*Report No. 44.*

# ANNUAL REPORT

OF THE

# RESEARCH COUNCIL OF ALBERTA

1943

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The following report, the Twenty-fourth Annual Report of the Research Council of Alberta, was submitted, in February, 1944, by the Director of Research Dr. R. Newton, President of the University of Alberta, to the Chairman of the Council the Hon. N. E. Tanner, Minister of Lands and Mines. The Chairman submitted the report to the Premier of Alberta, the Hon. E. C. Manning, who tabled it in the Legislature.

The first sixteen of the Annual Reports of Council were tabled in the Legislature, and subsequently published. The reports for the years 1936-1942 inclusive were tabled in the legislature but not published. The Council does not proposed to publish these reports; but it is hoped to publish special reports dealing with some of the more important subjects treated.

The present policy of the Council is to submit only brief Annual Reports to the Legislature; but to publish, from time to time as available, detailed reports on specific subjects.

This annual report, the first in the new series of brief reports, gives a general account of the work of the Council during the calendar year 1943.

The offices and laboratories of the Council are situated in the buildings of the University of Alberta. Requests for information and reports should be addressed to the Secretary, Research Council of Alberta, University of Alberta, Edmonton, Canada.

## MEMBERS OF COUNCIL

The Honourable N. E. Tanner, Minister of Lands and Mines, Chairman.

The Honourable E. C. Manning, Premier of Alberta, and Minister of Trade and Industry.

The Honourable W. A. Fallow, Minister of Public Works.

Dr. R. Newton, President of the University of Alberta, Director of Research.

L. E. Drummond, Esq., Edmonton.

J. E. Davies, Esq., Medicine Hat.

The Council operates under the Research Council Act of 1930, as amended 1943.

The offices and laboratories of the Council are at the University of Alberta. The Secretary is E. Stansfield.

## TECHNICAL ADVISORY COMMITTEE

Dr. R. Newton, President of the University of Alberta, Director of Research, Chairman.

Mr. R. S. L. Wilson, Dean of Applied Science, University of Alberta, Assistant Director of Research, Deputy Chairman.

Mr. W. D. King, Deputy Minister, Department of Trade and Industry.

Mr. G. H. Monkman, Deputy Minister, Department of Public Works.

Mr. A. A. Millar, Chief Inspector of Mines, Department of Lands and Mines.

Dr. J. A. Allan, Department of Geology, The University.

Dr. E. H. Boomer, Department of Chemistry, The University.

Dr. K. A. Clark, Department of Mining and Metallurgy, The University.

Prof. N. C. Pitcher, Department of Mining and Metallurgy, The University.

Prof. E. Stansfield, Fuels, Chief Research Engineer, and Secretary of Council, Secretary.

## TECHNICAL STAFF OF RESEARCH COUNCIL OF ALBERTA

The following have held full time, permanent appointments during the year:

Edgar Stansfield, Chief Research Engineer.

William A. Lang, Chemist, Fuels.

Jack S. Charlesworth, Chemist, Gasoline.

Edward Tipman, Assistant Chemist, Gasoline.

Anna Malanchuk, Compiler—from May.

Colin A. Genge, Assistant Chemist, Fuels—from May.

Catherine A. Fergie, Assistant Chemist, Fuels—from May.

Isobel H. Williamson, Assistant Chemist, Gasoline—from April.

Donald W. Clarke, Assistant Chemist, Fuels—to April.

The following held temporary appointments during the year:

Rose Pawluk, Assistant Chemist, Gasoline—July to September.

William B. McCormack, Assistant Chemist, Bituminous Sands—May to September.

William S. Peterson, Assistant Chemist, Bituminous Sands—from October.

Margaret Pike, Assistant Chemist, Gasoline—to March.

Gerdine Rowan, Assistant Chemist, Gasoline—January.

The following members of the Faculty of the University of Alberta assisted in the work of the Council:

Dr. John A. Allan, Geology.

Dr. Edward H. Boomer, Natural Gas and Bituminous Sands.

Dr. Karl A. Clark, Bituminous Sands.

Assistant Professor Andrew Stewart, Rural Electrification.

Associate Professor Wilfred E. Cornish (Deceased), Rural Electrification.

The services of Mr. W. I. McFarlane were made available for a short time, in connection with rural electrification, by courtesy of the City of Edmonton Power Plant Department.

# ANNUAL REPORT
## OF THE
# RESEARCH COUNCIL OF ALBERTA
## 1943

The Council was in active operation throughout the year, and the several reports which follow on the different phases of research give ample evidence of the great value and wide scope of the work done.

The increased staff and increased appropriation provided at the 1943 Session of the Legislature did not become available until April, so that the progress described later in several of the investigations is for work of only nine months or less.

The work was seriously handicapped, as was natural in war time, by difficulty in obtaining technical staff and services, by the impossibility of procuring some required equipment, and by delays in procuring other supplies.

The decision of Council to stress the publication of available information until this is brought up to date, has somewhat delayed the laboratory investigations and surveys. One report has been published and several others are in course of preparation.

Two distinct investigations are in progress on bituminous sands, and are reported below. The main investigation, No. 1, is under the direction of Dr. K. A. Clark in the Research Council's laboratory; a short investigation, No. 2, is under the direction of Dr. E. H. Boomer in the Department of Chemistry at the University.

The reports follow.

## BITUMINOUS SAND No. 1

Study of problems related to the development of the bituminous sands was resumed during the year. The last previous work by the Research Council of Alberta on these problems was reported in 1934. The intervening period was not devoid of progress however. During these years, attempted commercial development by Abasand Oils Ltd. was under way. Also, the Consolidated Mining and Smelting Company of Canada carried on studies both under its own and under federal government auspices. These and other activities have uncovered considerable new information.

Some interesting work was done in the Research Council of Alberta laboratories during the past year on the physical properties of bituminous sand. Two questions that are frequently asked are: how much space for oil is there in bituminous sand and how much of this space is filled with oil? These questions were answered for a good grade of sand from a quarry near McMurray. The answers are that about 40% of the volume of this bituminous sand is spaces between sand grains and that 85% of this total space is filled with oil. Most of the remaining space is filled with water.

Bituminous sand is heated in the process of separating oil from it and engineers need to know how much heat is required to raise its temperature. It was determined that it requires about one-fifth

as much heat to raise the temperature of bituminous sand as it takes to similarly raise the temperature of an equal weight of water.

Someone tries, every so often, to get the oil out of the bituminous sands without mining them, by heating the bituminous sand beds by some means operated from a drill hole. These people fail to realize how poorly heat travels through bituminous sand. It was determined that the coefficient of thermal conductivity of a typical sample of bituminous sand is 0.0035 in c.g.s. units. In other words, bituminous sand is not as good a heat insulator as the material put around steam pipes; but it is an exceedingly poor heat conductor. Needless to say the experimenters referred to have not had much success.

The hot water process of separating the oil from bituminous sands has always been a topic for study by the Research Council and its study has been renewed. The objective of the process is to win all the oil from the bituminous sand and at the same time have the recovered oil free from sand. Good success with the process has been had in the laboratory but large-scale plants have been disappointing in the matter of producing sand-free separated oil. The reason for this disappointment has been sought and much of it has been found. In the hot water separation process, the oil, which is heavier than water, is floated by means of air bubbles. The air bubbles can also float sand. The large dimensions of a large plant lead to an excessive amount of air bubbles unless the danger is understood and guarded against in the design.

Ichthyol is a pharmaceutical preparation used as a salve in the treatment of certain skin troubles. It is generally made from the oil obtained from certain oil shales. Some years ago, publicity was given to a claim that ichthyol could be made from the oil in the bituminous sand. A test of this claim was made in the laboratories of the Research Council. The indications were that the claim is true but that it is unlikely that bituminous sand oil will prove to be a profitable source of ichthyol.

One of the objections that has always been advanced against the manufacturing of gasoline from the bituminous sand oil has been the difficulty of removing the very high content of sulphur. This problem is being overcome rapidly by advances in the technique of oil refining. Some study of sulphur removal from gasoline made from the bituminous sand was done in the Research Council laboratories. The object of this work was to get first hand acquaintanceship with the new processes for sulphur removal which are appearing.

## BITUMINOUS SAND No. 2

Work on the problem of vis-breaking of Alberta bitumen was commenced in October. Progress was slow due to difficulties in obtaining equipment.

A sample of diluted bitumen from the Abasand plant was obtained through the Research Council and the diluent removed by distillation. The resulting crude bitumen was examined and its significant properties determined. It is not the same as virgin bitumen as recovered from the sands but will serve the purpose of the present work.

Apparatus has been procured, assembled and tested for the purpose of vis-breaking. The apparatus consists essentially of a

pump, single tube furnace, receiver and means of temperature, pressure and rate of flow control. Temperatures up to 1000°F, pressures to 1500 p.s.i. and rate of flow giving contact times from a fraction of a second to minutes can be provided. Accessory equipment for determination of the usual properties such as distillation range, gravity, viscosity, analysis of gases produced has been tested.

Routine experiments determining the vis-breaking characteristics of bitumen will commence early in 1944.

## COMPILATION OF NATURAL RESOURCES

For twenty-three years the Research Council of Alberta has, by investigation, by survey, and by study, accumulated a large mass of information with respect to the natural resources of the Province. Only a small percentage of this has so far been published. Other Provincial and Dominion organizations have similarly accumulated information which is not readily accessible. A compiler has been appointed by the Research Council to collect and organize such data in order to make it as available and useful as possible. It is planned to issue reports from time to time.

The main work of the year has been the compilation of data on Alberta coal. This work is still in progress, but a short report, for limited circulation, was completed on coals in the far north of the Province and in northern districts tributary to Alberta.

## FUELS

The sampling and analysis of the coals of Alberta, in co-operation with the Provincial Mines Branch, was continued actively in 1943, and the programme commenced in 1944 was completed. A new programme will start in 1944.

A number of samples of coal were analysed also in connection with projects undertaken by the Emergency Coal Production Board. During the year special tests included determinations of comparative storability of some coals.

Samples, to date, have been tested from 435 mines, located in 162 different townships scattered through the Province. The actual samples taken run into many thousands, some for analysis and others for special tests.

A good testimonial to the accuracy of the work of the laboratory is evidenced in a report published in 1943 on a cooperative investigation of the fusibility of coal ash made by 16 of the principal coal testing laboratories of North America.

A study was made and a paper published on alternative fuels for motor vehicles. This study was made in preparation for the anticipated increased demand and reduced supply of petroleum. It is proposed to ascertain the commercial possibilities of Alberta coals in this connection, and a cooperative investigation with the National Research Council has been planned, and initiated. This work involves the low temperature carbonization of the coals, to give a reactive producer gas fuel. A small apparatus has been constructed in which three coals can be tested at the same time, and a carbonizer has been designed for the low cost treatment of suitable Alberta coals. Progress so far, has been slow owing to lack of time of staff.

An experimental installation for the binderless briquetting of coal was completed during the year, but not tested. Coal operators

are showing increased interest in briquetting, particularly with respect to possible post war developments.

A study of the suitability of a number of typical Alberta coals for use in automatic domestic stokers was commenced. A small temporary building, with chimney, was erected to be equipped as a testing laboratory. Two main types of these stokers, the underfeed and the overfeed, are in general use and form a potential market for Alberta coal. Two hot air furnaces were purchased and a Fairbanks Morse underfeed stoker installed in one, and a Coutts Machinery overfeed stoker, kindly loaned by that Company, was installed in the other. The installation of furnaces and test equipment was not completed at the end of the year, but tests of coals will probably commence in February.

The Provincial gasoline testing laboratory previously operated by the Department of Trade and Industry, but with its own building on the University campus, was on April 1st transferred to the charge of the Research Council of Alberta. The transfer did not involve any change, either in the staff or in the nature of the work done.

More than 90% of the work of the year was for the Department of National Defence for Air, and consisted of tests of aviation gasoline from flying fields between the Great Lakes and the Pacific Ocean. In addition a few samples were tested for the Provincial Secretary's department, the Provincial Analyst, the Canol project, and some oil companies, etc. It should be noted, however, that this is not a custom laboratory designed to test any samples submitted.

The total number of samples tested during the year was 710 and the fees charged showed an increase of 12% over those for 1942. The full cost of operation of this laboratory was covered by the fees charged.

A special investigation was carried out on possible effects due to the addition of purple dye, on the storage and use of gasoline and other motor fuels.

## GEOLOGY

The geological work of the Council is directed by J. A. Allan in conjunction with the Department of Geology at the University of Alberta. Funds have not been made available for the publication of reports since 1935, so considerable data on the mineral resources of Alberta have accumulated.

Between April and July, Report 34 was written and proof read. This report consists of 196 pages and is in five parts:

Part I.—General geology of Alberta, with a geological map.

Part II.—Salt deposits at Waterways.

Part III.—Geology of Alberta soils.

Part IV.—Relief model of Alberta and its geological application.

Part V.—Geology of coal areas of Alberta, with coal areas map.

Five hundred copies of Part V were delivered to the Department of Lands and Mines for use and distribution.

A preliminary investigation was made of the coal deposits in the Grande Prairie district, and information was obtained on at least four occurrences of coal south of Wapiti River. The quality and

quantity of these coal deposits will be examined in 1944, provided the required technical personnel can be secured.

A field examination was made of a pumacite or volcanic glass deposit in the foothills west of Nanton and the Porcupine hills. This deposit is now being worked in a small way by D. Hopkins, and the processed material is being placed on the market as a cleanser and grease remover. Tests are being made on other uses for this natural product.

The Research Council, Geology Section, has cooperated for a number of years with the P.F.R.A., Dominion Department of Agriculture and the Soils Department at the University of Alberta. On the soil survey in 1943, J. A. Allan investigated the surface deposits in the Vermilion map area from Vegreville east to Vermilion and Kitscoty, and also the north side of North Saskatchewan valley from Frog lake west to Heinsberg, Myrnam ferry, Lafond and Brosseau. Additional information has been obtained on the glacial and other unconsolidated deposits, including clay and sand.

A field examination was made of various coal deposits including the coal stripping operations at Tofield, and the new coal stripping operations five miles east of Camrose.

Considerable assistance and advice was given to the Petroleum and Natural Gas Conservation Board in Calgary in connection with the geological work carried on under the supervision of the Board, particularly in connection with the preservation and utilization of rock core samples from various oil wells in Alberta. Recommendations have been made to the Honourable Mr. Tanner and to the Board on the best method of preserving the rock samples now on hand from many oil wells drilled.

Some time was spent in supplying information on coal deposits to the Coal Board of the Department of Munitions and Supply.

By request, J. A. Allan prepared short briefs for the Post-War Reconstruction Committee on:

1. Silica deposits in Alberta.
2. Clays and shales in Alberta.

Fullest cooperation was extended in many conferences with geologists from several oil companies who are now prospecting for oil in Alberta, discussing the geology of Alberta and supplying the companies with as much geological information as we have available. Similar cooperation was extended to several American engineers and geologists on northern development, especially on the possible occurrence of water supply and coal. Numerous requests have been received throughout the year for information on farm and town water supplies and for mineral and rock determinations for individuals and for high schools.

The available information in printed form is meagre on many mineral deposits and mineral products in Alberta. With funds for field investigation and when technical personnel is available to carry on these geological investigations, much valuable data on the mineral deposits and related natural resources, such as water, clays, sand, gravel, etc., could be obtained.

## RURAL ELECTRIFICATION

Substantial progress toward completion of a study of farm electrification was made possible through the active co-operation of many interested parties in the Province. All information collected and in the hands of other agencies was made available to the Research Council.

Consideration was given to the most suitable type of line for distribution of power to farms in Alberta. Specifications and estimates of costs for a 6,900 volt, single phase farm distribution line were prepared by professional engineers.

In order to secure information on density of farms and probable customers per mile of line, surveys were conducted in 18 districts, each of about one township in size. The districts selected were distributed throughout the portion of the Province already served by transmission lines. This large area includes approximately two-thirds of the rural population, and about the same proportion of all farms in the Province.

Experience suggests that if 30,000 farmers were connected over a period of 10 years, the average consumption at the end of the period might be about 750 kwh. per farm per year. The total consumption of 30,000 farms would then represent about 7 per cent of the total energy generated in the Province during 1941. In view of the anticipated drop in load at the end of the war it would appear reasonable to expect that there would be sufficient power available to proceed with an extensive programme of farm electrification at that time. There are, in any case, ample reserve sources of power should it later prove necessary to develop generating capacity to meet increasing farm or industrial load.

A full report on the study is in the process of preparation.

## MISCELLANEOUS PROJECTS

At the request of the Dominion War Metals Advisory Committee, some thirty-four samples of coal ash were tested for their vanadium content; these samples were selected to be representative of the coals of the Province. Vanadium was found in some samples, but only in traces of no commercial significance. A sample of bituminous sand was also examined without success.

The viscosity of oil at low temperatures is of importance in relation to the feasibility of pumping the oil in pipe lines exposed to winter temperatures. The viscosities of a sample of crude oil and of a sample of diesel oil were tested at low temperatures.

# LIST OF PUBLICATIONS
of
# RESEARCH COUNCIL OF ALBERTA
EDMONTON, ALBERTA

## ANNUAL REPORTS OF COUNCIL

**No. 3** (for the calendar year 1920); pp. 36. **(Out of print.)**
**No. 5** (for the calendar year 1921); pp. 86. **(Out of print.)**
**No. 8** (for the calendar year 1922); pp. 64. **(Out of print.)**
**No. 10** (for the calendar year 1923); pp. 76. **(Out of print.)**
**No. 12** (for the calendar year 1924); pp. 66. **Price 35 cents.**
**No. 16** (for the calendar year 1925); pp. 65. **Price 35 cents.**
**No. 20** (for the calendar year 1926); pp. 53. **Price 25 cents.**
**No. 22** (for the calendar year 1927); pp. 49. **Price 25 cents.**
**No. 24** (for the calendar year 1928); pp. 53. **Price 35 cents.**
**No. 25** (for the calendar year 1929); pp. 65. **Price 35 cents.**
**No. 26** (for the calendar year 1930); pp. 76. **Price 35 cents.**
**No. 27** (for the calendar year 1931); pp. 53. **Price 35 cents.**
**Nos. 28, 29 and 32** (for the calendar years 1932-1934); pp. 90. **Price 35 cents.**
**No. 33** (for 1935); pp. 43. **Price 35 cents.**
**Nos. 37-43** (for 1936-1942). Not published.
**No. 44** (for 1943); pp. 14. **Price 5 cents.**

## REPORTS—FUELS

**No. 10A** (1923); COMBUSTION OF COAL FOR THE GENERATION OF POWER, by C. A. Robb. **(Out of print.)**

**No. 14** (1925); pp. 64. ANALYSES OF ALBERTA COALS, with 18 maps and 2 charts. By E. Stansfield, R. T. Hollies, and W. P. Campbell. **(Out of print.)**

**No. 35** (1944); pp. 174. COALS OF ALBERTA—THEIR OCCURRENCE ANALYSIS AND UTILIZATION, by Edgar Stansfield and W. Albert Lang. **Price $1.00.**

Parts I-V—Occurrence, classification, production, special tests, general properties, preparation, utilization and combustion. **Price 50 cents.**

Part VI—Analytical and technical data by coal areas. **Price 50 cents.**

## REPORTS—ROAD MATERIALS

**No. 18.** THE BITUMINOUS SANDS OF ALBERTA, by K. A. Clark and S. M. Blair.

Part I (1927)—Occurrence, pp. 74. **Price 25 cents.**
Part II (1927)—Separation, pp. 36. **Price 25 cents.**
Part III (1929)—Utilization, pp. 33. **Price 25 cents.**

## REPORTS—SOIL SURVEY DIVISION

**No. 23** (1930); PRELIMINARY SOIL SURVEY ADJACENT TO THE PEACE RIVER, ALBERTA, WEST OF DUNVEGAN, by F. A. Wyatt and O. R. Younge; pp. 33 and colored map. Scale 1 inch to 4 miles. **Price 50 cents.**

**No. 31** (1935); PRELIMINARY SOIL SURVEY OF THE PEACE RIVER-HIGH PRAIRIE-STURGEON LAKE AREA, by F. A. Wyatt; with colored map. Scale 1 inch to 4 miles. **Price 50 cents.**

## REPORTS—GEOLOGICAL SURVEY

By Dr. J. A. Allan, Professor of Geology, University of Alberta.

**No. 1** (1919); pp. 104—A summary of information with regard to the mineral resources of Alberta. **Price 25 cents.**

**No. 2** (1920); pp. 138+14. Supplements the information contained in Report No. 1. **(Out of print.)**

**No. 4** (1921); GEOLOGY OF THE DRUMHELLER COAL FIELD, ALBERTA; pp. 72, and 6-color map (Serial No. 1). **(Out of print.)**

**No. 6** (1922, Part I); GEOLOGY OF THE SAUNDERS CREEK AND NORDEGG COAL BASINS, ALBERTA, by J. A. Allan and R. L. Rutherford; pp. 76 and 2-color map (Serial No. 2). **(Out of print.)**

**No. 7** (1922, Part II); AN OCCURRENCE OF IRON ON THE NORTH SHORE OF LAKE ATHABASKA, by J. A. Allan and A. E. Cameron; pp. 40; two maps (Serials Nos. 3 and 4). **(Out of print.)**

**No. 9** (1923); GEOLOGY ALONG BLACKSTONE, BRAZEAU AND PEMBINA RIVERS IN THE FOOTHILLS BELT, ALBERTA, by J. A. Allan and R. L. Rutherford; pp. 48, and 6-color map (Serial No. 5). **(Out of Print.)**

**No. 11** (1924); GEOLOGY OF THE FOOTHILLS BELT BETWEEN McLEOD AND ATHABASKA RIVERS, ALBERTA, by R. L. Rutherford; pp. 61 and 8-color map (Serial No. 7). One inch to two miles. **(Out of print.)**

**No. 13**; GEOLOGY OF RED DEER AND ROSEBUD SHEETS, by J. A. Allan and J. O. G. Sanderson. Two geological maps in 8 colors. Scale, one inch to three miles. Serial No. 8 Red Deer Sheet and No. 9 Rosebud Sheet. Five structure sections. **(Report in preparation.) Maps and sections 50 cents.**

**Map. No. 10** (1925); GEOLOGICAL MAP OF ALBERTA, by J. A. Allan. In 14 colors. Scale one inch to 25 miles. **(Out of print.)**

**No. 15** (1926); GEOLOGY OF THE AREA BETWEEN ATHABASKA AND EMBARRAS RIVERS, ALBERTA, by R. L. Rutherford; pp. 29 and 3-color map (Serial No. 11). One inch to two miles. **Price 50 cents.**

**No. 17** (1927); GEOLOGY ALONG BOW RIVER BETWEEN COCHRANE AND KANANASKIS, ALBERTA, by R. L. Rutherford; pp. 46 and 9-color map (Serial No. 12). Scale 1 inch to 1 mile. **Price 75 cents, or map alone 25 cents.**

**No. 19** (1928); GEOLOGY OF THE AREA BETWEEN NORTH SASKATCHEWAN AND McLEOD RIVERS, ALBERTA, by R. L. Rutherford; pp. 37 and 3-color map (Serial No. 13). Scale 1 inch to 3 miles. **Price 25 cents.**

**No. 21** (1930); GEOLOGY AND WATER RESOURCES IN PARTS OF PEACE RIVER AND GRANDE PRAIRIE DISTRICTS, ALBERTA, by R. L. Rutherford; pp. 80 and 6-color map (Serial No. 14). Scale 1 inch to 4 miles. **Price 75 cents.**

**No. 30** (1934); GEOLOGY OF CENTRAL ALBERTA, by J. A. Allan and R. L. Rutherford; pp. 41 and 10-color map (Serial No. 15). Scale 1 inch to 10 miles. **(Out of print.)**

**Map. No. 16** (1937); GEOLOGICAL MAP OF ALBERTA (Coloured), by J. A. Allan. Scale 1 inch to 16 miles. **Price 75 cents.**

**Map No. 17** (1939); GEOLOGICAL MAP OF ALBERTA (Black and white), by J. A. Allan. Scale 1 inch to 32 miles. **Price 5 cents.**

**Map No. 18** (1940); COAL AREAS OF ALBERTA, by J. A. Allan. Scale 1 inch to 32 miles. **Price 50 cents.**

**No. 34** (1943), in five parts, by J. A. Allan; pp. 202. **Price $1.50.**

Part I—General Geology of Alberta, pp. 37, and geological map No. 17, scale 1 inch to 32 miles. **Price 50 cents.**

Part II—Rock Salt Deposit at Waterways, pp. 19.

Part III—Geology of Alberta Soils, pp. 87. **Price 25 cents.**

Part IV—Relief Model of Alberta and its Geological Application, pp. 9.

Part V—Coal Areas of Alberta, pp. 36, and map No. 18, scale 1 inch to 32 miles. **Price 75 cents.**

## REPORTS—RURAL ELECTRIFICATION

**No. 36** (1944); pp. 107. RURAL ELECTRIFICATION IN ALBERTA, by Andrew Stewart. (Not available for distribution.)

Appendix I (1944); pp. 77. (Not available for distribution.)

Appendix II (1944); pp. 115 with maps. (Not available for distribution.)

## CONTRIBUTION SERIES

This series comprises papers submitted to technical societies or journals by members of the technical staff. They are not available for general distribution; but can be consulted in the original publication cited.

No. 1—Fuel Investigations of the Research Council of Alberta (1919-1940), by W. A. Lang. Trans. Canadian Institute of Mining and Metallurgy, Vol. XLV, 1942, pp. 27-44.

No. 2—Humidity Data Expressed in Grains Water Vapour per Pound of Dry Air, by Edgar Stansfield. Canadian Journal of Research, A 21, 1943, pp. 51-55.

No. 3—Alternative Fuels for Motor Vehicles, by W. A. Lang, The Engineering Journal, August 1943, pp. 449-454.

No. 4—Hot-Water Separation of Alberta Bituminous Sand, by K. A. Clark, Trans. Canadian Institute of Mining and Metallurgy, Vol. XLVII, 1944, pp. 257-274.

No. 5—Some Physical Properties of a Sample of Alberta Bituminous Sand, by K. A. Clark, Canadian Journal of Research, F 22, 1944, pp. 174-180.