MINES BRANCH,

DEPARTMENT OF MINES,

OTTAWA, CANADA.

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INTRODUCTORY: Coal, to most householders, is merely so much black lumpy material dumped in the cellar by the coal man for the winter's fuel supply, and many are the complaints by the housewife as to how dusty and dirty it is. To firemen and engineers it is just fuel for boilers, for stationary engines and locomotives and is good, bad, or indifferent, depending on their appreciation of its general burning qualities. But coal is more; it is the prime essential of industrial life, and hence the basis of our modern civilization. It is possessed of a sort of magic, in its ability to produce limitless wonders when treated in different ways; burn it in stoves or furnaces and we get heat; feed it to boilers and out comes steam, mechanical power and electricity; carbonize it and we get coke, gas, tar oils, ammonia, etc. From coal gas and coke come motor fuels, synthetic alcohols, oils and other chemical compounds, and from the tar oils by divers means come dyes, explosives, medicines, antiseptics, perfumes, photographic reagents, and an almost endless list of substances that

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** Superintendent, Fuel Research Laboratories, Mines Branch, Department of Mines.

minister to our present day needs. The main constituent of coal is carbon, and carbon in its purest crystalline form is none other than the diamond. It is a far call from the diamond to the much deplored soft, dirty coal, but in a certain sense, lumps of coal are diamonds in the rough.

KINDS OF COAL: Coal is commonly designated as hard or soft coal, but since there are different kinds of hard and soft coals, this classification is misleading. Anthracties, bituminous coals, and lignites are the three main classes of coal and each of these is divisible into sub-classes or groups. For example, the bituminous coals may be classified into several groups, depending on how much volatile matter or gas they contain. Coals may also be divided into coking and non-coking coals, that is, whether or not, when heated, they cake or form a coke. Most bituminous coals are coking coals, whereas anthracites and lignites are non-coking.

DISTRIBUTION IN CANADA: Of the world's total known coal resources, it is estimated that approximately one-sixth is in Canada. The coal mined in the Maritime Provinces is practically all bituminous, large supplies of which are also found in the Rocky Mountain and Pacific coast areas. Alberta domestic coals are either what are known as sub-bituminous or high grade lignites. However, Alberta and also British Columbia can produce in quantity practically every kind of coal known, with the possible exception of true anthracite. The coal mined in the Estevan area of southern Saskatchewan is also lignite. The central provinces of Manitoba,

Ontario and Quebec, although abounding in peat bogs of commercial value, are devoid of coal with the exception of northern Ontario, where lignite deposits have recently been opened up by the Ontario Government. Samplesnof this lignite are now being tested in the laboratories of the Department of Mines in Ottawa.

THE USES OF COAL: The three main uses of coal are for household heating, for steam and power generation, and as a raw material for processing, i.e., for coking, etc. The coals most suitable for domestic heating are, as you know, the anthracites and the so-called smokeless (domestic) coals, although in the coal producing provinces, the smoky bituminous coal is used extensively for house heating. For the generation of steam and power, the better grades of bituminous coal are in most demand, but in certain sections of the country lower grade coals are used. However, the burning of bituminous coal in the raw state is to be deplored on account of its smokiness and wastefulness; in fact, in highly industrialized countries the belching of smoke from chimneys is considered somewhat as a crime. Hence the necessity of treating it before use.

HANDICAPS AGAINST THE USE OF CANADIAN COAL: In the second progress report of the Dominion Fuel Board, mention is made of the favourable situation in respect to the extensive use of coke and Welsh anthracite, and that Central Canada is no longer dependent on anthracite from Pennsylvania. However, the Board has drawn attention to the fact that so far as our ceasing to depend upon imported bituminous coal for the manufacture of coke, the problem

is not yet solved. The distance between the market and our great producing fields is recognized as a great handicap, but there are other handicaps working against the greater use of Canadian coal. There is the probability of higher cost, which is affected not only by higher transportation costs but by the cost of mining, which in many cases is higher in Canada than in the United States. Moreover, there is the long standing preference for imported coal, and the first duty of Canadian fuel technologists is to assist in finding a greater use for Canadian coal.

GENERAL PROBLEMS: The mining, preparation for the market, and the general every-day use of coal are problems of primary importance, but the time allotted for this short talk will permit of only an outline of some of the more important research problems that are especially applicable to Canada. First is the survey of the more important coal seams from which coal is now being mined, to learn the variation in quality in different parts of the seam. The results of such an investigation will afford information as to how methods of mining may be changed to improve the quality of the coal output. Another field of investigation deals with the improvement in quality of the marketable product by altering methods for crushing, sizing, cleaning, shipping, and storing coal. Comparative burning tests on various coals in domestic heaters, in mechanically stoked boilers and in powdered fuel installations, etc., are essential in order to prove the merits of our coals in comparison one with another and with standard imported coals. Again there is the investigation of Canadian coals for making coke and the problem here is to find

those coals that will produce coke equal in general burning and handling qualities to the best grades now on the market. New processes for producing motor fuels and other oil products from coal also require attention. Such processes as the Bergius for the conversion of coal into oil and the Fischer process for converting coal gas into synthetic motor fuels require investigation in order to determine their technical and economic merits as applied to Canadian industrial conditions.

PROCESSING FOR THE PRODUCTION OF CRUDE OIL: In England, a great deal of attention is being paid to the treatment of coals by what is known as low temperature carbonization. By such treatment, a smokeless coke fuel is produced suitable for use in open grates, and in addition, comparatively large yields of crude tar oils are obtained. From these tar oils come a supply of crude petroleum for the navy and other purposes. In Germany, the lack of crude petroleum resources has been the incentive for the development of processes for the conversion of coal directly into oil and also for the production of synthetic motor fuels from tar oils and coal gas. But in Canada as in the United States, the situation (for the immediate future at least) is different, on account of the plentiful and cheap supply of crude petroleum. However, at present only about 2½ per cent of our crude oil consumption is produced in Canada and although the prospect of an ever increasing Canadian oil production is bright, no assurance is forthcoming that crude oil from wells will always

be plentiful; hence we must be constantly on the alert for new supplies. Other sources of crude oil in Canada are the oil shales of the Maritime Provinces and the bituminous sand deposits in Alberta, but the great and almost unlimited potential source of crude oil is coal, and this Candda possesses in abundance. Therefore, the study of coal for the discovery of processes for unlocking the oil and other riches that lie hidden in it, and the examination of the most economic methods of utilizing it, holds the attention of coal research workers today in Canada and elsewhere.

LOW TEMPERATURE CARBONIZATION: The question of low temperature versus high temperature carbonization for the production of coke is also important. For coking in large by-product oven and city gas plants by the well established high temperature processes, it is necessary to bring the coal from the mine to the city where there is a demand for the gas. By low temperature carbonization, where the disposal of the gas is not a problem, coking may take place at the mine and coke instead of coal will be the product shipped. Treatment by the low temperature method promises a greater utilization of Canadian coal for the production of coke, but a number of questions have to be answered before such a new industry can make headway. Low temperature carbonization processes vary considerably in their technical details and a process designed specially for a coking bituminous coal may be entirely unsatisfactory for non-coking, sub-bituminous or lignite coals. The merits of a given process operating on

Canadian coal will depend mainly on the ability to produce a coke or briquette sufficiently good to compete with high grade domestic fuels on the market. In other words, the problem is to choose the carbonization process that will be suitable for the coal rather than select the coal for the process.

The foregoing are some of the problems that present themselves, the solving of which are being seriously undertaken by the Department of Mines.

INCREASED USE OF GAS: The increase in the use of gas made from coal is another problem influencing the greater use of coal. The idea of pipinggas from coking operations at or near the mine has been advanced, but in Canada this would only apply to centres of population not too far away from the coal producing areas. Gas, however, is finding ever increasing uses. More and more city houses are being heated with it. We have refrigerators operated by gas as well as electricity, so that it is now possible to produce both heat and cold in the same room from the city gas supply. Gasoline can be made synthetically from coal gas and imagine, if you will, the possibilities of the development of a process on a small unit scale so that synthetic motor fuels may be produced in private homes and other buildings served with gas. Future developments along this line may make it possible to obtain the motor fuel supply for the family car from the city gas supply, thus converting private garages into private filling stations. You see, then, something of the future possibilities of coal and those industries requiring it as a raw material. Oil

refineries, instead of importing crude oil, will look to coal as their source of oil for refining into gasoline; large coking plants of the future will have their own refineries for the production of synthetic motor fuel; all of which may be made possible by research.

DIFFERENT KINDS OF RESEARCH ON COAL: The problems outlined above are general investigations, each divisible into separate and inter-related research projects, a descriptive list of which would be far too long to give here. Such a list would include many problems peculiar to petroleum and its products since research problems applicable to petroleum are also directly applicable to coal. For coal, as for other raw materials there are two kinds of research, namely, scientific or pure research, and industrial or applied research. A coal research programme to be of interest to industry should be comprised of problems of a practical nature, but this should be combined with research of a purely scientific nature. The chemist geologist and other scientists engaged in research, besides delving into the mysteries of coal from a scientific viewpoint, should keep the practical application of his problem constantly in mind and likewise the research engineer, chemical, mining, mechanical, etc., studying utilization problems should keep in constant touch with the results of research of an academic nature, such as the constitution of coal, its origin, and the biological, chemical, and physical changes that have taken place during its geological transformation.

GOVERNMENT RESEARCH ON FUEL AND FOOD: Research on coal is analogous to agricultural research, as fuel and food are primary essentials of life, and in as much as the coal and agricultural industries of Canada lack central organization and co-ordination, they are alike in requiring the assistance of Government, University and other publicly supported institutions. England, during the war, established its Fuel Research Station at East Greenwich under the Department of Scientific and Industrial Research, and in Germany even before the war coal research was fostered by the German Government. Institutions in the United States specializing on coal research include the various research departments of state universities, and large commercial firms, in addition to Mellon Institute and the United States Bureau of Mines.

NEW FUEL RESEARCH LABORATORIES: In Canada, the Department of Mines, since its inception, has undertaken considerable geological and practical utilization work on coal in its Geological Survey and Mines Branch respectively. In 1922, the Dominion Fuel Board was organized, and now as a step forward, the new Fuel Research Laboratories of the Department of Mines have been established. As part of the Division of Fuels and Fuel Testing of the Mines Branch, these laboratories will conduct research on solid, liquid and gaseous fuels and will afford facilities for investigations on Canadian coals not permissible hitherto. A feature of the new building on Booth Street (near Carling Avenue) is the large open laboratory for the installation of semi-commerical apparatus. The usual chemical laboratories are, of course, provided for small

scale research work. In these new laboratories, it will be possible, therefore, to conduct investigations on a test tube scale using a few grammes, or on a large laboratory scale on samples up to a hundred pounds or more, and on a semi-commerical scale. In addition to small scale research apparatus, the experimental equipment includes:

(1) An experimental domestic heating plant.
(2) A powdered fuel (steam boiler) installation.
(3) A large scale (wet and dry) coal washing equipment.
(4) A full size briquetting plant, and
(5) A commerical size by-product coke oven capable of consecutive experimental coking tests on 2-ton charges of coal.

Space is also provided for extensive experimentation on the low temperature carbonization of Canadian coals and a miniature oil refinery is contemplated for the treatment and study of low temperature coal tar and other oils. Those interested in a more detailed description of these new laboratories and the research programme planned are invited to write for descriptive bulletins and pamphlets. These may be obtained by addressing the Department of Mines, Ottawa.