Report No. 54

Twenty-Ninth ANNUAL REPORT

OF THE

RESEARCH COUNCIL OF ALBERTA

1948

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CONTENTS

The following report, the Twenty-ninth Annual Report of the Research Council of Alberta, was submitted in March, 1949, 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 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.
The Honourable W. A. Fallow, Minister of Public Works.
The Honourable J. L. Robinson*, Minister of Industries and Labour.
Dr. R. Newton, President of the University of Alberta, Director of Research.
L. E. Drummond, Esq., Edmonton.
J .E. Davies, Esq., Medicine Hat.

*Appointed to Council in October, 1948, to replace Hon. W. A. Fallow, Deceased.

The Council operates under the Research Council Act of 1930, as amended 1943 and 1945.

The offices and Laboratories of the Council are in the University of Alberta. The Secretary of Council is W. A. Lang.

TECHNICAL ADVISORY COMMITTEE

Dr. R. Newton, President of the University of Alberta, Director of Research, Chairman.
Mr. R. M. Hardy, Dean of Applied Science, University of Alberta, Assistant Director of Research, Deputy Chairman.
Mr. W. D. King*, Deputy Minister, Department of Industries and Labour.
Mr. J. E. Oberholtzer**, Deputy Minister, Department of Industries and Labour.
Mr. G. H. N. Monkman, Deputy Minister, Department of Public Works.
Mr. O. S. Longman, Deputy Minister, Department of Agriculture.
Mr. J. Crawford, Chief Inspector of Mines, Department of Lands and Mines.
Dr. J. A. Allan, Professor of Geology, the University.
Dr. K. A. Clark, Professor of Metallurgy, the University.
Mr. A. McCulloch, Chief Research Engineer.
Dr. J. D. Newton, Professor of Soils, the University.
Mr. J. E. Oberholtzer, Industrial Engineer (until September).
Dr. O. J. Walker, Professor of Chemistry, the University.
Mr. W. A. Lang, Secretary of Council, Secretary.

*Deceased.

**Appointed Deputy Minister, Department of Industries and Labour, September, 1948.

STAFF OF RESEARCH COUNCIL

The following held full time appointments on the technical staff during the year:

A. McCulloch, Chief Research Engineer, Fuels.
W. A. Lang, Senior Research Chemist, Fuels and Secretary of Council.
D. S. Pasternack, Research Chemist, Bituminous Sands.
M. B. B. Crockford, Geologist, Geology.
J. S. Charlesworth, Chemist, Gasoline and Oil Testing.
Wm. Odynsky, Soils Surveyor, Soils, from June.
J. E. Oberholtzer, Industrial Engineer, to September.
E. Tipman, Assistant Chemist, Gasoline and Oil Testing.
S. H. Ward, Assistant Chemical Engineer, Bituminous Sands.
J. Gregory, Assistant Chemical Engineer, Fuels, appointed Industrial Engineer in December.
W. H. A. Clow, Assistant Geologist, Geology, from May.
J. Fryer, Assistant Chemist, Fuels.
A. C. Bridge, Assistant Research Chemist, Fuels.
E. Sherlock, Assistant Research Chemist, Fuels.
M. M. Chmilar, Assistant Research Engineer, Natural Gas, to May.
S. J. Groot, Draftsman-Compiler.

The following held full time appointments on the non-technical staff during the year:

Miss K. S. Wark, Accountant-Librarian.
Miss R. J. Tate, Technical Stenographer, to June.
Miss S. M. Mackintosh, Technical Stenographer.
Miss P. A. Paterson, Stenographer, from June.
J. Tchir, Laboratory Assistant, Fuels, from September.
K. M. Dickinson, Laboratory Assistant, Fuels, from September.
R. Dalby, Laboratory Assistant, Natural Gas, to September.
R. Sacker, Laboratory Assistant, Gasoline and Oil Testing, to June.
A. Kostyk, Laboratory Assistant, Gasoline and Oil Testing, July-September.
R. C. D'Amur, Laboratory Assistant, Gasoline and Oil Testing, from September.

The following held temporary appointments during the year:

J. T. Cook, Assistant Geologist, May 1-September 22.
P. J. S. Byrne, Assistant Geologist, May 1-September 22.
E. J. Evans, Soils Assistant, May 1-September 30.
H. N. Hart, Soils Assistant, June 1-September 22.
C. J. McAndrews, Soils Assistant, May 1-September 30.
P. F. Melnyk, Soils Assistant, May 21-September 30.
R. P. Stone, Soils Assistant, May 15-September 30.
A. Wynnyk, Soils Assistant, May 1-September 30.
B. Hughes, Cook, Soils, June 1-September 22.
R. D. Dymond, Assistant Chemist, Straw, April 23-September 9.

W. G. Goward, Assistant Chemist, Straw, April 23-September 18.
J. P. O'Donnell, Assistant Chemist, Straw, April 23-September 23.
C. D. Gordon, Assistant Chemist, Straw, April 21-September 30.
Miss M. J. Blundell, Assistant Chemist, Straw, May 1-September 18.
R. C. Thurber, Assistant Engineer, Highway Research, May 1-September 15.
I. W. Sanden, Assistant Engineer, Highway Research, April 27-August 24.
D. E. Armstrong, Assistant Economist, Economic Survey, May 1-August 31.
D. R. Craig, Assistant Engineer, Bituminous Sands, May 10-September 4.
J. J. Eatock, Assistant Engineer, Bituminous Sands, May 10-August 7.
R. W. Edgecombe, Assistant Engineer, Bituminous Sands, May 10-September 18.
F. Friesen, Assistant Engineer, Bituminous Sands, May 10-September 4.
P. Leonidas, Assistant Engineer, Bituminous Sands, May 10-September 4.

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

Dr. J. A. Allan, Geology.
Dr. K. A. Clark, Bituminous Sands.
Dr. S. G. Davis, Natural Gas.
Dr. E. H. Gowan, Measurement of Ultra Violet.
Dean R. M. Hardy, Highway Research.
Dr. J. D. Newton, Soils Surveys.
Dr. W. Rowan, Animal Cycles.
Prof. A. Stewart, Economic Survey.
Dr. O. J. Walker, Utilization of Straw.

ANNUAL REPORT

of the

Research Council of Alberta

1948

The work of the Research Council of Alberta during 1948 included geological surveys of the coal, clay, sand and water resources of the province, a continuation of the soil survey of the Peace River district and further investigations into the cause of failure of provincial highways and of methods of road construction which will minimize failures. Fundamental studies of coal constitution and studies of processes for the upgrading of coal, particularly of the finer sizes, were undertaken by the Fuels Section. An economic survey was made to determine the pattern of production and unemployment in Alberta mines. The scope of the work of the Gasoline and Oil Testing Laboratory was broadened to include the analysis of all types of petroleum products with the exception of greases. Investigations for the recovery of bitumen from the McMurray bituminous sands were related to problems in the operation of the pilot-plant of Oil Sands Ltd. at Bitumount. The study of the applicability of the general method of water-flooding to recovery of oil from the bituminous sand was brought to a conclusion. Other investigations undertaken by the Council included the beneficiation of sand for glass, the chemical analysis of cereal straws and the measurement of ultra violet light. The Catalyst Testing project in connection with the synthesis of liquid fuels from natural gas was discontinued. The investigation, by the Industrial Engineer, of industrial processes that may be suitable for introduction into Alberta continues to be an important aspect of the work of the Council.

The renovation of the No. 1 Power Plant at the University for a coal preparation laboratory and the installation of the briquetting and coal crushing equipment in this building was completed in July. This building provides better facilities than previously available for carrying out the program of the Council on coal beneficiation.

The work on some of the projects has been curtailed both by inability to find suitably trained personnel and by delays in procuring supplies, but these few handicaps are lessening.

Report No. 51 "Annual Report of the Research Council of Alberta for 1947" was published during the year. A geological report on the Ribbon Creek-Elbow Area has been published as Report No. 52.

Members of the staff have contributed a number of technical papers to the scientific literature. In addition preliminary reports on certain of the investigations have been prepared and distributed as mimeographed circulars. A list of the major publications of the Council, since its inception, is given as an appendix to this report.

Brief summaries of the work under investigation during the year follow.

BITUMINOUS SANDS

The first half of the year was spent in completing the bituminous sand studies on hand and in assembling results for publication. The main project of the year was to have been the operation of the laboratory at the separation plant at Bitumount. The plant was not put into operation so little was accomplished at the laboratory.

Some further work was done on the role of the clayey content of bituminous sand in the hot water separation process. It has been realized for a long time that a high clay content affected the separation process adversely. More recently it was found that some clay content was necessary to the process. Good progress has been made in uncovering the way in which the clay functions. A technical report on the findings of the laboratory studies has been published as Report No. 53.

The study of the applicability of the general method of water-flooding to recover oil from the bituminous sands has been brought to a conclusion. The conclusion is that the method has no practical applicability. However, the study has yielded considerable new knowledge about the bituminous sand deposit. One finding of particular interest is that the oil in the southern part of the deposit is very viscous and that the oil becomes progressively more fluid northward. Because of these differences in viscosity the bituminous sand in the southern part of the deposit, near McMurray for instance, is so firmly cemented together by the viscous oil that excavating it is a troublesome operation. At the Abasand Oils Ltd. quarry the bituminous sand beds had to be loosened with explosives before excavation by power shovel was feasible. Farther north, the much more fluid oil holds the sand together much less firmly. At Bitumount the bituminous beds are dug directly by power shovel without difficulty. The findings of the water-flooding studies have been put into report form for publication.

The Research Council of Alberta has equipped the laboratory at the Bitumount plant and has undertaken to operate it. Plans were laid to do so during the inter-varsity period for plant control and for collecting operational data. The loss of the warehouse and its contents by fire in May seriously delayed the final completion of the plant. When it was set into operation in September mechanical

difficulties in the separation plant were encountered. The Board of Trustees decided to postpone plant operation until the spring. Consequently there is nothing to report about laboratory work.

FUELS

The chemical and physical survey of Alberta coals, based principally on the examination of the channel samples of coal seams taken by the District Mines Inspectors of the Provincial Mines Branch of the Department of Lands and Mines, has continued as in former years. In order to establish an adequate basis for the more systematic development of the survey, a detailed study has been made of the whole of the analytical data now available. It has been found that the way in which the properties of Alberta coals vary, differs, generally speaking, from that shown by the coals of the United States and Europe. No explanation can yet be advanced for this occurrence, but it is thought that it might be due to the more extreme conditions of pressure under which the coals of Alberta have been formed.

The calculated relationships of the properties of Alberta coals, find useful application in checking the accuracy of analytical results and permit one to distinguish readily coals which have weathered, such as may occasionally be obtained in the course of geological surveys. Of particular scientific interest is the observation that with Alberta coals, the capacity moisture contents appear to follow a step-wise course as the carbon contents increase and the oxygen contents decrease in passing from immature to mature coals. This observation provides supporting evidence for what apparently is a related phenomenon, namely the step-wise change shown by measurements of the reflective power to light, of discrete areas of polished surfaces of coal specimens, which has been reported by Dr. C. A. Seyler of the British Coal Utilization Research Association. Experimental work is in progress with selected Alberta coals to determine if measurements of the total reflective power to light with these coals show a similar progression.

The first stage of the investigations with the New Stansfield retort for the low-temperature carbonization of subbituminous coals has been concluded satisfactorily. The principles of operation of the retort have been established using the results of carbonization tests which have been carried out in the laboratory. The working capacity of the present retort is approximately 21 1/2 cwts. of coal per 24 hour working day. With adequate instrumentation and scientific control the retort will operate continuously for long periods. Under these conditions, 56 to 58 per cent. by weight of a subbituminous coal containing about 25 per cent. of water is obtained as a char which contains 8-10 per cent. of volatile matter. Apart from small quantities of carbon monoxide (and possibly of other combustible gases), combustion of the volatile matter from the coal is

practically complete and heat is transferred at a high rate from the hot gaseous products to the coal undergoing carbonization.

Further experimental work is necessary to determine the maximum throughput of a baffle system such as is employed in the retort, and to ascertain whether utilization of the considerable amount of waste heat for partially or completely drying the coal to be carbonized, or for preheating the air for combustion, would be the more economic procedure.

The investigation on the briquetting of blends of non-coking and coking bituminous coals, and of non-coking subbituminous coal and coking bituminous coal was continued. The program included the carbonization of the briquettes in a small vertical retort. A procedure has been developed for determining the quality of the carbonized briquettes, and for the collection of the tar products that may be recovered in the carbonization step. It was considered inadvisable to design and build carbonization equipment on a pilot-plant scale until more information had been obtained from the small-scale tests.

Two new investigations were started, one a study of the briquetting quality of various asphalts produced within the province; the other a study of the possibility of the production from slack coal of a product of suitable size and quality for domestic and industrial purposes without the use of pressure. The former investigation is being undertaken with the co-operation of the coal firms having briquetting plants and the oil refineries producing asphalt within the province.

Completed copies of the questionnaire soliciting detailed information on present coal cleaning practices in the Coal Industry in Alberta in the subbituminous and bituminous coal mines have now been received. An analysis of the information in the questionnaires has led to the suggestion that consideration might be given in the subbituminous mines to the desirability of adopting a somewhat lower size limit for subbituminous coals to be marketed for stoker purposes. As in coal-producing regions elsewhere, one problem of great importance is the cleaning of fine coal. Coal-cleaning other than picking is not practiced in the subbituminous coal mines of Alberta. The coals mined are relatively low in mineral matter content. Tests, however, which have been made on a working demonstration model of a plant for the dry cleaning of fine coal, using an aerated bed of sand of suitable working gravity, have shown that the mineral contents of the fine subbituminous and bituminous coals can be reduced by this method. Experimental work in the laboratory has centred on a study of the factors operative in hindred settling such as occurs, for example, in jig washing. The results obtained emphasize the importance of the voidage factor and particular attention

has been directed to this in the light of investigations by other workers which have recently been published.

Technical assistance has been given to the Provincial Mines Branch as requested from time to time, particularly in the matter of the atmospheric pollution of mine air with exhaust gases from Diesel locomotives, on the sampling and analysis of mine air and on the revision of regulations for the rock dusting of coal mines. Some account of the tests on Diesel exhaust gases carried out by the Research Council is included in a paper read by J. A. Brusset, Esq., on Diesel Traction in Coal Mines, before the Jubilee Convention of the Canadian Institute of Mining and Metallurgy held in Vancouver early in 1948. Whilst a few visits have been paid to coal mines in the Edmonton district, visits to coal mines elsewhere have not been possible.

A submission on the scope of coal research in Canada was prepared and presented to members of the Dominion Coal Board at a meeting held in Calgary, April, 1948.

A paper dealing with the low-temperature carbonization of subbituminous coals in the New Stansfield Retort was read before a meeting of the Division of Gas and Fuel Chemistry of the American Chemical Society at its 114th Meeting held in St. Louis, Missouri from September 6-10.

Lectures dealing respectively with some aspects of the fuel resources of the Province and with the application of scientific data to fuel selection and utilization have been delivered before the Canadian Institute of Mining and Metallurgy at meetings held respectively in Winnipeg and Edmonton.

An account of the preliminary phases of the work on the properties of Alberta coals is published in the Journal of the Institute of Fuel, Vol. 22, 1948, page 10.

A visit has also been made to certain coal research organizations in the United States, selected since some of the researches being undertaken there have a bearing on the research programs of the Research Council.

The visits of representatives of the Council for Scientific and Industrial Research of Australia, of the British Commonwealth Scientific Office (United Kingdom Mission), and of two members of a delegation representing the Engineering Industries of Great Britain, have provided opportunities for discussion on modern scientific and technical developments relating to the occurrence, preparation and utilization of coal and on the research work at present in progress in the laboratories of the Research Council.

The closest contact continues to be maintained with the Provincial Mines Branch and every assistance has been given by the Provincial Chief Mines Inspector and his technical staff in response to requests which are made to the Mines Branch from time to time. Appreciation must also be recorded of the courtesies invariably shown by the Coal Operators and the members of the staffs of the coal mining companies.

GASOLINE AND OIL TESTING

The Provincial Gasoline and Oil Testing Laboratory has examined during the year practically every type of liquid petroleum product with the exception of grease. The analytical work carried out for the Royal Canadian Air Force in Western Canada under the scheme of co-operation with the Dominion Government Department of National Defence has been extended to include the examination of samples of petroleum products submitted by the Army. As in former years a considerable volume of testing has been done for several of the Provincial Government Departments. The testing of commercial samples for which payment is made at standard rates has been continued.

A detailed report has been published on the quality of gasoline sold in the Province of Alberta from 1939 to 1947. This survey covers the period up to the end of 1947 during which the sampling and examination of gasoline has been officially conducted. Hereafter it is hoped to publish each year a motor gasoline survey of the Province for the preceding twelve months' period. The survey for the year 1948 has been completed and copies of this as well as the former survey are available on request to the Gasoline and Oil Testing Laboratory.

The closest contact continues to be maintained with the Petroleum Sub-committee of the Canadian Government Specifications Board of the National Research Council, on which body the Research Council of Alberta is officially represented. This Sub-committee is responsible for the formulation and drafting of petroleum products specifications for the Armed Services and for the Canadian Government. Through this group also, the highest degree of accuracy is maintained in analytical methods for petroleum testing used by other research and testing organizations throughout Canada and by the major oil companies. Experimental work has been and continues to be carried out in the Gasoline and Oil Testing Laboratory in connection with the work of this Sub-committee.

Technical assistance has been given to the Provincial Government, Department of Industries and Labour in the re-drafting of Alberta Standard Specifications for Motor Gasoline.

Work of a confidential nature has been carried out for the Defence Research Board of the Dominion Government Department of National Defence.

GEOLOGY

Several projects and a number of routine investigations were undertaken in 1948. The principal projects were a search for high grade clays, and a detailed survey of mineral resources in specific areas with emphasis on water supply. Other investigations were carried out respecting coal and glass sand. In addition to the above undertakings, the preparation of geological maps has required considerable attention. The year's activities are summarized topically below.

Clay

A small number of clay samples, taken late in 1947 from the Cypress Hills of southern Alberta, were sent to Professor W. G. Worcester, at the University of Saskatchewan, for burning tests. Results of these tests showed that a few of the clays have good possibilities for use in terra cotta, heavy pottery and sewer pipe. In 1948, as a consequence of these preliminary investigations, a diligent examination was made of all known outcrops of clay and shale that indicated possibilities for use in the manufacture of the better class of pottery such as stoneware, sewer pipe and whiteware. Since the Whitemud formation is the principal source of the better grade of clays in Saskatchewan, particular attention was given to this rock formation, which outcrops in the Cypress Hills of southeastern Alberta. Aerial photographs were used in locating likely clay outcrops.

In this survey over 100 clay samples were obtained. Additional clay and shale samples were taken from other rock formations in the Crowsnest Pass and Red Deer River areas. These clay and shale samples have been sent to the Ceramics Division, Bureau of Mines, Ottawa, for testing. The report on these clays has not yet been received.

A summary of the known clay deposits of Alberta was compiled late in 1947 and is now available to interested persons.

Coal

In view of the present interest in the strip mining of coal, an examination was made of certain operating mines and prospects in the Crowsnest Pass, Ribbon Creek and Drumheller areas. Some assistance was given to coal operators during the time of these visits.

Since aerial photographs of the Ribbon Creek area, Kananaskis River district, were made available after the completion of the 1947 survey, and since active development has been undertaken in this area, a few weeks were spent in further geological investigations in order to bring the information up to date. The report, on this area which contains important coal measures, has been published as Research Council of Alberta Report No. 52.

Water Supply, Gravel, Sand, Etc.

It is proposed to survey the province systematically in order to gather information with respect to water supply, coal, gravel, sand, clay and other minerals of economic importance. A unit of coverage is the area included in a map of uniform size called a sectional sheet, which has dimensions approximately 50 by 90 miles. In these surveys special attention is given to correlating geologic conditions with water supply as well as examination of mineral deposits.

In the past summer two units east of Calgary were surveyed. One area, covered by the Rainy Hills sectional sheet, lies between townships 16 and 24, ranges 16 to 29, west of the fourth meridian, and supports such towns as Cessford, Empress, Hilda and Brooks; the other, the Blackfoot sectional sheet, takes in the area between townships 17 and 24, ranges 16 to 29, west of the fourth meridian, and includes such towns as Gleichen, High River and Vulcan. The Rainy Hills area was worked first. In this area almost every farm was visited and water supply information obtained in considerable detail. It was thought that the value of the water well data gathered in this way was disproportionate to the effort expended, and that in further surveys almost equivalent results could be obtained by collecting water well data from fewer, selected sources. Work in the Blackfoot area followed this latter plan with satisfactory results.

In the Rainy Hills area detailed data were collected on over 400 water wells, and a number of samples from water wells were taken for chemical or bacterial analysis. As a whole this region has difficulty in obtaining a sufficient supply of ground water; for only in a few centres, viz., Cessford, Empress and Hilda, is the water supply sufficient for their needs. The irrigation district about Brooks and Duchess has a water problem, for at present irrigation ditches are the prinicipal sources of supply.

Since the larger part of Rainy Hills area is within the dry belt, and hence climatically favourable for the accumulation of sodium sulphate (mirabilite) deposits, which occur in southwestern Saskatchewan in commercial quantities, testholes were dug on the margins of sloughs and lakes. These tests did not encounter commercial deposits of sodium sulphate.

The area covered by the Blackfoot Sheet was surveyed in less time than the Rainy Hills Sheet. In general there is little trouble in obtaining adequate water supplies in this region, there being just two areas, viz., Gladys Ridge, and in the vicinity of Milo, where ample supplies of good potable water are not easily available. These two areas were given special attention during the survey, and contact will be maintained with well-drillers in an endeavour to assist in further development. Reports on these two sectional sheets are in preparation.

Sand for Glass

A deposit of sand situated near Peace River town was examined in some detail and further samples secured. This sand runs high enough in silica (98.8% after beneficiation by magnetic separation and tabling) to be classed as a glass sand. The sand is undergoing further tests, the conclusions of which will be incorporated in a report already near completion.

Two occurrences of reportedly high silica content sand were examined, but they are not of commercial importance. One of these deposits, near Hilda, is a sand deposited by glacial action, and has a very limited extent. The other deposit, near Bellis, while apparently of considerable extent, is composed of brown sand of insufficient purity for glass sand.

Geological Maps

Since the Geological Survey of Canada has turned out geological maps of Saskatchewan, Manitoba, and the Maritime Provinces, that body was approached regarding the compilation of a similar map for Alberta. This the Survey agreed to do, subject to certain assistance and approval of the Research Council. Work on this project is now well advanced.

The geological map of the Ribbon Creek area, has been printed. This map, with cross-sections, accompanies the geological report on the above area.

HIGHWAY RESEARCH

The work during the summer consisted of a systematic study of soil conditions and the densities secured with the construction procedures being used on three particular new construction jobs in the Province. The three projects on which work was done were located in the area immediately east of Edmonton in a fine silty type of soil; the area west of Medicine Hat in a silty soil in a dry area; and in a heavy clay soil and muskeg area west of Edmonton. With the co-operation of the contractors the effect of varying the operations as to number of passes of compaction equipment, thickness of compacted layer and so forth were studied.

The field data are still in the process of being analysed. However, several general conclusions may be drawn from the information now available. The importance of close moisture control on the job is very evident from the data. It is expected that the detailed study of the data will provide information as to the range over which the moisture content may be varied from the optimum if satisfactory densities are to be secured. The program also showed the need of further work being done on the most efficient methods for adding the necessary water to the soil to be built into the embankment if the water is to be most efficiently used in the construction.

This is particularly so in dry areas. The opposite problem exists in areas in which the moisture content of the soil being placed in the embankment is wetter than the optimum. In many respects this creates a more serious difficulty than in the case where water must be added to the soil to get efficient compaction. It is expected that a study of the data will yield a certain amount of information on desirable alterations in the method of compaction to more efficiently handle the wet soils. The work has also indicated the desirability of careful organization as to the use of the compaction equipment in conjunction with the operation of the dirt moving equipment on the job.

The financial assistance on this project was augmented by a grant of $500.00 to the Department of Civil Engineering of the University made by the Prairie Road Builders Section of the Canadian Construction Association. This additional money enabled the scope of the project to be expanded somewhat from what it would have been possible to do with the grant from the Research Council alone. Acknowledgement is made of the complete co-operation given to the project by the contractors on whose jobs the project was conducted.

INDUSTRIAL PROJECTS

During the year requests for information have been received on a wide variety of subjects. Inspection trips were made to many plants in Alberta and investigations were carried out on a number of possible industrial developments. Assistance was rendered the Provincial Industrial Development Board in connection with plants in which the Provincial Industrial Development Corporation had a financial interest. The Industrial Engineer also provided liaison between the Council, provincial government and industrial organizations.

It is gratifying to report that the Rock Wool plant was operated successfully in 1948, that a propane plant with a capacity of 17,000 gallons of liquefiable gases, mainly propane, was built at Turner Valley and that a plant to process Alberta bentonite and other materials for the preparation of drilling muds for the oil industry has been enlarged.

NATURAL GAS RESEARCH

The testing of catalysts, for use in the synthesis of liquid fuels from carbon monoxide and hydrogen, was discontinued in May, 1948. The development of the Leduc Oil field in 1947 had minimized the urgency in Alberta for synthetic fuels from natural gas and from coal. The Council will continue to maintain contact with work being done elsewhere on both the Bergius hydrogenation and Fischer-Tropsch synthesis processes and also on the gasification of coal to produce a suitable gas for use in the synthesis process. The equipment used for the natural gas project has been loaned to the Depart-

ment of Chemical Engineering at the University for use in fundamental studies of chemical synthesis.

ECONOMIC SURVEY

A study of under-employment in the Alberta coal industry was commenced in May, 1948. It will be completed early in 1949 and a report prepared for distribution. The following summary outlines progress to date.

During the war years the pattern of production and employment in most Alberta coal fields improved considerably; and, up to the present, conditions generally have remained relatively favourable in comparison with those prevailing prior to 1939. However, even in such periods of relatively high activity, there is a significant amount of under-employment of workers attached to the industry, and many Alberta mines operate below full-capacity. Slack periods occur, and, in some fields, mining operations may be suspended entirely or may be carried on for no more than one or two days a week. The resultant under-employment is associated with less-than-full utilization of plant; and with higher average costs per ton of coal mined.

For purposes of analysis under-employment may be classified under two headings: seasonal and intermittent. A worker is defined as *intermittently employed* when he is employed less than full-time, but obtains enough work to keep him 'hanging around' the mine. A worker is defined as *seasonally employed* if he is employed only for part of the year, and for the remainder is laid off or drifts out of the industry on his own because of low earnings. Intermittent employment is seasonally distributed; during the slack summer months workers tend to be employed fewer days per week than in the winter months. But the effects of seasonal and intermittent employment are significantly different; and the two conditions may require different treatment.

The first step in the problem was the measurement of seasonal and intermittent employment. This involved a statistical analysis of employment, over the past 20 years, for each of the six most important fields in the Province. ("Fields" as referred to here, coincide with the Mines Branch division of coal producing areas, as indicated in the Annual Report of the Branch.)

Monthly data were tabulated; and graphs prepared. Five-year monthly averages disclosed little seasonal fluctuation in the level of employment in the fields supplying coal to the railways. Intermittent employment in these fields, although severe in the early thirties, showed considerable improvement even before the war. On the other hand, in the domestic fields, both seasonal and intermittent employment have been significant, even during recent years. For this reason, and because less attention had apparently been given to them in other enquiries, it seemed desirable to direct consideration mainly to the domestic fields.

In terms of the incidence of under-employment, the labour force in any particular field can be divided into three categories.

Group A. Those workers who are steadily employed throughout the year, e.g., administrative and maintenance workers, and some workers steadily employed at mining coal during the winter months and who are put at deferred maintenance in the summer months. Some of these workers are on salary: others are wage-earners. The distinguishing characteristic is that of continuous employment.

Group B. Those workers who, although not fully and continuously employed, are given enough employment to keep them 'hanging around' the mine all year. The "Evans Report" refers to such a group, and concludes that, since these men stay on at the mine year after year, they must feel that, combining summer and winter earnings, annual earnings are adequate.

Group C. Those workers who, although perhaps securing substantially full employment during the winter months, are not employed in the mines for some substantial period during the summer months.

For any field the number of individual workers falling into these three categories could be accurately determined only from the record of the companies; that is, by a field study in which the time sheets of the mines could be examined and workers classified from the records of time worked. Such a study might prove valuable, but was not possible with the resources available. An alternative procedure was therefore devised. The method can be illustrated by reference to the Edmonton field.

The published statistics indicate the employment of 656 men in the Edmonton field on December 31, 1945. This number included 39 officials, 33 horse haulage employees, 4 ventilation employees, 29 timber men, 3 pump men, 111 administrative employees, 19 foremen and clerks, 18 engine men, 20 tradesmen, mechanics, carpenters, etc., and 101 men classed as 'other employees'. In all, these employees numbered 374; and would include all the workers in Group A. Consultation with informed persons suggested that the number receiving full-time continuous employment would be between 100 and 150.

The statistical estimate of the number of workers in Group A rests on two assumptions. First, that the services of these employees are independent of, and bear no significant relation to, the amount of coal actually raised, within the limits of present capacity. Second, that the output of coal varies in proportion to the number of other workers employed, i.e., the output per man of the other workers is constant, regardless of the number employed. It follows that, if the number of workers in this group (Group A) were correctly estimated, and their working time deducted from the total number of shifts, the

amount of coal actually raised divided by the remaining shifts worked would be constant.

Table 1, gives the five-year averages (1936-1940) of the number of shifts worked and of the amount of coal mined per month. The number of tons mined per man-shift is computed from these two averages. It is clear from the table that there is a marked slump in output per man during the summer months.

In Table 2, 2,300 shifts (the equivalent of 100 men working 23 shifts per month) are subtracted from the total shifts worked per month, and the remainder is divided into the total output. With the exception of August and September, the variation in output per man, so derived, is relatively slight, i.e., from 3.98 tons to 4.22 tons. The crude estimate in Table 1 shows a variation from 2.35 to 3.71 tons. It is thought that the low estimates for August and September may be due to additional employment for deferred maintenance or development work prior to the season up-swing in activity. Similar calculations were made, assuming more than 2,300 shifts of continuous employment, without narrowing the range of output per residual man. Consequently, the procedure suggests an estimate of 100 employees in Group A, in the Edmonton field.

As employment does not normally fall below 350 in the Edmonton field, there would appear to be another group of approximately 250 men in Group B, i.e., who are given enough employment to keep them 'hanging around' the mines all year.

The estimated number of workers in Group C may be found from the difference between the high and low monthly employment. In the Edmonton field employment ranges from 850 in the winter to 350 in the summer. Consequently, there must be some 500 men who are subject to seasonal employment, and are 'laid off' for a period during the summer months. The pattern of their employment is roughly as follows. They are taken on about September and are given work for 3 or 4 days a week. As coal orders increase, their employment become fairly stable, and remains so until January or February. As the summer months approach the number of shifts worked per month decline, and more and more of the workers are laid off or drift out of the mines on their own.

The analysis described above was applied to the Edmonton, Lethbridge and Drumheller fields with the following results. As the results are necessarily only approximations all proportions are deduced to the nearest 5%.

Proportion of Workers in Groups A, B, and C
Edmonton, Lethbridge, Drumheller

	Group A %	Group B %	Group C %
Edmonton	10	30	60
Lethbridge	10	35	55
Drumheller	10	20	70

Table 1

AVERAGE OUTPUT PER MAN-SHIFT ("MAINTENANCE" MEN INCLUDED)

Edmonton Field 1936-1940

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5 years average of shifts worked	21,224	18,555	12,528	8,269	6,677	5,882	5,499	7,453	10,386	17,676	20,657	19,937
Average output	75,371	69,924	40,231	24,760	17,970	14,751	12,923	17,067	30,850	62,119	73,998	70,405
Output per man	3.55	3.71	3.21	2.99	2.69	2.51	2.35	2.29	2.97	3.51	3.58	3.53

Table 2

AVERAGE OUTPUT PER MAN-SHIFT EXCLUSIVE OF "MAINTENANCE" MEN

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5 years average of shifts worked	21,224	18,885	12,528	8,269	6,677	5,882	5,499	7,453	10,386	17,676	20,657	19,937
Shifts worked by "Maintenance" Men	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300	2,300
Remaining shifts worked	18,924	16,555	10,228	5,968	4,377	3,582	3,199	5,153	8,086	15,376	18,357	17,637
Output per man	3.98	4.22	3.91	4.15	4.11	4.12	4.04	3.32	3.82	4.04	4.03	3.99

Consideration has been given to the relation between under-employment and cost per ton raised. This aspect of the problem has been touched upon in other enquiries. The evidence and conclusions from other enquiries have been summarized; and an independent estimate has been attempted.

The general literature and the many commission reports on the coal industry have been reviewed; and the proposals for alleviating the problems of the industry, particularly those associated with under-employment, have been studied. Other measures being given consideration include (a) Regular monthly payments by customers, with delivery at the convenience of the mine. Under this arrangement the mine could take full advantage of the capacity of the customers' bins for storing summer coal, (b) Summer delivery to customers combined with deferred payments. Under this arrangement, which is a modification of the first, the customer would accept delivery of coal during the summer, but would not be required to pay until the fall.

SOILS

In the Peace River District the soil survey covered the eastern portion of the Smoky River Sheet, except for about five townships. About 33 townships, or 760,000 acres within township 73 to 80 inclusive and ranges 14 to 19, west of the 5th meridian, were covered. The following townships were surveyed: townships 73 to 76, ranges 14 to 16 inclusive; townships 77 to 79, ranges 14 to 18 inclusive, and township 80, ranges 14 to 17 inclusive.

Because of the late spring the survey was not started until June 7th, but the weather was better than last year, and satisfactory progress was made. About 6 townships were done by car, about 12 by saddle horse, and the remainder were done by walking the cutlines. The field work was completed on September 17th.

About 15 percent of the quarter section parcels of this area are at present cultivated, at least in part. The remainder is virgin land, of which a considerable percentage may be available for settlement. About one-third of the surveyed area, or about 250,000 acres, consists of fairly good or better arable land. In this surveyed area, 9 townships are reserved for a Metis colony and 1 township for an Indian reserve.

The available crown land is characterized by a fairly heavy stand of mixed forest cover, a considerable percentage of which is green. The cover is essentially poplar with occasional spruce and some pine bluffs. Clearing plans were prepared for about 20,000 acres during the summer, and for an additional 20,000 acres in October.

A soil survey and map of townships 75 to 80, from range 20, west of the 5th meridian, to range 6, west of the 6th meridian, inclusive, is now being prepared, and should be ready for publication this winter.

Five townships remain to be surveyed on the Smoky River Sheet, namely, townships 77 to 80 inclusive, range 19, and township 80, range 18. A considerable amount of checking is required also to complete the eastern half of the Smoky River Sheet. Then it is recommended that the soil survey be expanded southward from the top of township 72 to the bottom of township 69, from ranges 14 to 19 inclusive, to complete the High Prairie Sheet. This would include all arable land north of the Swan Hills within these ranges. When this block is completed a second area suitable for publication will have been completed. This area would consist of townships 69 to 80, ranges 14 to 19, inclusive, west of the 5th meridian. It would contain approximately 72 townships or 1,660,000 acres. When this block is completed the survey could be expanded westward to cover the Sturgeon Lake-Valley View country. Otherwise, if it is desired and the land is subdivided, the Blueberry area could be surveyed.

The following soil surveys were carried out by the surveyors paid by the Dominion Department of Agriculture: Preliminary irrigation soil surveys were extended from the Taber area as far east as Medicine Hat on the south side of the South Saskatchewan River. The revision survey of the Red Deer Sheet was completed, and some field work was done on the Brazeau Sheet. The Peace Hills Sheet soil survey report, dated September, 1947, was finally published, but this report has not been released because the soil maps have not been received from Ottawa.

In June, members of the Alberta Soil Survey, attended a meeting of the National Soil Survey Committee in Guelph. The main objects of this meeting were to improve the system of classification, and to obtain better correlation of the surveys throughout Canada. The Dominion Department of Agriculture paid expenses to these meetings.

During the summer inspections were made of areas in Alberta recently covered by soil surveys. These included areas in the Peace River District, the Red Deer Sheet, and in some areas between Taber and Medicine Hat which are included in the St. Mary's irrigation development scheme.

In early August an international soil survey correlation trip was made through Saskatchewan, Alberta, British Columbia, Idaho and Montana. Soil surveyors from Washington, D.C., and the western states, as well as from Ottawa and the western provinces took part. The main object was to obtain some agreement on the classification of gray wooded and mountain soils. The trip proved to be very helpful in this regard.

An agreement between the Soils Department of the University of Alberta, the Research Council of Alberta, and the Dominion Experimental Farms, in regard to the organization of soil surveys in Alberta, was satisfactorily completed in 1948.

UTILIZATION OF STRAW

The physical and chemical studies of samples of wheat and oat straws collected in 1946 and 1947 were continued during the summer months. All the samples of Rescue Wheat straw have now been analysed and most of the samples of Thatcher Wheat straw from 1946 have been completed. Some progress has been made in the analysis of oats straws and wheat straws from varieties other than Thatcher and Rescue.

Internodes were found to average about 50% cellulose; nodes, chaff, leaf and sheath about 40% cellulose. Alpha-cellulose ran about 10% less than cellulose for all samples. Solubilities in hot water, 1% alkali, and alcohol-benzene mixture were lower for the internodes than for nodes, chaff, leaf and sheath. Pentosan content was about 25% in all samples except leaf, which was 10% lower.

Chaff, leaf, and sheath showed higher ash and silica content than internodes and nodes. It was felt that this may be due to dust or sand on the unwashed straw samples sent in, and it is suggested that calculations based on an ash-free basis, as well as on the present moisture-free basis, might prove interesting.

Results obtained from holocellulose determinations were very inconsistent, believed due to the fact that the method used was susceptible to different interpretations by different workers. (T.A.P.P.I., T-9-m) There appears to be no satisfactory, reasonably short method to use as a substitute for the above. (Ind. Eng. Chem., 25, 1250 (1933). Cross and Bevan cellulose ran about 20% below values for holocellulose.

Rescue Wheat straw showed less ash and silica in internodes and nodes; chaff, leaf, and sheath were the same as for other samples of wheat straw. Solubilities in hot water, 1% alkali, and alcohol-benzene mixture were somewhat lower than in other samples; while cellulose content of nodes, chaff, leaf, and sheath was about 5% higher, and lignin was 2% higher than other wheat samples. Pentosans, holocellulose, Cross and Bevan cellulose, internode cellulose, and alpha cellulose were consistent with the other samples.

There seems to be no significant difference between wheat and oat straw.

A beginning has been made on the preliminary study of the data now available from Thatcher Wheat straw. When one chooses a particular constituent in a particular part of the plant from straws grown at different places in the Province on different soil types under varying moisture conditions, one finds that many of the values are close to the average of the values although there are some that vary considerably from the average. It is thought that climate, soils and other factors lead to these variations. A start has been made to compare the composition of the straws taken as a whole with one another.

ANIMAL CYCLES AND MEASUREMENT OF ULTRA VIOLET LIGHT

Experimental enclosures needed for the Animal Cycle investigation have been built at Elk Island Park and will be stocked during the spring from the local rabbit supply. Records on the amounts of ultra violet light continue to accumulate. These will shortly be analysed and it is hoped to be able to draw tentative conclusions relative to the variation of ultra violet light with different seasons, etc.

A pamphlet "The Ten-Year Cycle" prepared by Dr. W. Rowan and distributed by the Extension Department of the University outlines the nature and importance of animal cycles to the sportsman.

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. **(Out of print.)**
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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.**
No. 45 (for 1944); pp. 18. **Price 5 cents.**
No. 47 (for 1945); pp. 21. **Price 5 cents.**
No. 50 (1946); pp. 28. **Price 5 cents.**
No. 51 (1947); pp. 28. **Price 5 cents.**
No. 54 (1948); pp. 27. **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. In six parts. **Price $1.00.**

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Part II (1927)—Separation, pp. 36. **(Out of print.)**
Part III (1929)—Utilization, pp. 33. **Price 25 cents.**

No. 53 (1949); THE ROLE OF VERY FINE MINERAL MATTER IN THE HOT WATER SEPARATION PROCESS AS APPLIED TO ATHABASKA BITUMINOUS SANDS, by K. A. Clark and D. S. Pasternack; pp. 22. **Price 15 cents.**

REPORTS—SOIL SURVEY DIVISION

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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.

No. 6—Purification of Silica Sand—Alberta Tar Sands Suitable for Glass Manufacturing, by E. O. Lilge, Canadian Chemistry and Process Industries, Vol. XXIX, July, 1945, pp. 480-482.

No. 7—Bituminous Sands of Alberta, by K. A. Clark, The Oil Weekly, August 13, 1945, pp. 46-51.

No. 8—Asphaltic Road Oils from Alberta Bituminous Sand, by K. A. Clark, Canadian Chemistry and Process Industries, Vol. XXIX, September, 1945, pp. 616-618.

No. 9—Research and the Coal Industry in Canada, by W. A. Lang, Trans. Canadian Institute of Mining and Metallurgy, Vol. XLIX, 1946, pp. 51-62.

No. 10—Recent Work of the Research Council of Alberta, by E. Stansfield, Bulletin Canadian Institute of Mining and Metallurgy, No. 406, February, 1946, pp. 121-128.

No. 11—Some Recent Conceptions of Coal Structures, by A. McCulloch, Canadian Chemistry and Process Industries, November, 1947.

No. 12—Elimination of Water from Wet Crude Oil Obtained from Bituminous Sand by the Hot Water Washing Process, by K. A. Clark and D. S. Pasternack, Part I—Continuous Settling at Atmospheric Pressure, Part II—Continuous Settling Under Pressure; Evaporation. Canadian Chemistry and Process Industries, January, 1948, and November, 1947.

No. 13—The Oil-Sand Separation Plant at Bitumount, by K. A. Clark, Western Miner, August, 1948.

No. 14—The Fuel Reserves of Alberta, by W. A. Lang, Trans. Canadian Institute of Mining and Metallurgy, Vol. LII, 1949, pp. 15-22.

No. 15—Geology of Kootenay Coal Measures in Southwestern Alberta, by M. B. B. Crockford, Bulletin Canadian Institute of Mining and Metallurgy, No. 443, March, 1949.

No. 16—Oldman and Foremost Formations of Southern Alberta, by M. B. B. Crockford, Bulletin American Association of Petroleum Geologists, Vol. 33, April, 1949.

MIMEOGRAPHED CIRCULARS

No. 1 (1947); Significance of General Laboratory Tests on Fuels and Lubricants, by J. S. Charlesworth.

No. 2 (1947); Alberta Motor Gasoline Surveys 1939-1947, by J. S. Charlesworth and E. Tipman.

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No. 5 (1948); Poplar Market Survey, by A. Stewart, A. R. Brown and D. E. Armstrong.