly the principles on which the dynamic methods of testing are based. The merits of the different methods are compared and the uses that can be made of the results are discussed.

***Deformation Around a Mine Shaft in Salt.***

by K. Barron and N.A. Toews, Proc. Rock Mechanics Symposium, Queen's University, Kingston, Ontario, December 6-7, 1963, p. 115-136, (Published by Mines Branch, Dept. of Mines and Technical Surveys, Ottawa).

The recovery of potash from the vast deposits in Saskatchewan has presented conditions unique in Canadian mining history. Recognizing this, The International Minerals and Chemical Corporation (Canada) Ltd. proposed that research be initiated, in both the potash and the overlying salt, to obtain information pertinent to mine design, stability, safety and economy. This resulted in a cooperative research program involving the company, Dr. S. Serata, consultant, and the Mines Branch, Dept. of Mines and Technical Surveys, Ottawa.

Initial studies were made in the unlined portion of the shaft in the salt above the potash beds. Measurements were made of displacements, relative to the shaft axis, of points on the surface of the shaft and within the solid surrounding the shaft. A diametral extensometer and an extensometer to measure the longitudinal deformation of boreholes around the shaft were used.

The objective of these measurements was to obtain data on the creep (or deformation as a function of time) of salt around a simple opening and to correlate this data with theoretical ideas on the behaviour of the material.

***Efficient Burning of Eastern Canadian Coals***

by E.R. Mitchell, F.D. Friedrich, R.G. Fohse, L.B. Geller and G.K. Lee, Fifteenth Dominion-Provincial Conf. on Coal, Halifax, N.S., (Sept. 19-20, 1963).

Through a broad research program it has been demonstrated that Eastern Canadian coals can be burned as efficiently and conveniently as competitive fuels provided that suitable equipment is made available. Much has been learned about the features that are necessary to make equipment technically suitable, but economics govern the extent to which they can be applied. The electric utility industry can well afford to apply a high degree of technology, but similar refinements for smaller classes of equipment are out of the question. Thus, there are certain limitations within which engineering advances can be expected. Many existing large stokers with a capacity exceeding 500 lb coal/hr are amenable to modification and new ones can be adequately designed, sometimes at extra cost. On the other hand, only limited improvements can be made to small stokers with a capacity below 500 lb coal/hr because they are the underfeed type; in this size range a new, automatic and simpler firing concept is needed. One described in this paper seems to hold promise both as a conversion stoker and as part of a packaged boiler.

**National Report - Canada**

by T.S. Cochrane and A. Ignatieff, Conf. Inter. sur l'Avancement Rapide Dans les Chantiers d'Exploitation des Mines de Houille, Institute National de l'Industrie Charbonniere, Liège, (1963).

**Pull-Tests as a Measure of Roof Bolt Efficiency and of Roof Bolt Design**

by T.S. Cochrane and F. Grant, Can. Min. and Met. Bull., 56, p. 877-879 (Dec. 1963).

A variety of practical tests have been tried in the mining industry to determine the support properties of mine roof bolts. Such tests include torsion wrench readings, hammer blow tests and the use of plates with built-in tension indicators. This paper gives some details of pull tests with a hydraulic jack, as carried out in coal mines of Western Canada.

**Development of a Model for a Mine Structure**

by K. Barron and G. Larocque, Can. Min. Jour., p. 43-50 (August 1963).

This paper describes the development of a structural model for an iron ore mine for the purpose of determining stress distributions around openings. The requirements for similitude between the model and the prototype are discussed in relation to the detailed properties of the prototype. Plaster of Paris was chosen as the model material. Different mixes enabled model materials with large, controlled variation of physical properties to be made in order to obtain similitude with the properties of the various rock types. The techniques used in construction of the model and the loading frame are described. Instrumentation for the measurement of internal and surface strains in the model and for load measurement is described. Results of initial loading experiments are given and discussed. The future testing program is considered.

**Mining Research Advances on Several Fronts**

by M.A. Twidale, Northern Miner Annual Review, p.33, (Nov.28, 1963).

(A review of new developments by industry, government and university groups).

***Strain-Time-Strength Relationships in a Marine Clay***

by D. F. Coates, K. N. Burn, G. C. McRostie, Trans. Eng. Instit. of Canada, Vol. 6, (1963).

Although the variation of shear strength of cohesive soils with the duration of stress has been examined by several investigators, allowance for this effect is not wide-spread in foundation engineering design. This situation exists owing to the lack of sufficient information on the various causes of change in shear strength with time and of established techniques for determining the basic properties. For example, an apparent change in shear strength can occur with a change in pore pressure. Considerable research has been done on this subject in saturated soils, which may be used in engineering analysis and design. However, the experimental techniques for measuring pore pressures on planes of failure has not yet been satisfactorily established, which raises some doubts on the conclusions based on pore pressure measurements at the ends of samples. Where this mechanism applies the passage of time in the field may lead to greater or lesser stability depending on the initial conditions.

Alternatively, a change in shear strength in some soils may result from a viscous reaction to stress. In other words, the soil at some stress levels or some magnitudes of shear stress behaves like a viscous medium which, given sufficient time, may produce excessive strains or even failure. Where such a mechanism operates the passage of time cannot be expected to lead to increased stability.

***Rock Mechanics Applied to the Design of Underground Installations to Resist Ground Shock from Nuclear Blasts***

by D. F. Coates, Rock Mechanics Proceedings, 5th Symposium, University of Minnesota, p. 535-562 (May 1962).

Analyses of some of the problems facing the designer of underground installations that are required to resist the effects of nuclear explosions are presented. The problems that are considered are restricted to those involving rock mechanics. In addition, consideration is only given to those installations requiring relatively large chambers.

Underground installations of this nature are generally permanent. Hence they cannot be treated exactly like mining openings. For example scaling of walls and backs may not be possible after the installation is completed; rehabilitation and replacement of sets in deteriorated sections generally is not possible; support such as rock bolting must resist corrosion. Also, the shape of openings cannot normally be modified after experience has indicated the nature of ground reaction.



Many of the analyses involve the use of elastic theory, which provides a point for criticism. However, aside from the fact that there is little other theory that is as serviceable, use of elastic theory has some justification. For dynamic loads many rocks produce straight line stress-strain curves, at least on the loading cycle, which generally satisfies the principal requirement of elasticity. Also, other ground reactions, e.g. visco-elastic, plasto-elastic, elasto-plastic, etc., can be considered as modifications of the answer obtained from the elastic solution. The solutions for these other materials must still include the same equilibrium equations and boundary conditions. The compatibility equations will be different. Hence the elastic solution can always be considered as a first approximation and, if necessary, extrapolation can be by judgment.

### ***Some Physical Properties of Rocks and Their Relationship to Uniaxial Compressive Strength***

by D. F. Coates, J. E. Udd, R. G. K. Morrison, Rock Mechanics Proceedings, Symposium, McGill University, p. 27-51 (1963).

The results of laboratory testing of mine rocks by graduate students at McGill University are presented; compression, tension, torsion and shear tests were used. The results are analysed for any relationship they might have to uniaxial strength of each rock.

A critique of the uniaxial compression tests is then presented. This section examines the information that exists on the detailed stress distribution in the sample together with the empirical relationships between size, shape and maximum stress sustained by the sample. The areas requiring more research are then identified.

### ***Analysis of Pit Slides in Some Incompetent Rocks***

by D. F. Coates, K. L. McRorie, J. B. Stubbins, Trans. AIME, Vol. 226, p. 94-101 (March 1963).

Twenty-two pit slides that occurred in two Canadian open pit mining properties are analyzed. Information on the results of laboratory tests of the rocks and a brief description of the geological environment are also presented. One deduction from the study is that slides seem to be predictable by using established theory. This corroboration indicates that, contrary to normal mining practice, the appropriate slope angle should vary with the height of the wall. In addition, if the general ground water level around an open pit can be reduced, the appropriate slope angles of the walls could then be increased by a determinable amount. The ultimate objective of these investigations is to determine the relationship between the percentage probability of failure of any slope designed with specific strength parameters. With this relationship it would then be possible to determine optimum slope angles.

## PHYSICAL METALLURGY DIVISION

### *Grain Boundary Segregation of Thallium in Tin*

by F. Weinberg, Trans. Met. Soc. AIME, 227, p. 223-230 (Feb. 1963).

The relative concentration of Tl<sup>204</sup> at grain boundaries in controlled orientation bicrystals has been examined by autoradiographic techniques, and by activity measurements of grain boundary surfaces exposed by preferential melting. The autoradiographs indicate that thallium is concentrated at grain boundaries in as-grown bicrystals, but not in well-annealed bicrystals. They also indicate that the solute concentration and the distribution on as-grown bicrystal surfaces are markedly different than that of the bulk material.

### *Growth Substructure in Rapidly Solidified Zn-2 Pct Au Alloys*

by F. Weinberg, Trans. Met. Soc. AIME, 227, p. 276-278 (Feb. 1963).

A very regular growth substructure was observed in Zn-2% Au alloys rapidly frozen by pouring the molten metal in water. A similar substructure was not observed for alloy additions other than Au. The preferential etching of the Au depleted region at the substructure boundary is attributed to microporosity.

### *Solute Distributions in Directionally Solidified Rods of Dilute Sn-Ag Alloys*

by F. Weinberg, Trans. Met. Soc. AIME, 227, p. 231-238 (Feb. 1963).

The distribution of solute during the progressive solidification of dilute Sn-Ag alloys was determined in both solid and liquid as a function of growth rate, rod diameter, temperature gradient, and solute concentration, using radioactive tracer techniques. The results indicated that partial mixing occurs in the liquid during freezing for most of the conditions investigated, approaching complete mixing for larger rod diameters (> 2 mm) and slow growth rates.

### *The Solidification of Dilute Binary Alloys*

by F. Weinberg, Trans. AIME, 227, p. 112-124 (Feb. 1963).

Dilute binary alloys have been solidified under controlled thermal conditions, and solute distributions, temperatures during freezing and melting, and the position and morphology of the solid-liquid interfaces have been examined. Binary Zn, Sn, and Pb based alloys were investigated with solute additions of Ag<sup>110</sup>, Au<sup>198</sup>, Sn<sup>124</sup>, Tl<sup>204</sup>, Sn<sup>113</sup>, and Zn<sup>65</sup>. Appreciable solute segregation occurred in most of the ingots, depending on the solute concentrations, distribution coefficients,

and freezing conditions of the alloys. Measurements were made of the general solute distribution by sectioning layers of material from the ingot circumference and counting the activity of each layer.

#### ***Welding of Steel at Low Ambient Temperatures:***

by K. Winterton, W.P. Campbell and M.J. Nolan, *Welding Research Bull.*, No. 86, 27 pp (March, 1963).

It has long been recognized that problems exist when welding is attempted at low ambient temperature. This is reflected in the restrictive clauses inserted in many specifications and codes. However, the nature and causes of these difficulties have never been clearly defined. This report considers the welding of steel at low ambient temperatures under three headings: (1) the effects of cold on men, materials and machinery; (2) the metallurgical factors involved; and (3) the code requirements. An effort has been made to present the findings of all authoritative sources, including the results of correspondence with experts in many countries. The results of these considerations are presented in the form of a synopsis at the end of the report. They indicate that, provided proper precautions are taken, there is no absolute lower limit to the ambient temperature at which welding can be performed.

#### ***Plastic Deformation in Cobalt Crystals***

by K.G. Davis and E. Teghtsoonian, *Trans. Met. Soc. AIME*, 227, p. 762-767 (June 1963).

Two types of twins were observed in cobalt crystal rods deformed by bending. The crystallography of both types of twins were determined and the results compared to twinning in other H.C.P. systems.

#### ***The Effect of Cross Slip on the Fatigue Behaviour of Copper and Copper-Zinc Alloys***

by J.T. McGrath and R.C.A. Thurston, *Trans. AIME*, 227, p. 645-650 (June 1963).

Polycrystalline specimens of copper and copper with various additions of zinc were tested in plane-bending fatigue. In tests performed at a constant stress, the fatigue life of copper increased slightly with the addition of up to 15% zinc. There was a sharp increase in fatigue life as further additions of zinc of up to 35% were made. Surface observations showed that the coarse slip bands that are characteristic of fatigue became narrower as the concentration of zinc increased. The rate of crack propagation also decreased with increasing zinc content. It is suggested that the fatigue behaviour is controlled by cross slip processes.

*The Creep-Rupture Embrittlement of Metals as Exemplified by Aluminum*

by H. H. Bleakney, *Can. Met. Quart.*, 2(3), p. 291-315 (July-Sept. 1963).

Creep-rupture tests have been conducted on a variety of alloys made from high-purity aluminum containing iron and silicon, both separately and in combination. The investigation was designed to provide information on the creep-rupture embrittlement of aluminum as influenced by composition and temperature, and to establish the rate at which embrittlement occurred in the tests.

Iron by itself, was found to embrittle aluminum. The embrittling effect of silicon, by itself, is negligible. Tests on alloys containing iron alone had a tendency to show minimum ductility at intermediate times to failure. Alloys with both iron and silicon also showed minimum ductility at about the same time to failure, but this minimum was at lower ductility values, and remained constant, for each test, at longer times to failure.

The results of the investigation confirm a previously stated postulate that impairment of cohesion across grain boundaries, by impurities accumulated in the course of creep-rupture tests of metals, is a necessary and sufficient condition for the development of inter-crystalline embrittlement.

*Mines Branch Probes Welding Frontiers!*

by W. P. Campbell, *Can. Machinery and Metalworking* 74(8), p. 54-55, 76 (August 1963).

The results are presented of recent welding research from the Welding Section, Physical Metallurgy Division. The subjects covered comprised the following: weldability studies on pipeline steels; studies of the cruciform weldability test; welding of tin bronze castings; weldability of steel at low ambient temperatures; and arc physics using high-speed photography.

*Vacuum Degassing and Feeding of Carbon Steel Castings*

by D. E. Parsons, *Modern Castings* 44(3), p. 433-453 (Sept. 1963).

The relationship of gas content to deoxidation, pinholes, porosity, mould materials, and temperature was studied by comparison of non-degassed, ladle degassed, and vacuum stream degassed carbon steels. Castings were examined with respect to macrostructure, porosity, tensile ductility, impact strength, notched endurance limit, and centreline shrinkage.

The hydrogen content of basic steel was reduced consistently to 1.2 - 1.7 ppm; the oxygen content was reduced to 0.004 wt % or less; and the nitrogen reduction varied between 0 and 50% depending on melt and vacuum degassing procedures. Refinement of macrostructures, reduction of porosity, increase of impact strength, and increase of notched bar fatigue endurance limit were obtained in 4 x 12 x 12 in. slab castings having riser hydrogen contents in the range 1.0 to 1.4 ppm.

Good surfaces were obtained on castings poured in dry sand or CO<sub>2</sub> sand moulds, with the best surfaces obtained with metal poured at an optimum low temperature. Pinholing, which occurred with silicon-killed non-degassed metal cast in green sand moulds, particularly when tapped at 1700°C (3100°F), was avoided when the metal was degassed to riser hydrogen contents below 1.5 ppm.

***Origin of Copper Used by Canadian West Coast Indians in the Manufacture of Ornamental Plaques***

by A. Couture and J. O. Edwards, National Museum of Canada, Bull. No. 194, Contributions to Anthropology, 1961-62, Pt 11.

"Coppers" specimens selected from the collection of the National Museum of Canada were investigated in order to determine whether they were of European or of American Indian origin. The evidence presented in the following report indicates that the "coppers" examined are of European or white North American origin. Their thickness evenness, their surface smoothness and, in certain cases, their size suggest that the original copper pieces were fabricated with heavy equipment. Furthermore, the presence and the distribution of cuprous oxide in the microstructure are strong indications that the metal had been melted, and, since it is generally accepted that the North American Indian did not know how to melt, this fact supports the conclusions derived from visual examination.

***Void Formation in Aluminum Bicrystals Subjected to Cyclic Reversed Bending***

by J. T. McGrath, Can. Met. Quart., 2(4), p. 345-354 (Oct. - Dec. 1963).

Grain boundary voids are found when aluminum bicrystals of non-symmetric orientation are subjected to cyclic reversed bending. The voids are most prominent in specimens with endurance of about 10<sup>6</sup> cycles and less. Fatigue cracks are found to initiate at and propagate from these voids. Electron microscope studies of thin foils taken from the boundary region reveal a dislocation structure of sub-boundaries and loops. A similar structure is found in areas remote from the boundary. From oxide replicas of the boundary region, jogs are

observed where slip bands intersect the boundary. Multiple slip is not observed. It is suggested that voids nucleate where sub-grain boundaries intersect the main boundary.

***Strain Rate Dependence of the Flow Stress in Cadmium Crystals***  
by K. G. Davis, Can. Jour. Phy. 41, p. 1454-1460 (1963).

The strain rate dependence of the flow stress in cadmium crystals of 99.9 and 99.9999% purity tested in tension at 77°K has been investigated. A Cottrell-Stokes  $\tau$ - $\dot{\epsilon}$  relationship is fairly closely followed, with a change in slope at a stress corresponding to the end of the linear region of glide. The change in slope is much less pronounced in the lower-purity material.

***Development of an Improved Steel for Use in Large Marine Propulsion Shafts***

by R. D. McDonald, Jour. Amer. Soc. Naval Engrs. 71(1), p. 811-816 October 1963).

A considerable improvement in propulsion shafting material can be attained by small additions of manganese and vanadium to 0.50% maximum carbon steel. This material was shown to provide strength levels considerably higher than carbon steel shafting currently in use when in the normalized and tempered condition, and with a minimum of extra cost in additives or processing techniques. The impact toughness was greatly increased at ambient temperatures and these high impact strengths prevail at much lower temperatures due to a substantial drop in the transition temperature. The material was also found to be suitable for liquid quenching with reasonably good hardenability if still higher strengths were required.

***Some Properties of Plain Carbon Steels Containing Uranium***  
by G. P. Contractor, CIMM Bull. 56(611), p. 199-208 (1963).

Medium and low carbon steels modified with uranium were studied to evaluate the influence of uranium on forgeability, mechanical properties, response to heat treatment and microstructure. Uranium contents ranged up to 0.70%. The medium carbon steels are hot short if the uranium content exceeds about 0.35%. More uranium can be tolerated in low carbon steels. The hot shortness is caused by the formation of intergranular phase  $UFe_2$ .

Critical transformation temperatures, Jominy hardenability, and resistance to tempering are not significantly affected by the presence of uranium. Similarly, uranium has little or no effect on the tensile properties of carbon steels. Addition of uranium has a favourable effect on the stress-rupture characteristics and some beneficial effect on fatigue properties. However, more results are required for verification.

In the steels investigated, it seems that most of the uranium carbide combines to form complex inclusions of U (O, C, N) or U(C, N) rich in oxygen or nitrogen or both. Above 0.35% U, uranium carbide is believed to occur as discrete spheroidal or dot particles which are stable at heat treating temperatures.

***The Contribution to Intercrystalline Embrittlement of Soft Metal Films Surrounding Hard Grains***

by H. H. Bleakney, Can. Met. Quart., 2(4), p. 399-403 (Oct. - Dec. 1963).

A concept of embrittlement through weakening of grain-boundary zones by solute impoverishment has been used to explain creep-rupture embrittlement of metals. A weighty objection to this explanation is seen in the fact that the cohesive strength of the "weak" grain-boundary envelopes is undoubtedly very much greater than the flow-strength of the "hard" grains; and long before cracks could develop in the boundary envelopes, the grains would flow and fracture. To test the validity of this objection, a tension test specimen was prepared from a steel bar having a microstructure consisting of a thin ferrite-network around large grains of fine pearlite. After breaking, a longitudinal section was prepared and examined under the microscope. The path of the fracture was found to be predominantly transgranular; and those parts that were intergranular were an obvious result of the previously formed cracks across the pearlite grains.

*SECTION 3 - AVAILABLE INVESTIGATION  
REPORTS*



**ABBREVIATIONS USED FOR ORIGINATING DIVISION (PAGES 59-84)**

- MPD - Mineral Processing Division**
- EMD - Extraction Metallurgy Division**
- MSD - Mineral Sciences Division**
- FMPD - Fuels and Mining Practice Division**
- PMD - Physical Metallurgy Division**

## MINES BRANCH INVESTIGATION REPORTS 1958

- IR 58-1  
Preparation of Bismuth Alloys Containing Various Amounts of Sodium and Rubidium  
by W. A. Pollard - PMD
- IR 58-2  
Geothermal Prospecting for Oil: A Preliminary Study of Its Applicability in Western Canada  
by J. Visman - FMP
- IR 58-3  
Globules on Cadmium Copper Wires  
by A. Couture and J. O. Edwards - PMD
- IR 58-4  
Solvent Extraction for the Recovery of Uranium and Thorium from Leach Solutions of a Uranium Ore (Ref. 7/57-7) from the Bancroft Area, Ont.  
by R. Simard - EMD
- IR 58-5  
Dynamic Shear Tests on Fuze Closing Discs  
by P. J. Todkill - PMD
- IR 58-6  
Metallurgical Examination of a Section of a Cast Iron Gear Housing  
by R. D. McDonald - PMD
- IR 58-8  
The Investigation of Certain Uranium Oxide Samples Produced at the University of BC, Vancouver, by Hydrometallurgical Techniques  
by N. F. H. Bright and A. H. Webster - MSD
- IR 58-9  
An Investigation into the Use of Ferrophosphorus as an Aggregate for the Production of Heavy Concrete  
by V. A. Haw - MPD
- IR 58-10  
The Investigation of a Limestone Sample for Use in Highway Construction from Dibblee Construction Co., Ottawa  
by R. L. Bayne - MPD
- IR 58-11  
Lightweight Aggregate Tests on Samples Submitted by the Crow's Nest Pass Coal Co., Limited  
by H. S. Wilson - MPD
- IR 58-12  
Determination of Low Temperature Notched Impact Strength of 3/8 inch "L. D." Steel Plate  
by D. E. Parsons - PMD
- IR 58-13  
Thermal Conductivity Determination on Sample of Highly Compressed Rockwool Block, Holmes Foundry Ltd., Sarnia, Ontario  
by H. M. Woodrooffe - MPD
- IR 58-14  
Investigation of Lightweight Aggregate Tests on Queenston Shale (Quebec Lightweight Aggregates Mining Corporation)  
by H. S. Wilson - MPD
- IR 58-16  
Concentration of Barite from a Sample of Tailings from Giant Mascot Mine Ltd., Submitted by H. L. Hill and Associates, Vancouver, B. C.  
by R. A. Wyman - MPD

- IR 58-19  
Beneficiation of Pyrophyllite from Newfoundland Submitted by the American Encaustic Tiling Co., Inc. by R. A. Wyman - MPD
- IR 58-20  
Examination of Certain Uranium Trioxide Hydrate Samples from Eldorado Mining and Refining Ltd., Port Hope, Ont., in Relation to their Pelleting Behaviour by N. F. H. Bright and A. Jongejan - MSD
- IR 58-26  
Production of a Wave Guide for the Defence Research Telecommunications Establishment, Dept. of Nat. Defence, Shirley Bay, Ontario by W. A. Pollard and T. E. Davis - PMD
- IR 58-27  
Cellular Concrete Investigations for the Nova Scotia Dept. of Mines by V. A. Haw - MPD
- IR 58-31  
Metallurgical Examination of Mended Fourdrinier Wire Cloth by G. W. Toop and J. O. Edwards - PMD
- IR 58-33  
Beneficiation Tests on a Sample of Barite-Fluorite from Memramcook, N. B., Submitted by Mr. Wm. Papke by R. A. Wyman - MPD
- IR 58-34  
Metallurgical Examination of Three Boiler Grate Bars which Warped in Service by R. K. Buhr - PMD
- IR 58-35  
Second Report on Evaluation of the Properties of High Tensile Steel Sheet Piling (Larssen III) for Use at Comeauville, N. S. by D. R. Bell - PMD
- IR 58-36  
Dry-Working of a Sample of Granite from B. C. Submitted by D. A. Sloan to Develop a Variety of Products by R. A. Wyman - MPD
- IR 58-40  
Report on Durability Investigations of Limestone from near St. Catharines for Use in Concrete Using Freeze Thaw Methods by V. A. Haw - MPD
- IR 58-41  
The Cold Water Process for the Recovery of the Bitumen from the Bituminous Sands of Alberta by D. S. Montgomery and M. P. Plant - Fuels
- IR 58-44  
Exfoliation Tests on Vermiculite from North Bay, Ont., Submitted by Mr. N. Miller by H. S. Wilson - MPD
- IR 58-45 -  
An Investigation into the Use of Shale from the Minto Coal Field as a Source of Lightweight Aggregate by V. A. Haw, H. S. Wilson and N. G. Zoldners - MPD
- IR 58-51  
Production of Titanium Alloy Ingots by Consumable Electrode Arc Melting by J. W. Suiter - PMD

- IR 58-60  
Prepact Intrusion Grout Investigation by the St. Lawrence Seaway Authority  
by N. G. Zoldners - MPD
- IR 58-65  
Development of Sewer Pipe Bodies from St. Johns Clay and New Jersey Fireclays  
by J. G. Brady - MPD
- IR 58-68  
Evaluation of Shale Samples from Hillbank, Vancouver Island, B.C.  
by J. G. Brady - MPD
- IR 58-72  
Welding Procedure for the Repair of a Large Steel Casting Forming the Main Frame of a Construction Power Shovel  
by M. J. Nolan - PMD
- IR 58-74  
The Corrosion of Stainless Steel Pipe, Welded by Various Methods in Moist Sand  
by I. I. Tingley - EMD
- IR 58-77  
Effect of Temperature on Conductor Concentricity in a Bent RG-18/U Co-Axial Cable Under Uniform Vibration  
by F. W. Marsh - PMD
- IR 58-81  
Petrographical and Mineralogical Examination of Four Rock Samples from Canadian Johns-Manville Co. Ltd., Asbestos, Quebec  
by R. M. Buchanan - MPD
- IR 58-87  
Heavy Liquid Investigations on Three Aggregate Samples Submitted by the Spratt Sand and Gravel Co., Metcalfe Rd., Ottawa  
by C. M. Bartley - MPD
- IR 58-88  
Further Lightweight Aggregate Tests on Fly Ash Submitted by the Hydro-Electric Power Commission of Ontario  
by H. S. Wilson - MPD
- IR 58-92  
The Development of Improved Zinc-Base Die Casting Alloys (Project Zn-6), Phase II (a): Preparation of Model 1000 ABC Die Casting Machine for Production of Die Cast Test Pieces  
by H. Guttman - PMD
- IR 58-98  
Investigation of Concentration and Properties of a Sudbury Garnet Submitted by H. Wiemer  
by W. J. D. Stone - MPD
- IR 58-104  
Evaluation of Snow Plow Wing Shoes in 1957-1958 Winter for the Ontario Department of Highways  
by R. K. Buhr and D. K. Faurschou - PMD
- IR 58-107  
The Effect of Speed on Fourdrinier Wire Wear  
by G. W. Toop - PMD
- IR 58-109  
Mineralogical and Petrographical Investigation of Pyrophyllite-Bearing Rocks from Manuels, Newfoundland  
by R. M. Buchanan - MPD

- IR 58-110  
An Investigation into the Mineral Constituent and Possible Use of a Volcanic Ash Containing Bentonite from Irvine, Alberta  
by A. G. Sadler - MPD
- IR 58-111  
Classification of Alumina CX 25 in Hardinge Air Classifier on Request from Aluminum Co. of Canada  
by R. A. Wyman - MPD
- IR 58-116  
Canadian Ground Stress Investigations  
by A. Brown - FMP
- IR 58-122  
Rolls Crushing and Screening Trials on a Sample Submitted by Baker Talc Company  
by R. A. Wyman - MPD
- IR 58-123  
Investigation of Concentration of Graphite from Mount Laurier, Quebec, Submitted by Dr. L. J. LaRue  
by W. J. D. Stone - MPD
- IR 58-125  
Soldering of Copper-Plated Aluminum Sheets  
by A. Couture - PMD
- IR 58-127  
Radioactive Tracer Tests During an Arc-Furnace Pilot Run  
by G. G. Eichholz - MSD
- IR 58-131  
Metallurgical Examination of Failed Cap Screws from Mercury Pumps  
by G. W. Smith - PMD
- IR 58-132  
Examination of a Defective ("Pinholed") Steel Casting from Ford Motor Company of Canada Limited, Windsor, Ontario  
by D. K. Faurschou - PMD
- IR 58-136  
Evaluation of Rockland Limestone for Use in Concrete  
by V. A. Haw and F. E. Hanes - MPD
- IR 58-138  
A Study of the Relation Between the Properties of Cokes Produced by Means of Two Laboratory Methods and Coke Produced Industrially  
by E. Swartzman, J. C. Bothman, T. E. Tibbetts and E. J. Burroughs - FMP
- IR 58-140  
An Investigation into the Concrete-Making Properties of Mill Tailing Sand from Sigma Mines (Quebec) Ltd., Bourlamaque, Que.  
by N. G. Zoldners - MPD
- IR 58-141  
Tensile Strength Tests of Four-drinier Wire Strands Before and After Weaving  
by G. W. Toop - PMD
- IR 58-146  
Metallurgical Examination of a Stainless Steel Impeller Which Failed in Service  
by D. K. Faurschou - PMD
- IR 58-151  
Mineralogical Investigation of Three Samples of Magnesite-Bearing Rock from S. E. British Columbia Submitted by Harbour Natural Resources Limited  
by R. M. Buchanan - MPD

- IR 58-152  
Treatment of Lorraine Shale to Overcome Scumming  
by S. Matthews - MPD
- IR 58-155  
Further Investigations Into the Use of Iron Sinter Supplied by Noranda Mines Ltd., as a Colouring Material in Building Brick  
by A.G. Sadler - MPD
- IR 58-157  
Beneficiation Investigation of Pyrophyllite-bearing Rocks from Manuels, Newfoundland  
by W.J.D. Stone - MPD
- IR 58-159  
A Microscopic Examination of Brucite Granules in Limestone from Wakefield, P.Q.  
by R.M. Buchanan - MPD
- IR 58-164  
Tabling of Brucite Mill Products from the Aluminum Co. of Canada, Ltd., Plant at Wakefield, Quebec  
by R.A. Wyman - MPD
- IR 58-165  
Highlights of Test Work Performed on a Kyanite-Bearing Gneiss from the Sudbury Property of Northern Kyanite Mines Limited  
by R.A. Wyman and W.J.D. Stone - MPD
- IR 58-166  
High Density Concrete with Ilmenite Aggregate  
by V.A. Haw and N.G. Zoldners - MPD
- IR 58-170  
Metallurgical Examination of a Banshee Aircraft Wing Hinge Fitting  
by D.E. Parsons - PMD
- IR 58-174  
Failure of Pump Cylinders Castings  
by R.F. Knight - PMD
- IR 58-175  
Retractable Antennae Mast  
by J.A. Perry - PMD
- IR 58-180  
Examination of Scale Deposit on Tungsten Alloy Block  
by J.J. Sebisty - PMD
- IR 58-182  
Pelletizing and Bloating of Queenston Shale from St. Gregoire, P.Q.  
by H.S. Wilson - MPD
- IR 58-183  
Manufacture of Sand Aggregate from Lockport Dolomite  
by V.A. Haw - MPD
- IR 58-192  
Examination of a Defective Austenitic Manganese Steel 5 1/2 ft. Bowl Liner  
by R.K. Buhr - PMD
- IR 58-195  
Clay Products from Prince Edward Island Clays and Shales  
by J.G. Brady - MPD
- IR 58-196  
Metallurgical Examination of Corroded Brass Bellows  
by G.W. Toop - PMD

IR 58-198

Investigation of a Water Problem  
at Bridgewater, N. S.  
by J. P. Lively - MPD

IR 58-207

A Mineralogical Report on a Urani-  
ferous Conglomerate from Klerks-  
dorp Consolidated Goldfields Ltd.,  
Johannesburg, South Africa  
by M. R. Hughson - EMD

IR 58-209

Durability of Air-Cooled Slag from  
Algoma Steel Corporation  
by V. A. Haw and N. G. Zoldners -  
MPD

IR 58-211

A Viscometer for Mineral Suspen-  
sions  
by G. R. Purdy - EMD

IR 58-220

Beneficiation of a Silica Sample  
from Dutch Settlement, Nova Scotia  
by R. K. Collings - MPD

IR 58-221

Mineralogical Examination of Six  
Soil Fractions Submitted by the  
Atomic Energy of Canada Limited,  
Chalk River, Ontario  
by R. M. Buchanan - MPD

MINES BRANCH INVESTIGATION REPORTS 1959

- IR 59-1  
The Beneficiation of Two Silica  
Samples from Golden, B.C.  
by R. K. Collings - MPD
- IR 59-4  
Testwork on Solvent Extraction of  
Nitrate Eluates for the Production  
of Uranium Trioxide Progress  
Report  
by A. J. Gilmore - EMD
- IR 59-10  
The Mechanism of Oxidation in  
Titanium  
by J. C. Turgeon - EMD
- IR 59-13  
Concentration of Fluorspar from  
Birch Island, B.C.  
by R. A. Wyman - MPD
- IR 59-25  
Measurement of Kiln and Furnace  
Residence Times by Means of  
Radioactive Tracers  
by G. G. Eichholz - MSD
- IR 59-34  
The Beneficiation of Silica from  
Hilton, Que.  
by R. K. Collings - MPD
- IR 59-43  
Investigation of Refractory Mortars  
by S. Mathews - MPD
- IR 59-45  
Beneficiation and Evaluation of  
Pointe Fortune Gravel for Quebec  
Hydro Electric Commission  
by F. E. Hanes - MPD
- IR 59-46  
Examination of Further Uranium  
Oxide Samples Produced by Hydro-  
metallurgical Procedures at the  
University of B. C.  
by A. H. Webster and N. F. H.  
Bright - MSD
- IR 59-51  
Investigation of the Cause of  
Failure of Three Axles for Mine  
Head Sheaves  
by D. I. Bell and R. C. A. Thurston  
- PMD
- IR 59-60  
Investigation of Coal Waste Shales  
from Nova Scotia for the Produc-  
tion of Lightweight Aggregate  
by H. S. Wilson - MPD
- IR 59-65  
An Investigation of Garnet from  
the Sudbury Area, Ontario  
by J. S. Ross - MPD
- IR 59-72  
Regeneration of Lime from Cal-  
cium Carbonate Waste Sludges  
from the Beaverlodge (Sask.)  
Plant of Eldorado Mining and  
Refining Limited  
by H. M. Woodroffe, H. S. Wilson,  
J. S. Ross and E. G. Joe - MPD
- IR 59-78  
Carbonization of Canmore (Alta.)  
Coal Briquettes in a Vertical  
Shaft Furnace  
by H. P. Hudson and J. H. Walsh  
- FMP



- IR 59-80  
X-ray Diffraction and Spectrographic Investigations of Material from the Wreckage of an Aircraft Submitted by the British Columbia Research Council  
by J. F. Rowland - MSD
- IR 59-81  
Grinding Tests on Samples of Breeze and Range Cokes from the Steel Company of Canada Limited, Hamilton, Ont.  
by T. F. Berry - MPD
- IR 59-84  
Metallurgical Tests on a Sample of Mill Tailing and on a Sample of Refinery Slag, from Consolidated Discovery Yellowknife Mines Limited, Yellowknife, N. W. T.  
by J. L. Giroux - MPD
- IR 59-88  
An Investigation Into the Iron Content of Two Zinc Concentrates from Quemont Mining Corp., Noranda, Que.  
by E. H. Nickel - MSD
- IR 59-89  
Investigation of a Sample of Iron Ore from Bobs Lake, Ontario, Submitted by Clinton Kehoe  
by J. D. Johnston - MPD
- IR 59-90  
Concentration of Apatite from the Kingston Area in Ontario  
by W. J. D. Stone - MPD
- IR 59-92  
Design and Operation of Wire Wear Tester and Preparation of Wear Samples  
by G. W. Toop and J. O. Edwards - PMD
- IR 59-93  
Design and Operation of Wire Fatigue Tester  
by G. W. Toop - PMD
- IR 59-94  
Investigation on Durability of Concrete Made with Gravel from Pointe Fortune, Que.  
by N. G. Zoldners - MPD
- IR 59-95  
The Removal of Uranium from an Anion Exchange Resin by a Strong Chloride Elution Process: A Preliminary Investigation  
by J. C. Ingles and E. D. Kornelsen - EMD
- IR 59-98  
A Flow Gauge Employing a Radioactive Tracer  
by J. D. Keys, G. E. Alexander and G. G. Eichholz - MSD
- IR 59-106  
Investigation of Impurities in Back Mine Feldspar  
by H. M. Woodrooffe and J. E. Reeves - MPD
- IR 59-109  
Investigation of Iron Ore from Calvin Township, Ontario, Submitted by Peerless Canadian Explorations Ltd., Toronto  
by W. S. Jenkins - MPD
- IR 59-110  
Measurement of the Residence Time of a Rotary Kiln with Radioactive Tracers  
by G. G. Eichholz - MSD

IR 59-111

Amalgamation and Refining Tests  
on Silver Concentrates from Siscoe  
Metals of Ontario, Limited,  
Gowganda, Ont.

by T. F. Berry - MPD

IR 59-112

Water Quality Studies in Canada for  
the International Association of  
Scientific Hydrology 1958-1959

by J. F. J. Thomas and J. Ungar -  
MPD

IR 59-114

Flotation Tests of Copper from  
Atlantic Coast Copper Corporation,  
Springdale, Newfoundland

by G. O. Hayslip - MPD

IR 59-118

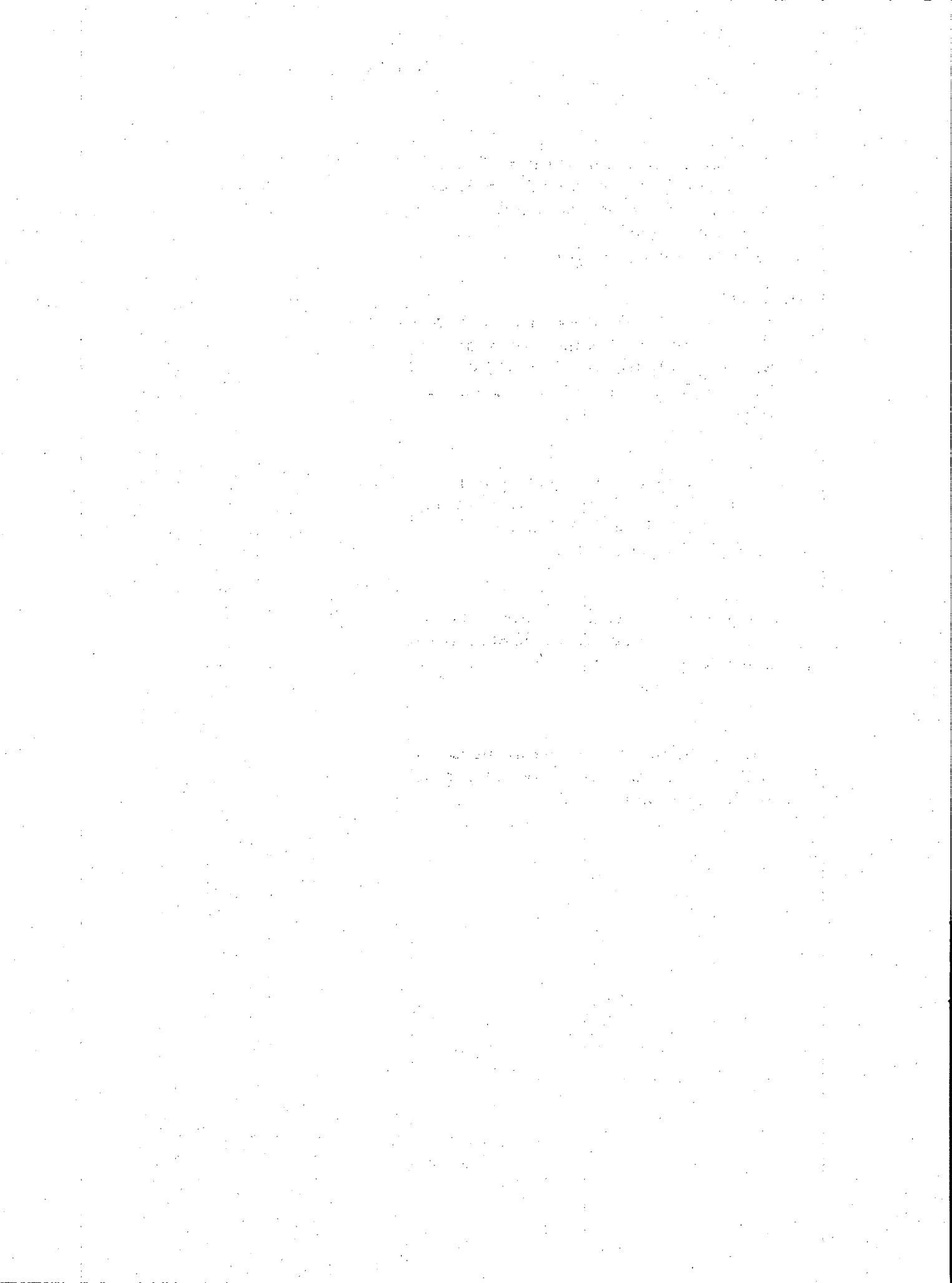
Investigation Into a Chipping Prob-  
lem in the Manufacture of Structural  
Tile from Queenston Shale

by A. G. Sadler - MPD

IR 59-119

The Occurrence of Gallium in Lepi-  
dolite from Bernic Lake, Manitoba

by E. H. Nickel - MSD



## MINES BRANCH INVESTIGATION REPORTS 1960

- IR 60-1  
The Distribution of the Niobium Content Between Light and Heavy Fractions in Ore Samples from Quebec Columbian Limited, Oka, Quebec  
by E.H. Nickel - MSD
- IR 60-6  
Evaluation of Two Clays and One Shale from Delson, Quebec, for Lightweight Aggregate  
by H.S. Wilson - MPD
- IR 60-7  
Concentration of Beryl and Columbite-Tantalite from Pegmatite Samples, Winnipeg River Area, Manitoba  
by R.A. Wyman - MPD
- IR 60-9  
Concentration of Magnesite from Fort Steele, B.C.  
by W.J. D. Stone and R.A. Wyman - MPD
- IR 60-10  
Mineralogy of Two Ore Samples from the Verna Mine, Eldorado Beaverlodge Division, Eldorado, Saskatchewan  
by M.R. Hughson - EMD
- IR 60-16  
Flotation Tests on Three Samples of Copper Ore from Kam Kotia Porcupine Mines Limited, Near Timmins, Ontario  
by G.I. Mathieu - MPD
- IR 60-17  
Investigation of a Sample of Potsdam Sandstone from Leeds County, Ontario, Submitted by Rochester and Pittsburgh Coal Co. (Canada) Limited, Toronto, Ontario  
by R.K. Collings - MPD
- IR 60-18  
Concentration of Barite Samples from Mountain Minerals Limited Limes in British Columbia  
by R.A. Wyman - MPD
- IR 60-19  
Mineralogical Composition of Conglomerate Ore and of Associated Acid-Consuming Rocks from Milliken Lake Uranium Mines Limited, Elliot Lake, Ontario  
by S. Kaiman - EMD
- IR 60-20  
Investigation of a Gold-Silver Ore from Big Town Copper Mines Limited, Courville Township, Senneterre Area, Quebec  
by J.L. Giroux - MPD
- IR 60-21  
Grinding Investigations on Craigmont Ore from Canadian Explorations Limited, Salmo, B.C.  
by W.S. Jenkins - MPD
- IR 60-23  
Tracer Measurement of Contact Time at the Algom-Quirke Mill  
by G.G. Eichholz - MSD
- IR 60-25  
The Iron Content of Sphalerite Samples from Quemont Mining Corporation, Noranda, Quebec  
by E.H. Nickel - MSD

IR 60-29

Examination of Ammonium Diuranate (Yellow Cake) Samples Produced by the Extraction Metallurgy Division, Mines Branch, October 1959 to January 1960  
by N. F. H. Bright, A. H. Webster and R. H. Lake - MSD

IR 60-30

Pilot Plant Testing of an Iron Ore from Boston Township, Ontario, Submitted by Jalore Mining Company Limited, Toronto, Ontario  
by D. E. Pickett - MPD

IR 60-33

A Review of the Investigation of the Fusion of Apatite, 1949 to 1955  
by J. E. Reeves - MPD

IR 60-35

Investigation of the Properties of New Glasgow, Nova Scotia, Clay and Shale Used in the Sewer Pipe Industry  
by J. G. Brady - MPD

IR 60-39

A Mineralogical Analysis of Two Samples of Oolitic Iron Ore from the Clear Hills Area of Alberta  
by E. H. Nickel, N. F. H. Bright and Miss E. E. Lepine - MSD

IR 60-40

Examination of Boiler Tubing for DDE 261 and Class  
by R. F. Knight - PMD

IR 60-41

A Survey of Water Quality at Camp Muskwa, Fort Nelson, B. C., 1959  
by J. F. J. Thomas - MPD

IR 60-42

Mineralogical Examination and Determination of Ceramic Properties of Seven Samples Submitted by the Iron Ore Company of Canada, Schefferville, P. Q.  
by J. G. Brady and R. M. Buchanan - MPD

IR 60-47

A Mineralogical Investigation of Nickel Ore from the Timiskaming District of Ontario, Submitted by Fatima Mining Company, Limited  
by E. H. Nickel - MSD

IR 60-51

Magnetic Concentration of Iron Ore from Tamara Mining Limited, Wexford Township, P. Q.  
by W. S. Jenkins - MPD

IR 60-53

An Investigation Into the Use of Waste-Coal Mine Shale from New Brunswick as a Source of Lightweight Aggregate  
by V. A. Haw, H. S. Wilson and N. G. Zoldners - MPD

IR 60-55

The Flotation of Pyrite from Plant Tailing of Willroy Mines Limited  
by G. O. Hayslip - MPD

IR 60-57

A Grinding Investigation on Ore from Beaverlodge Mines, Limited, Saskatchewan  
by T. F. Berry - MPD

IR 60-59

An Investigation of Gold Losses in Flotation Tailing from Delnite Mines Limited, Timmins, Ontario  
by G. O. Hayslip - MPD

- IR 60-61  
Recovery of Iron from Baffin Island  
Samples Submitted by Turner Baffin  
Prospecting Syndicate, Toronto,  
Ontario  
by P.D.R. Maltby - MPD
- IR 60-63  
Concentration of Zeolites from  
Canada Creek, King's County, Nova  
Scotia  
by R.A. Wyman - MPD
- IR 60-64  
Flotation Tests on a Silver-Copper  
Ore from Selkirk Ptarmigan Mines  
Ltd., Edgewater, B.C.  
by R.W. Bruce - MPD
- IR 60-65  
Concentration of Graphite from the  
Perth Area of Ontario  
by W.J.D. Stone - MPD
- IR 60-76  
Radioactive Fallout Elements in  
Plant Samples from Vancouver  
Island  
by J.L. Horwood - MSD
- IR 60-78  
Concentration of Titaniferous Mag-  
netite Ore from Laurentian Titan-  
ium Mines Limited, Wexford Town-  
ship, P.Q.  
by W.S. Jenkins - MPD
- IR 60-81  
Concentration of Titaniferous Mag-  
netite Ore from Cross Lake, Mani-  
toba, for Noranda Mines Limited  
by W.S. Jenkins - MPD
- IR 60-84  
Tri-N-Butyl Phosphate Extraction  
of Uranyl Nitrate from an Ion  
Exchange Mill Eluate for the Prod-  
uction of High Purity Uranium  
Dioxide  
by A.J. Gilmore, V.M. McNamara  
and R. Simard - EMD
- IR 60-85  
A Mineralogical Study of Zinc  
Concentrates from Sherritt Gordon  
Mines Limited, Fort Saskatchewan,  
Alta.  
by W. Petruk - MSD
- IR 60-87  
Beneficiation of Barite from  
Summit Lake, B.C.  
by R.A. Wyman - MPD
- IR 60-88  
The Magnetic Concentration of  
Pyrrhotite in Zinc Concentrate  
from Willroy Mines Limited,  
Manitouwadge, Ontario  
by G.O. Hayslip - MPD
- IR 60-90  
Flotation of Chalcopyrite from  
Ore of New Hosco Mines Limited,  
Mattagami Lake Area, Quebec  
by T.F. Berry - MPD
- IR 60-95  
Production of High Purity Ammon-  
ium Diuranate by the Sulphuric  
Acid Elution-Amine Extraction  
Process  
by A.J. Gilmore, V.M. McNamara,  
H.W. Parsons and R. Simard -  
EMD
- IR 60-96  
Controlled pH Leaching of Elliot  
Lake Ores  
by B.H. Lucas and W.A. Gow -  
EMD

- IR 60-98  
Preparation of Experimental Al-Mg-Zn Alloy Extrusions  
by W.A. Pollard - PMD
- IR 60-99  
Mineralogical Report on Leached Residue from the Beaverlodge Operation, Eldorado Mining and Refining Ltd., Eldorado, Sask.  
by M.R. Hughston and S. Kaiman - EMD
- IR 60-105  
Reduction of Firmly-Cemented Sandstone to Grain Size by Roll Crusher and Muller Mixer  
by R.K. Collings - MPD
- IR 60-108  
Investigation of a Gold-Iron Ore Submitted by Findlay Creek Syndicate from Mineral Leases on Findlay Creek, B.C.  
by G.I. Mathieu - MPD
- IR 60-109  
Investigation of a Placer Sand Submitted by Messrs. Johnson and Associates, Box 344, Nanton, Alberta  
by T.F. Berry - MPD
- IR 60-111  
Flotation of Acid Consumers from Elliot Lake Ores  
by W.R. Honeywell, V.F. Harrison, W.A. Gow and H.W. Smith - EMD
- IR 60-113  
Investigation Into Some Possible Ceramic Uses of a Kaolinized Feldspar from Chateau Richer, P.Q.  
by K.E. Bell - MPD
- IR 60-120  
Refining of Uranium from Leach Plant Ion Exchange Nitrate Eluates by Extraction with Dibutyl Butylphosphonate  
by V.M. McNamara, H.W. Parsons and R. Simard - EMD
- IR 60-122  
An Investigation to Improve the Extraction of Gold from the Flotation Concentrate of Sullivan Consolidated Mines Limited, Sullivan Mines, Quebec  
by G.O. Hayslip - MPD
- IR 60-124  
Flotation of Acid Consumers from Bancroft Uranium Ores  
by W.R. Honeywell, V.F. Harrison, W.A. Gow and H.W. Smith - EMD
- IR 60-126  
Concentration of Cordierite from a Gneissic Rock from Southwestern Quebec  
by J.E. Reeves - MPD
- IR 60-128  
Heavy-Media and Flotation Tests on Zinc Ore Submitted by Zenmac Metal Mines Limited, Toronto, Ontario  
by T.F. Berry - MPD

MINES BRANCH INVESTIGATION REPORTS 1961

- IR 61-2  
Determination of the Chemically Combined Iron in Sphalerite from Noranda Mines Limited  
by M. H. Haycock - MSD
- IR 61-8  
Progress Report on the Spectrophotometric Determination of Silicon in Light Metals and Alloys (Co-operative Studies with the CSA Committee on Analytical Methods)  
by Elsie M. Penner, W. R. Inman and A. E. Laroche - MSD
- IR 61-10  
Pitting Corrosion in Copper Water Supply Line in Prince George, B. C.  
by G. J. Biefer - PMD
- IR 61-12  
Recovery of Gold from an Ore from Preston Mines Limited, South Porcupine, Ontario  
by T. F. Berry - MPD
- IR 61-14  
The Determination of Small Amounts of Zirconium in Steels by X-ray Spectrography  
by Dorothy J. Reed and A. H. Gillieson - MSD
- IR 61-18  
Evaluation of Four Ploughshare Materials  
by R. K. Buhr - PMD
- IR 61-19  
Grinding Investigation on a High Grade Copper-Zinc Ore from Consolidated Vauze Mines Limited, Noranda, Quebec  
by T. F. Berry - MPD
- IR 61-24  
The Failure of a Bell Helicopter Blade Grip  
by E. G. Eeles - PMD
- IR 61-25  
The Use of the Gold-Leaf Test to Check the Effects of Certain Possible Contaminants of Cyanide Solutions  
by H. H. McCreedy, C. C. Clark and W. A. Gow - EMD
- IR 61-27  
Magnetic Concentration of Iron from Copper Flotation Tailings from the Benson Lake, B. C., Property of C. M. and S. Co. Limited  
by R. S. Kinasevich - MPD
- IR 61-31  
Observations on the Corrosion of Zirconium Alloys Containing Copper and Molybdenum  
by C. F. Dixon - PMD
- IR 61-40  
Flotation of Silver-Lead-Zinc Ore from Jordan River Mines Property for Bralorne Pioneer Mines Limited, Vancouver, B. C.  
by G. I. Mathieu - MPD
- IR 61-41  
Recovery of Iron from Samples Submitted by Can-Fer Mines Limited, Toronto, Ont.  
by D. E. Pickett and P. D. R. Maltby - MPD

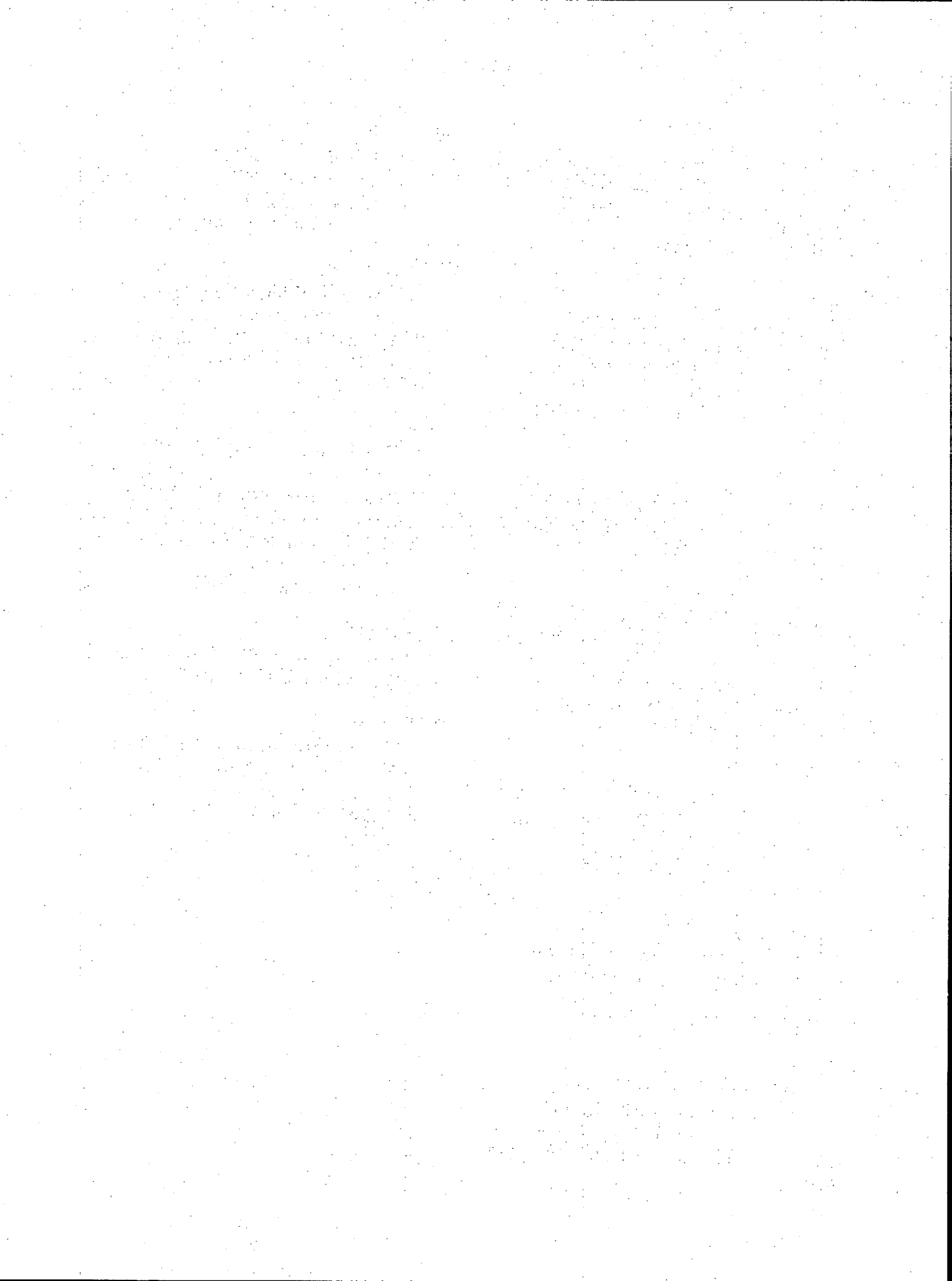


- IR 61-44  
Cobbing and Concentration Tests on a Copper-Bearing Iron Ore Submitted by Western Ferric Ores Limited, Vancouver, B.C.  
by G. O. Hayslip - MPD
- IR 61-46  
Investigation of Stress Distribution in Stud Link Anchor Cable  
by F. W. Marsh - PMD
- IR 61-47  
Beneficiation of a Manganese Ore Received from J. Pauloski, Massett, B.C.  
by R. S. Kinasevich - MPD
- IR 61-48  
Quantitative Determination by the Stallwood Air-Jet DC Arc Technique. I. Trace Impurities in Titanium Dioxide  
by A. H. Gillieson - MSD
- IR 61-49  
Mineralogical Report on a Manganese Ore from Ghana, West Africa  
by M. R. Hughson and S. Kaiman - EMD
- IR 61-51  
Magnetic Concentration of Wash Plant Tailing and Other Samples from the Iron Ore Company of Canada, Schefferville, Quebec  
by P. D. R. Maltby - MPD
- IR 61-53  
Dust and Radiation Monitoring at Algoma Steel Corporation Ltd., Sault Ste. Marie, Ont. May 2-3, 1961  
by G. G. Eichholz - MSD
- IR 61-55  
Determination of Graphitic Carbon in Sulphide-Containing Rocks and Ores  
by W. L. Chase - MSD
- IR 61-56  
Standardization of Sieves from Canadian Ingersoll-Rand Company Limited, Sherbrooke, Quebec  
by T. F. Berry - MPD
- IR 61-57  
Concentration of Scheelite in a Gold Ore from H. G. Young Mines Limited, Balmertown, Ontario  
by R. W. Bruce - MPD
- IR 61-62  
Determination of Cadmium, Copper, Iron, Lead, Silver and Thallium in High Purity Zinc  
by A. E. Laroche, C. H. McMaster and Miss E. M. Kranck - MSD
- IR 61-63  
Air-Monitoring During First Uranium-Steel Production at Atlas Steels Ltd., May 17-19, 1961  
by C. McMahon and G. G. Eichholz - MSD
- IR 61-64  
Dust Monitoring at Algoma Steel Corporation Ltd., Sault Ste. Marie, Ont., June 6, 1961  
by C. McMahon - MSD
- IR 61-65  
The Evaluation of a Limestone from Ghana as a Source of Hydraulic Lime  
by J. D. Acheson and J. S. Ross - MPD

- IR 61-66  
Crushing Tests on a Sample of Clinoptilolite Submitted by Atomic Energy of Canada, Limited, Chalk River, Ontario  
by T.F. Berry - MPD
- IR 61-68  
A Comparison of the Explosibility Characteristics of Some Canadian Coal Mine, Base Metal Mine and Industrial Dusts  
by W.J. Montgomery - FMP
- IR 61-69  
Recovery of Iron, Gold and Platinum from a Sample Submitted by Gra Dorphan Mining Company Limited, Tulameen, B.C.  
by P.D.R. Maltby - MPD
- IR 61-70  
Impurities in Refractory Metals Powders  
by L.G. Ripley, Elsie M. Penner, A.H. Gillieson, W.R. Inman and R.H. Donahoe - MSD
- IR 61-71  
The Calcination of Algoma Siderite Ore  
by N.F.H. Bright and R.H. Lake - MSD
- IR 61-73  
Flotation Tests on Two Samples of Copper Ore from the Sunro Mine for Cowichan Copper Co. Ltd., Vancouver, B.C.  
by G.I. Mathieu - MPD
- IR 61-78  
Uranium Dust Monitoring at Atlas Steels Limited, Welland, Ont., June 16, 1961  
by C. McMahon - MSD
- IR 61-79  
Magnetic Concentration of Titaniferous Magnetite from Saguenay Exploration and Mining, Inc., Outremont, Quebec  
by R.S. Kinasevich - MPD
- IR 61-80  
Quantitative Determination by the Stallwood Air-Jet DC Arc Technique. 2. Trace Impurities in High Purity Copper  
by K. Bhaskara Rao and A.H. Gillieson - MSD
- IR 61-81  
Quantitative Determination by the Stallwood Air-Jet DC Arc Technique. 3. Trace Impurities in High Purity Gold  
by Elisabeth M. Kranck - MSD
- IR 61-87  
Material Examination of the Fractured Propeller Blades from the Icebreaker CMS Camsell  
by T.S. Plaskett - PMD
- IR 61-95  
Uranium Dust Monitoring at the Steel Co. of Canada Ltd., Hamilton, Ontario, July 18-19, 1961  
by C. McMahon - MSD
- IR 61-97  
Concentration Tests on Two Samples of Tungsten Ore from the Grey River Area, Newfoundland, for American Smelting and Refining Co., Buchans, Nfld.  
by G.I. Mathieu - MPD
- IR 61-98  
Some Recent Developments in the Zinc Plating of Steel Cartridge Cases in Canada  
by W. Dingley - EMD

- IR 61-99  
Quantitative Determination by the Stallwood Air-Jet DC Arc Technique. 4. Trace Impurities in Aluminum, Magnesium, Tin and Zinc  
by K. Bhaskara Rao - MSD
- IR 61-100  
Investigation Into the Cause of Failure of a Back Bolt for Steel Sheet Piling  
by R.D. McDonald and W.A. Morgan - PMD
- IR 61-103  
Pilot Plant Investigation of Iron Ore Sample 'E' from Kukatush Mining Corp. (1960) Ltd., Kukatush, Ont.  
by P.D.R. Maltby and L.L. Sirois - MPD
- IR 61-104  
Evaluation of Californian 'Feather-ock' for Use as Exterior Wall Facing  
by W.G. Leslie, J.A. Soles and N.G. Zoldners - MPD
- IR 61-105  
Beneficiation of Mill Products Produced by Langis Silver and Cobalt Mining Co. Ltd., New Liskeard, Ont.  
by T.F. Berry - MPD
- IR 61-109  
Investigation of the Occurrence of Inclusions in Tin-Plated Steel for Dominion Foundries and Steel, Ltd., Hamilton, Ont.  
by J.F. Rowland - MSD
- IR 61-111  
The Potentiometric Titration of Chlorides  
by L.G. Ripley and W.R. Inman - MSD
- IR 61-112  
Spectrophotometric Determination of Chlorides  
by L.G. Ripley and W.R. Inman - MSD
- IR 61-113  
The Determination of Chloride Content in Three Zinc Oxide Samples from Hudson Bay Mining and Smelting Co. Ltd., Flin Flon, Manitoba  
by L.G. Ripley and W.R. Inman - MSD
- IR 61-117  
Investigation of Some Causes of Errors in the Determination of Tin in Zircaloy  
by A.E. Larochelle, S.R.M. Badger, J.F. Fydell, J.F. Rowland and W.L. Chase - MSD
- IR 61-118  
Examination of Two Pieces of a Split Pile from the Ferry Terminal Wharf at Caribou, Nova Scotia  
by C.M. Webster and W.A. Morgan - PMD
- IR 61-119  
Beneficiation Tests on Vermiculite from the Sudbury Area, Ont. (Project MP-IM-6103)  
by R.A. Wyman - MPD
- IR 61-120  
Concentration and Cyanidation Tests on a Gold-Silver Ore from Silbak Premier Mines Ltd., Portland Canal Area, B.C.  
by G.I. Mathieu - MPD
- IR 61-121  
Radiometric Analysis of Uranium Ore Samples from Western Nuclear Inc., Rawlins, Wyoming  
by C. McMahan - MSD

- IR 61-123  
Mineralogical Investigation of Fractions from Tests on the Bird River Chromite Ore for Stratmat Co. Limited  
by W. Petruk - MSD
- IR 61-125  
A Mineralogical Investigation of Iron Ore from the Swift Creek Deposit in the Clear Hills Area of Northwestern Alberta  
by E. H. Nickel and D. J. Charette - MSD
- IR 61-126  
The Processing of Certain Limestones for Use as Whiting Substitute  
by J. S. Ross - MPD
- IR 61-131  
Markets for Metallurgical Coal and Coke - Western Canada and Western United States  
by T. H. Janes, R. B. Elver, J. H. Walsh and J. C. Botham - MIN. RES. and FMP
- IR 61-137  
Two Stage Flotation Treatment of Uranium Ores from Faraday Uranium Mines Limited  
by W. R. Honeywell and V. G. Harrison - EMD
- IR 61-143  
An Investigation of Sandstone from the Lake Timiskaming Area of Ontario  
by R. K. Collings - MPD
- IR 61-144  
Investigation of Shale from the Vicinity of Ottawa, Ontario, as Lightweight Concrete Aggregate  
by N. G. Zoldners and H. S. Wilson - MPD
- IR 61-145  
Residence Time Measurements of a Shaft Furnace for the Iron Ore Co. of Canada Ltd.  
by G. G. Eichholz - MSD
- IR 61-147  
Semi-Autogenous Grinding Tests on an Iron Ore from Can-Fer Mines Limited, Kowkash, Ontario  
by P. D. R. Maltby and D. E. Pickett - MPD
- IR 61-148  
The Development of Improved Zinc-Base Die Casting Alloys. Phase II: The Effects of Addition Elements on the Mechanical Properties of Zamak Type Zinc-Base Die Casting Alloys  
by H. Guttman - PMD
- IR 61-149  
Investigation of Pipeline Failure  
by K. Winterton - PMD
- IR 61-150  
An Investigation Into the Cause of Failure of a Section of a Gas Transmission Pipe Line  
by C. M. Webster and W. A. Morgan - PMD



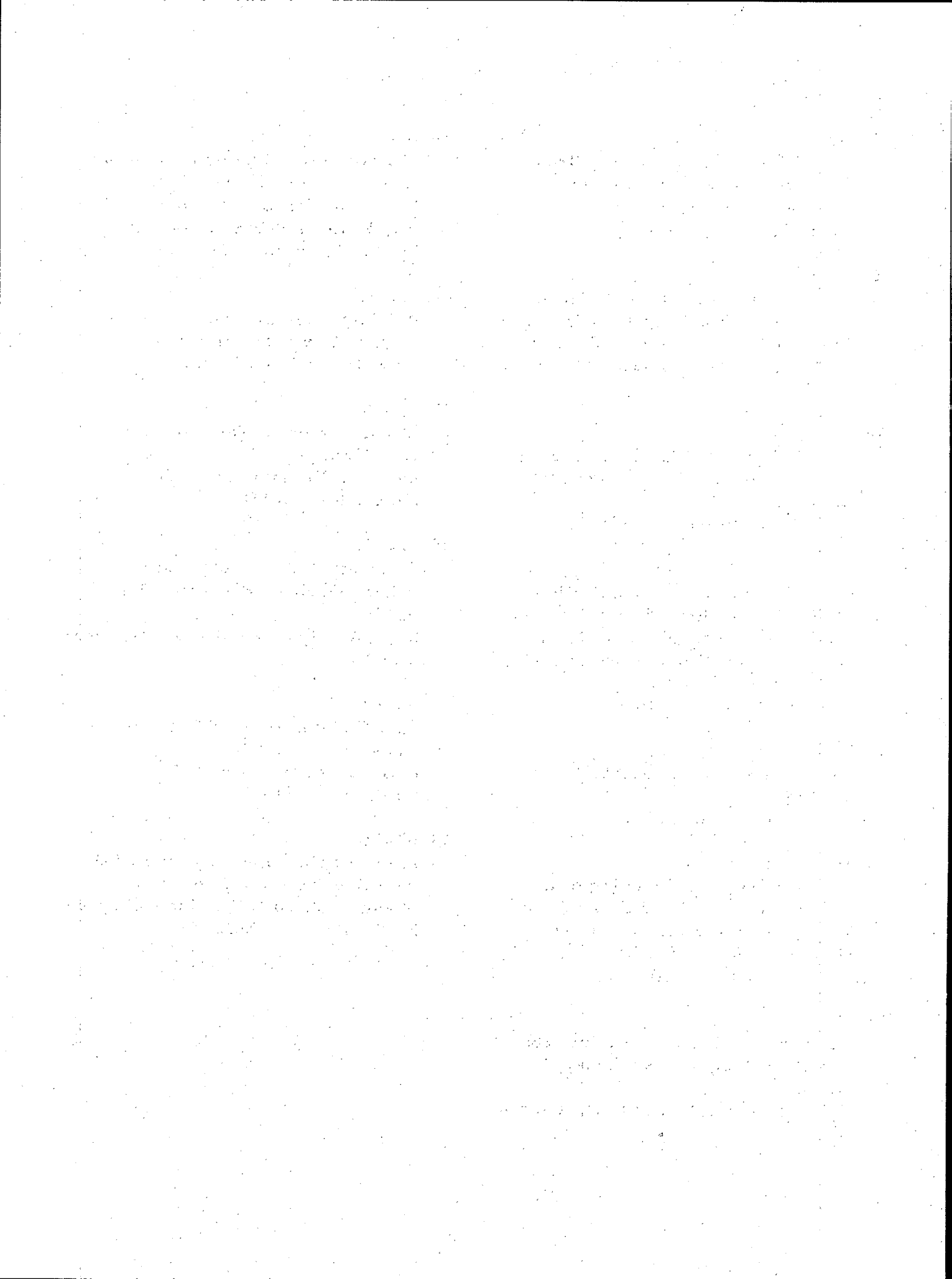
MINES BRANCH INVESTIGATION REPORTS 1962

- IR 62-3  
Influence of Transformation Reactions on Mechanical Properties and Corrosion Behaviour of Zirconium-Copper-Molybdenum Alloys  
by C. F. Dixon - PMD
- IR 62-9  
Barylite from Seal Lake, Labrador  
by E. H. Nickel and D. J. Charette  
- MSD
- IR 62-10  
Flotation Tests on an Oxidized Copper Ore from Phoenix Copper Company Limited, Grand Forks, B. C.  
by G. O. Hayslip - MPD
- IR 62-12  
Conductimetric Tests on Solution from Canadian Copper Refiners Limited  
by T. R. Flint - MSD
- IR 62-20  
Air Dust Monitoring at Dosco, Sydney, N. S., April 10, 1962  
by C. McMahon - MSD
- IR 62-21  
Concentration of Ilmenite from Titaniferous Magnetite Ore from Laurentian Titanium Mines, Ltd., Wexford Township, Quebec  
by W. S. Jenkins - MPD
- IR 62-23  
Determination of Hydrogen, Oxygen and Nitrogen in Molybdenum, Niobium, Tantalum and Tungsten  
by G. Smelsky and N. S. Spence - PMD
- IR 62-24  
Flotation of Lean Yellow Ore from Iron Ore Company of Canada, Schefferville, Que.  
by L. L. Sirois - MPD
- IR 62-25  
The Application of Computing Methods to X-ray Fluorescence Analysis - 1. Stainless Steels  
by A. H. Gillieson, K. S. Milliken and Miss M. J. Young - MSD
- IR 62-26  
The Application of Computing Methods to X-ray Fluorescence Analysis - 2. Copper and Nickel in Ores  
by A. H. Gillieson and Miss M. J. Young - MSD
- IR 62-31  
Flotation Tests on a Silver-Lead Ore from Magnet Cove Barium Corporation, Walton, N. S.  
by G. O. Hayslip - MPD
- IR 62-33  
The X-ray Identification of Aurostibite from South Africa  
by J. M. Stewart - MSD
- IR 62-34  
Examination of Canadian Pacific Coast Indian "Coppers"  
by A. Couture and J. O. Edwards - PMD
- IR 62-38  
Concentration of Mica from Valemount, B. C. (Project MP-IM-6116)  
by F. H. Hartman - MPD

- IR 62-39  
Investigation of Gold Recovery from Mill Products, from Madsen Red Lake Gold Mines Ltd., Madsen, Ontario  
by G. I. Mathieu - MPD
- IR 62-42  
Observations on Steel for RCN Tanker/Supply Ship (Provider)  
by D. R. Bell - PMD
- IR 62-43  
Investigation of a Mill Tailing for Hydraulic Backfill at New Calumet Mines Ltd., Calumet Island, Que.  
by T. F. Berry - MPD
- IR 62-44  
Studies on the Colouration and Chemical Quality of Some Lake Waters in the Shabiskwia-Badesdawa-Miminiska Lake Areas  
by J. F. J. Thomas - MPD
- IR 62-46  
Clay Mineralogy Investigation of Seventeen Samples of Bentonite Submitted by the Iron Ore Co. of Canada, Schefferville, P. Q.  
by R. S. Dean - MPD
- IR 62-47  
Neutron Activation Analysis of Two Ore Samples Submitted by Dr. R. H. Wright, Vancouver, B. C.  
by H. P. Dibbs and J. L. Horwood - MSD
- IR 62-49  
Investigation of a Gold Ore from McKinney Gold Mines Ltd., Rock Creek, B. C.  
by T. F. Berry - MPD
- IR 62-55  
An Investigation of Bentonites from Southern Manitoba  
by J. S. Ross and R. M. Buchanan - MPD
- IR 62-56  
Flotation and Cyanidation Tests on a Sample of Bearing Sulphide Concentrate, Submitted by Precambrian Mining Services Ltd., Yellowknife, N. W. T.  
by G. I. Mathieu and R. W. Bruce - MPD
- IR 62-57  
Evaluation of Brucite Limestone from Wakefield, Que., for Use as Concrete Aggregate  
by N. G. Zoldners - MPD
- IR 62-59  
Beneficiation of Barylite from Seal Lake, Labrador (Project MP-IM-6102)  
by K. M. Brown - MPD
- IR 62-63  
Conductometric Determination of Carbon in High Purity Molybdenum, Niobium, Tantalum and Tungsten Metals  
by R. Kobus, R. G. Sabourin and W. R. Inman - MSD
- IR 62-64  
Beneficiation Tests on Samples of Iron Ore from Lake St. Joseph Iron Limited in Northwestern Ontario  
by W. S. Jenkins
- IR 62-65  
Amalgamation, Concentration and Cyanidation Tests on a Gold Ore from Hanna Gold Mines Ltd. (N. P. L.), Cassiar, B. C.  
by G. I. Mathieu - MPD

- IR 62-66  
Cyanidation Tests on Two Ores  
from Bevcon Mines Limited,  
Perron, Quebec  
by T. F. Berry - MPD
- IR 62-68  
Grinding Investigation of Three  
Samples of Ore from East Malartic  
Mines Limited, Norrie, Quebec  
by M. J. Walker and T. F. Berry -  
MPD
- IR 62-71  
Beneficiation of Silica Rock from  
Canal Flats, B. C. (Project MP-  
IM-6208  
by F. H. Hartman - MPD
- IR 62-75  
Comparative Gold Precipitation  
Tests on "Durham Ultrafine" and  
"Durham Standard" Zinc Dusts  
Submitted by Dillons Chemical Co.  
Ltd., Montreal, P. Q.  
by R. P. Bailey - MPD
- IR 62-76  
Weldability Testing of X52 Steel  
Sample  
by K. Winterton - PMD
- IR 62-78  
Semi-Autogenous Grinding of a  
Sample of Copper-Zinc Ore from  
Mattagami Lake Mines Limited,  
Mattagami Area, Quebec  
by R. W. Bruce - MPD
- IR 62-80  
The Study of Carbonate Minerals  
from the Wabush Lake Area,  
Labrador  
by N. F. H. Bright and R. H. Lake -  
MSD
- IR 62-84  
Mineralogical Examination of an  
Iron Ore from Crown Prince  
Claim on Vancouver Island, B. C.  
for Western Ferric Ores Ltd.  
by W. Petruk - MSD
- IR 62-87  
A Mineralogical Investigation of  
Souxite Ore from Bolivia  
by E. H. Nickel - MSD
- IR 62-93  
Conductometric Tests on Noranda  
Leach Pulp  
by G. G. Eichholz and G. E.  
Alexander - MSD
- IR 62-98  
Concentration of Beryl from  
Amos, Quebec (Project MP-IM-  
6115)  
by R. A. Wyman and F. H. Hartman  
- MPD
- IR 62-102  
CSA Cement Testing Programme  
Phase I  
by N. G. Zoldners and V. M.  
Malhotra - MPD
- IR 62-114  
Mineralogical Investigation of an  
Iron Ore from the Lodestone  
Mountain Area in British Columbia  
by W. Petruk - MSD





## MINES BRANCH INVESTIGATION REPORTS 1963

- IR 63-1  
Mineralogical Report on a Sulphide Flotation Concentrate, Pamour Porcupine Mines Ltd., Pamour, Ontario  
by M. R. Hughson and S. Kaiman - EMD
- IR 63-2  
Corrosion of Uranium-Bearing and Uranium-Free "Stelcoloy" Low Alloy Steels Subsequent to Exposure in Acid Mine Water at Denison Mines, Elliot Lake, Ontario  
by G. J. Biefer - PMD
- IR 63-5  
Detection and Analysis of Metallurgical Defects in Steam Turbine Rotors  
by R. D. McDonald - PMD
- IR 63-9  
Investigations on a Carboniferous Gold Ore from Kerr-Addison Gold Mines Limited  
by W. R. Honeywell and H. H. McCreedy - EMD
- IR 63-12  
A Mineralogical Report on a Diamond Drill Core Sample from Phelps Dodge Corporation of Canada Ltd., Toronto, Ontario  
by M. R. Hughson and S. Kaiman - EMD
- IR 63-13  
Conductimetric Plant Tests at Noranda Mines Limited  
by G. G. Eichholz and G. E. Alexander - MSD
- IR 63-14  
Conductimetric Plant Tests at McIntyre Porcupine Mines Ltd. by G. G. Eichholz and G. E. Alexander - MSD
- IR 63-20  
Examination of Broken Shaft from Pretoria Avenue Bridge, Ottawa, Ontario  
by D. E. Parsons - PMD
- IR 63-36  
The Determination of Small Amounts of Niobium in Mild Steels by X-ray Spectrography  
by Mrs. D. J. Reed - MSD
- IR 63-39  
A Chemical Precipitation Method for the Production of a Homogeneous, High Purity Powder Applicable to the Lead Zirconate Titanate Solid Solution Series  
by V. M. McNamara and W. A. Gow - EMD
- IR 63-43  
Uranium-Treated High Carbon Wire Rope Steel  
by R. F. Knight and G. P. Contractor - PMD
- IR 63-46  
Preliminary Conductivity Probe Tests for Shawinigan Chemicals Limited  
by G. E. Alexander and G. G. Eichholz - MSD

- IR 63-51  
The Application of Computing Methods to X-ray Fluorescence Analysis. 3. Mathematical Derivation of a Correction Factor to Compensate for Variation in Surface Finish and Size of Samples  
by A. H. Gillieson, K. S. Milliken and Miss M. J. Young - MSD
- IR 63-53  
The Application of Polarography as a Rapid Control Method in the Determination of Zinc in Zinc Concentrates  
by C. H. McMaster - MSD
- IR 63-59  
The Effects of Some Fabrication Conditions on the Properties of Lead Zirconate-Titanate Ceramics  
by A. H. Webster - MSD
- IR 63-63  
Evaluation of Depressants Used in Iron Ore Flotation  
by L. L. Sirois and T. B. Sundara - MPD
- IR 63-66  
Analysis of Crushed Pellets Produced by Erie Mining Company for Standardization Purposes  
by D. J. Charette, J. C. Hole, F. W. Brethour and W. R. Inman - MSD
- IR 63-73  
Examination of Failed Engine Exhaust Assemblies for CS2F Aircraft  
by W. P. Campbell and R. D. McDonald - PMD
- IR 63-76  
Causes of Leakage in Commodity Tanks; RCAF D-38 Refuellers  
by M. J. Nolan and W. A. Pollard - PMD
- IR 63-98  
Uranium Air Dust Monitoring at Atlas Steels Limited, Welland, Ontario, August 9th, 1963  
by C. McMahon - MSD
- IR 63-106  
The Production of High Purity Niobium Oxide from Pyrochlore-Perovskite Concentrate  
by F. J. Kelly and W. A. Gow - EMD
- IR 63-118  
The Preparation of Commercial Grade Vanadium Pentoxide from Boiler Fly Ash Submitted by Canadian Petrofina Ltd., Pointe-aux-Trembles, Quebec  
by J. A. Vezina and W. A. Gow - EMD
- IR 63-119  
A New Method for Determining Fineness of Cement  
by V. M. Malhotra and G. G. Wallace - MPD
- IR 63-121  
Uranium Air Dust Monitoring at Atlas Steels Limited, Welland, Ontario, November 6, 1963  
by C. McMahon - MSD