

CANADA

DEPARTMENT OF MINES

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SUMMARY REPORT

ON THE

PETROLEUM AND NATURAL GAS
RESOURCES OF CANADA

BY

Frederick G. Clapp and L. G. Huntley.

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SCOPE OF THE REPORT.

The instructions were to write a report on the petroleum and natural gas resources of the Dominion, which will outline the history of developments, status of production, stratigraphy, drilling methods, markets, methods of transportation, quality, utilization, and such other technical details as are necessary in exploiting these resources to the best advantage. Such a report is of value to an operator in one field who may wish to be informed on conditions or methods existing in some other field, and it is needed furthermore for a layman who may intend entering the petroleum or natural gas business or associated enterprises, and who may demand truthful information regarding conditions or methods in various parts of the Dominion.

WORK DONE TO DATE.

The work referred to in this report has, up to the present, consisted chiefly of field-work. This work was commenced in May, 1912, and was prosecuted intermittently during the summer and autumn. All provinces in Canada which have produced any petroleum or natural gas were visited, and references thereto will be included in the report. The statements outlining existing conditions are corrected up to the summer of 1912.

SUMMARY OF RESULTS.

The conclusions arrived at and information obtained may be summarized under the following outline:—

Uses of Petroleum.—Ever since the discovery of petroleum in commercial quantities in America, the number of uses of both the crude and refined products have been growing, until at present the production is far from sufficient to supply the demand. In a work such as the present one, it seems essential to give an outline of the uses of petroleum, in order to make clear what may be done by the industry in meeting the present demand; consequently this consideration will be taken up in a special chapter. It will include a discussion of the growing demand for gasoline, and of the methods used for extracting this substance from certain types of natural gas in the oil fields. Natural gasoline plants are in frequent use in the United States, but are very rare in Canada.

Classification and Value of Petroleum.—It may not be generally understood that a great difference exists in the character of petroleum in various parts of the Dominion, and between the Canadian oils and those of other countries. Most oils are suitable for special purposes, and consequently the pipe line companies have classified them into a number of grades depending on the character and demand in different fields, and have set a price for each particular grade. This price is changed from time to time according to the changing supply and demand.

Geological Occurrence of Petroleum and Natural Gas.—While the oil business has very generally been viewed by the public as a gambling enterprise, and while many companies have conducted it as such, we are now able to say that the days of taking great chances are past. A careful study of local conditions will now enable an expert to judge to a considerable extent what may be expected of any particular property. While it is not possible to absolutely predict whether a well drilled at a particular point

will produce oil, we can nevertheless gain a fair knowledge of the conditions prevailing under a property of any size, and for this purpose a detailed knowledge of the geology is necessary in all cases. Geological details, where they are known, are given in the special chapters describing the different fields, but in addition the report will summarize the geological conditions common to all the fields, explaining the relations of the production to different types of geological structure.

Control of Oil and Gas Territory.—Various methods are in use in different parts of the country by which companies and individuals acquire the right to drill on prospective oil and gas land. The methods differ mainly on account of the various ownership conditions in the different provinces; and in addition there is much difference in the form of lease within every particular province. The report will outline the various methods and conditions of acquiring and holding territory.

Methods of Drilling.—Many different methods of drilling are in use in different parts of the world, and a discussion of these is absolutely necessary in order to give a clear understanding of the expense of operating. While a full discussion would fill many volumes, enough will be said to meet the needs of the industry in Canada. This chapter will also include a discussion of the cost of drilling, and of the differences between drilling by contract and drilling done directly by the operating company in various fields.

In any field it is important to know what type of drilling rig is used in any other particular field. The particular fuel used in drilling must be known, the methods and size of casing, and also the water problems which will be encountered are important. A driller also wishes to know what time will presumably be consumed in drilling the well, what fishing tools are practicable, and what sort of packers, liners, strainers, and other accessory equipment are common. It is also important, in each particular field, to know whether the wells are generally shot.

Transportation and Storage.—Since a great many different methods exist for storing petroleum and for transporting it to the refineries or to the markets, and since these methods are not commonly understood except by people engaged actually in the petroleum business, a brief chapter will be devoted to the methods of transportation and storage. This will also include a description of the methods used in transporting natural gas to distant municipalities.

Measurement and Transportation of Natural Gas.—Much ignorance exists among those not associated with the natural gas industry, as to the methods by which gas is transported and the conditions prevailing; consequently this report will give a short chapter on the volume of gas wells, their measurement and methods used in determining the pressure.

Descriptions of Individual Fields.—It is planned to take up every oil and gas field in the Dominion, and individually to describe its geographic, topographical, and geologic situation. The character and amount of the production, with a brief history, the depth of wells, and drilling methods will be given in all cases.

Desirability of Keeping Good Records.—A feature of the oil and gas business, which is not commonly appreciated, but which is nevertheless very important, is that accurate records should be kept, not only of the depth of the sand and of the amount of production, but also of the exact depth at which each formation is encountered in drilling the wells, the depth at which they were cased, whether particular seams of water, oil, or gas were encountered, and such other information as may be valuable to a driller in sinking other wells in the same region. While the importance of such considerations may not be apparent in all cases, it is possible to say that, when the records throughout a particular field are collected and correlated by an expert, they never fail to give information of future value, which can not be gained in any other

way. The writers of this report, having visited all the fields in the Dominion, have cause to regret that records as a rule are not kept carefully, accurately, or systematically, although certain companies must be excepted from this statement. It is hoped there will be early improvement in this matter.

Conservation of Natural Gas.—The writers are firm advocates of the movement for conservation of natural gas. By this should be understood conservation in its broadest sense, including prevention of actual waste, the abolition of wasteful methods of utilization, and the passage and enforcement of such laws as will assure the wisest possible utilization of gas for the best interest of all the people. While the waste of gas in Canada has not been as great as in the United States, this circumstance has been largely due to the fact that fewer fields have been developed. With the discovery of gas in large quantities at both ends of the Dominion, we should take care that the laws for its development and utilization are all that can be desired.

Bibliography.—An exhaustive bibliography has been prepared on the oil and gas developments of the Dominion, and this will form a part of the report. The bibliography is also an index to all literature on the subject so far as known.

SOUTHERN ALBERTA.

Status of Development.—Natural gas development in Alberta, which was started at Medicine Hat in 1891 by a well drilled in search of coal, has grown to large proportions within the past two years. The principal centres of production at present are the town of Medicine Hat and its environs, which produce from 25,000,000 to 30,000,000 cubic feet per day, and the Bow Island district, situated 40 miles west of Medicine Hat, which produces about 75,000,000 cubic feet per day. From the latter district a pipe line has been laid for the purpose of supplying the city of Calgary, 160 miles distant, and fourteen other municipalities along the route. No other gas of importance has been developed in southern Alberta.

Gas-producing Formations.—In the Medicine Hat field, the gas is found in several formations at depths ranging from 200 to 1,300 feet. The principal producing sand, however, is encountered at from 1,000 to 1,300 feet in depth. The rock pressure is about 560 pounds, and the volumes of individual wells are between 1,000,000 and 7,000,000 cubic feet per day.

In the Bow Island field the important productive stratum is encountered at about 2,200 feet in depth, and is generally correlated with the Dakota sandstone, although Dr. Eugene Coste believes it to be of Niobrara age. There are fourteen producing wells in this field, all owned by the Canadian Western Natural Gas, Light, Heat, and Power Company, Limited. The initial production ranges from 2,000,000 to 24,000,000 cubic feet per day per well, with a rock pressure of 800 pounds.

Cost of Drilling.—Compared with the cost of drilling in the eastern and mid-continent fields, the expense in Alberta is very high. In the Medicine Hat field the drilling of gas wells is contracted for at prices ranging from \$6.50 to \$8 per foot, depending upon the diameter at which the hole is finished. In the Bow Island field, the first wells cost as much as \$20,000 each, and the present outlay is in the neighbourhood of \$16,000 for a 2,200 ft. gas well.

Price of Gas.—Gas is sold for domestic consumption in the city of Medicine Hat for fifteen cents per 1,000 cubic feet, and for manufacturing purposes at five cents per 1,000 cubic feet. The city has, however, made a number of contracts for supplying gas to manufacturing plants free of cost for a five-year period. This appears to be a very short-sighted policy, in view of what is now known regarding the length of life of gas producing territory when drawn upon freely. Moreover the value of natural gas as a fuel is too great to justify its waste by being given away. The rates for natural gas in the cities of Calgary, High River, Lethbridge, Macleod, and other towns situated on the western Canada pipe line, are fixed at twenty cents per 1,000 for manufacturing and thirty-five cents for domestic purposes.

Present Drilling.—Owing to the high cost of operating and to several other conditions, most of the drilling is now being done by several large companies and by municipalities, the latter for advertising and local promotion purposes. The wild-cattling to date has failed to discover any extensive fields besides those mentioned. These are, however, believed to be capable of great extension.

SOUTHWESTERN ALBERTA AND SOUTHEASTERN BRITISH COLUMBIA.

(Pincher Creek District.)

Status of Development.—The operations which were commenced in the Pincher Creek and South Kootenay Pass district in 1902, have resulted in the drilling of 17 or 18 wells up to the present time, ranging in depth from 200 to 1,900 feet. While two of these gave evidence of possibly proving small oil producers if they had been properly handled, the remaining wells never produced more than about a barrel a day at their best. In the summer of 1912, two companies were deepening old wells in a more or less desultory way, but no additional production had been encountered. Some wells are still rigged for pumping, however.

Productive Formations.—The seepages which occur in this district, and which led to the drilling and to the usual accompanying boom and stock-selling period, exude from what Dr. Dawson describes as a "somewhat anomalous occurrence of petroleum" in rocks of Cambrian age. It remains an occurrence of scientific interest only, since, even if oil had ever been found in quantity in rocks of this age, the greatly disturbed and faulted condition of the Pincher Creek and South Kootenay rocks must have precluded the possible existence of an oil reservoir of any importance.

Quality of Oil.—The small quantities of petroleum produced were of high grade, being about 42 degrees Baume, and contained a large percentage of light oils, but no sulphur. It is an interesting scientific fact that this and other "freak" fields commonly yield high grade oil.

NORTHERN ALBERTA.

Status of Oil Developments.—The immense seepages of tar and petroleum residue known as the "tar sands," which occur along the banks of Athabaska river and between that river and the Peace River country, have proved an alluring basis for oil prospecting, notwithstanding the belief of geologists who have visited the region, that oil would not be encountered near the outcrop of these sands, and furthermore notwithstanding the fact that no petroleum in commercial quantities has ever been found in rocks of similar age to those which occur below the Devonian limestone in this region; nevertheless drilling has been active in the vicinity of Fort McMurray and Fort McKay and in the intervening territory along the Athabaska river. Several of the wells, which have been sunk from near the top of the Devonian limestone and at the base of the Dakota or "tar sand," have encountered small pockets of thick tarry oil in the limestone; but up to the present time no oil has been recorded in commercial quantity in this north country. As an example of the futility of some of the efforts, it may be said that in June, 1912, one well at Fort McMurray was drilling in the Laurentian formation underlying the Devonian limestone.

Not all of the wells in the far north are so situated as to be absolutely futile. For example, a well drilling 80 feet west of the old Geological Survey well¹ at Pelican, on the Athabaska river, struck several good flows of gas; but of less volume

¹ Geol. Survey, Can., Vol. V, p. 1445. 1890-91
Geol. Survey, Can., Vol. X, p. 19 A.

than the first well. The old well is capped and used to furnish fuel for drilling purposes, and the present hole is being continued in hope of finding oil below the limestone, the gas having been cased off.

In June, 1912, fifteen or sixteen holes had been drilled between Athabaska Landing and Fort McKay, but no oil had been produced in commercial quantity. A number of companies formed for the exploitation of asphalt claims in this district have their headquarters in Edmonton, but as the lack of transportation facilities up to the present time has prevented the handling of such bulky material, their operations have consisted principally in stock-selling. The building of a railway to Fort McMurray, however, would make these deposits of considerable value for many purposes. A number of drilling outfits went north during the past summer to commence operations.

Geological Conditions.—The first exposure of Devonian limestone observed south of Lake Athabaska, occurs some 10 miles below the mouth of the Calumet river, and from near this point "tar sands," of an estimated thickness of from 50-250 feet, outcrop for many miles along the Athabaska river. The limestone, dipping to the south, disappears beneath the river near Crooked rapid, and the "tar sand," likewise dipping below the surface near Boiler rapids, probably constitutes the reservoir which contains the gas encountered at Pelican rapids. Continuing to dip southward, this formation lies at a depth of about 3,000 feet at Morinville, and near Calgary reaches an estimated depth of 5,000 feet. What is supposed to be the same sand has been discovered as the principal gas-bearing formation of southern Alberta, and in drilling for oil this horizon is the one desired by operators.

Status of Gas Developments.—The government gas well, drilled at Pelican Rapids in 1897, still has a pressure reported as about 500 pounds. The gas is used as fuel for drilling purposes. The well which is being drilled at present, 80 feet west of the old well, struck gas both in what was believed to be the Niobrara formation and also in the Dakota sand, but the gas was cased off and drilling continued in hope of finding oil.

The government test well at Athabaska Landing still shows a little gas bubbling through a hole full of water, although it never produced gas in any quantity, and did not reach the Dakota formation. The well which has been drilling at Morinville for the past five years has reached a depth of about 3,500 feet, and has found as yet only a small showing of gas in the upper part of the well. A dry hole was drilled some years ago at Edmonton to a depth of approximately 1,900 feet.

On June 18, 1912, a test drilled by the municipality of Tofield, 35 miles southeast of Edmonton, struck a small flow of gas, about 800,000 cubic feet, at a depth of 1,051 feet, without reaching the Dakota sandstone. A second well is now being drilled for the municipality. The success of the drilling at Tofield has led to the starting of a well by the town of Vegreville, about the same distance due east of Edmonton.

Methods and Cost of Development.—Development and drilling along the Athabaska river has been upon Government land. The expense of drilling, which is very great on account of the necessity of establishing camps and of the cost of transportation in this district, has made it difficult for an inexperienced man or one with small capital, to operate, most of the drilling being done by stock companies. A well on the Athabaska had already cost about \$25,000 at a depth of 1,400 feet, and the end was not in sight. Both United States Standard and Canadian Standard rigs are used with 72 ft. and 56 ft. derricks, respectively. A number of second-hand pole-tool rigs have also been taken into the north country. Drilling for gas at Morinville, Edmonton, Tofield, and Vegreville is all done by means of United States Standard rigs, and operated, as a rule, by drillers from the United States.

The second well at Tofield is reported to have been contracted for at a rate of \$10 per foot of depth, for a depth of 2,000 feet. Owing to the large tracts of land controlled by the railways and by various development companies, drilling will probably be done largely by such concerns, or by municipalities for local use, as is the case in the Medicine Hat and Bow Island districts.

The high cost of drilling in these fields is also partly accounted for by the necessity of casing to the bottom of the hole, on account of the caving nature of the formations passed through. This necessitates a very large hole, several strings of heavy casing of different sizes, and the long tedious work of "under-reaming." The high salaries which must be paid to drillers in these fields is also an added factor in the expense.

Future of the Alberta Fields.—Owing to the factors mentioned, combined with the great depth of hole necessary to test the Dakota or Niobrara formations in the belt situated between the gas development and the mountains, which in Alberta is the territory where oil supposedly will be found, this territory has remained practically untested. Several holes have been drilled at Calgary, resulting in only small quantities of gas, although none were of sufficient depth to test the strata which are productive at Bow Island, and to which the great asphalt seepages along the Athabaska river probably owe their origin.

The crest of the main arch of the formations passes about 100 miles east of Edmonton and appears to cross the Athabaska river in the vicinity of Crooked rapids. Medicine Hat and Bow Island lie near this crest, while Calgary and Edmonton are situated in a great trough which parallels the mountains. Dr. Eugene Coste calculates that to test the Dakota sand at Calgary would require a well approximately 5,000 feet in depth. As to whether the principal gas horizon is saturated with salt water in the bottom of this structural depression, and if so, how far up the eastern slope the water extends, is a matter which can only be determined by the drill. The history of most oil and gas fields of the world has shown that the "pay" formations contained large quantities of salt water in their lowest depressions, the oil pools occurring along the anticlinal flanks above the saturated zone, and being in turn bordered by the main gas pools higher on the slope of the anticlines.

While the foregoing remarks are intended to apply to the west side of the principal west Canada anticline, they will apply also to its eastern slope. Therefore, drilling in Saskatchewan, if conducted systematically at points recommended by an expert after a study of local geological structure and other conditions, may be expected to result in the development of petroleum in some localities. Meanwhile the rapid increase in population in Alberta is rendering necessary the development of the central gas belt stretching northward from Medicine Hat towards the Athabaska.

BRITISH COLUMBIA.

No oil or gas in commercial quantity has been developed in this Province. From a well drilled at the entrance of Otard bay on Graham island in the Queen Charlotte group of islands, a showing of oil and gas was encountered near the bottom of the hole, which in June, 1912, was between 600 and 700 feet deep. In this district much tar-impregnated limestone is exposed, but no oil production has been developed. Several dry holes were drilled in other localities at various dates.

MANITOBA.

While several wells have been drilled in the southern part of Manitoba, yet no oil or gas in commercial quantity has ever been discovered in this Province.

SASKATCHEWAN.

Status of Developments.—Several borings were made years ago in the vicinity of Regina in the Province of Saskatchewan,¹ ranging from 100 to 1,550 feet in depth, but accomplished no results except obtaining a small show of gas and large amounts of salt water. A well drilled at Moosejaw in 1911 reached a depth of 1,200 feet, and developed a small show of gas, but this likewise was discontinued on account of salt water. Land was leased in 1911 at Saskatoon and vicinity, and in the early part of 1912 a well was being drilled to test that territory. The tar seepages on Buffalo lake have been known for years, but reports of high grade oil north of Prince Albert have lacked confirmation. However, during the summer of 1911 a well was drilled by a lumbering firm operating about 120 miles north of Moosejaw on the Canadian Pacific railway. The well was drilled to a depth of 1,730 feet, and encountered a very good showing of dark oil at this depth in a coarse sandstone.

Prospects for Future Oil Development.—If an oil-bearing zone lies to the east of the anticline on which the main Alberta gas belt exists, it must be situated to a large extent in western Saskatchewan. Since the formations which are found saturated with salt water in wells drilled at Regina and Moosejaw appear to limit the probability of oil existing east of those cities, prospecting between them and the Alberta border probably offers the best chance for the operator.

The principal Alberta anticline may be explained as similar in structure in some respects to the well-known Cincinnati anticline which lies west of the Appalachian mountains in Ohio and Indiana. While the higher portions of certain porous strata along that anticline held great gas fields, the same strata somewhat away from the anticlinal domes have yielded large oil pools.

PROVINCE OF QUEBEC.

Status of Oil Development.—In 1896 and 1897 and previous to those years, numerous wells were sunk on Gaspé peninsula for oil, the holes ranging in depth from a few hundred feet to an extreme of 2,700 feet. The numerous surface indications and the small showings of oil in wells, resulted in no production of commercial value and the field was abandoned. The area in which boring has been done extends in a north-westerly direction from Seal cove, on the north side of Gaspé bay, to Falls brook on a branch of York river, 33 miles distant. Upwards of fifty-two wells were drilled,² the best of them having had an initial production of 24 barrels per day. There has been no oil development elsewhere in the Province of Quebec.

Status of Gas Development.—Surface seepages containing gas in the vicinity of Three Rivers, Nicolet, and a few other localities in the Province led to early drilling in search of their source. A few small gas wells were discovered, and at one time, in 1899, the production amounted to 55,000 or 60,000 cubic feet per day. The wells ranged in depth from less than 100 feet to 1,100 feet, extending into the Hudson River shales. At a later date other wells were drilled at St. Barnabé, and the gas was piped to supply the town of Three Rivers. Its installation in a factory, however, exhausted the gas and the field was abandoned in 1907.

Wells of small value have been reported at various times at Three Rivers, St. Barnabé, Yamachiche, Louisville, Nicolet, and St. Gregoire. Numerous tests have been drilled at Montreal and neighbouring localities, but none have developed gas sufficient to supply more than single houses. A test was drilled a few years ago at Laprairie to a depth of 2,700 feet, while another was drilled at St. Geneviève two years ago to a depth of 1,800 feet or more, neither producing oil or gas. The Province of Quebec gives no indication at the present time of developing fields of either petroleum or natural gas.

¹ Trans. Royal Soc. Can., Vol. IV, 1886, pp. 92-3-4.

² Geol. Survey, Canada, Vol. XV, 1902-3.

NEW BRUNSWICK.

Status of Gas Development.—In New Brunswick the Maritime Oilfields, Limited, has continued drilling, and has brought in some gas wells of large volume, which are piped to supply Moncton, a city of 12,000 inhabitants. The field is one of considerable promise, and the Company mentioned has a lease of 99 years on 10,000 square miles of supposed oil and gas territory. This Company has taken over the holdings of the New Brunswick Petroleum Company. The first gas went through the line on March 23, 1912, and Moncton is the only city in New Brunswick supplied with natural gas, although the gas is piped to the village of Hillsborough.

The development lies in the vicinity of Stony Creek. In July, 1912, there were 15 productive wells in the field, 14 of which produced gas. Several are pumping oil to the amount of one barrel or so per day, most of which is found near the east side of the belt. Twenty-five wells have been drilled in all. The production of the gas wells runs as high as 6,000,000 cubic feet per day, and one well had an initial production of 12,000,000. The present production of the field is reported to be 58,000,000 cubic feet of gas per day. The rock pressure runs as high as 500 pounds.

Productive Formations.—The surface strata in the New Brunswick field consist of Carboniferous sandstones and shales, under which Devonian sandstones and shales are productive. The oil and gas comes from three groups of sands, each consisting of a number of lenses.

Methods and Cost of Drilling.—Wells in the Stony Creek field range from 1,200 to 2,000 feet deep. They are now spaced up to half a mile apart, although at first they were sometimes placed only 600 feet apart. The Pennsylvania method of drilling is used exclusively, with 72 ft. standard derricks. The usual cost is about \$10,000 for each well.

Character and Price of the Gas.—The gas is very dry, and analysis has proven it unsuitable for the manufacture of gasoline. It is sold in Moncton and Hillsborough for domestic consumption at forty cents per thousand, and for gas engine use at twenty-seven cents per thousand.

Status of Oil Development.—Drilling in the oil fields at Dover and Memramcook was commenced in 1901 and a pumping area of 24 square miles between the tidal water of Petitcodiac and Memramcook rivers was developed, but the wells had extremely small production and have long since been abandoned.

The oil produced in the Stony Creek gas field is retailed locally for \$4 per barrel, although most of it is sold to the Intercolonial railway at \$1.75 per barrel for making Pintsch gas.

ONTARIO.

Status of Oil and Gas Development.—Drilling in the Ontario oil and gas fields commenced in the early sixties, coincident with the development of the prolific fields of northwestern Pennsylvania. The gas fields in Welland and Haldimand counties were developed, and more recently have been extended westward along the lake shore in a belt over 90 miles long and from 3 to 4 miles in width. Some good gas wells have also been drilled at Canborough and Caistorville in Haldimand county. Meanwhile the older gas-producing districts of those counties have been practically exhausted. While new production will be developed from time to time in small areas, and old fields enlarged to some extent, yet the production, both of petroleum and natural gas, in Ontario, is on the decline, and the total depletion of the underground supply is approaching. There may be some hope of discovering oil in the Trenton limestone by deeper drilling, but as yet no oil or gas has been found in quantity in this formation in Ontario.

In Welland, Haldimand, Norfolk, and Elgin counties, the larger companies are making strenuous efforts to discover gas. In Haldimand county some new gas has

been developed at Selkirk, and along the lake front in this vicinity, and also at Canborough in the northern part of the county. A gas field has also been developed within the past five or six years in Tilbury, Romney, and Raleigh townships in Kent county. The gas from this field is consumed in Kent, Essex, and Lambton counties. In Norfolk county the Dominion Natural Gas Company has developed a gas field south of Simcoe, and this Company is trying to extend it southwest to Port Royal and Port Rowan. The gas is piped to Hamilton and intermediate points. At Delhi in the same county a local company has drilled a half dozen gas wells inside the town limits within the past two years, the gas being used for local consumption. In Elgin county the companies are developing a promising pool in Bayham township in the vicinity of Vienna and Port Burwell. Pipe lines from this district supply the towns of Tilsonburg and Aylmer.

The oil production in the vicinity of Leamington in Essex county was abandoned in 1907, the district having been flooded by salt water. The prolific pools at Petrolia and Oil Springs in Lambton county continue to produce, showing a steady annual decline, as no new wells are being drilled. The same applies to the Bothwell field in Kent county, which exhibits the same characteristics as the pools in Lambton county. Careful methods of production, combined with very favourable underground conditions, have made the production of these pools a remarkable one, considering the small average production per well. In 1910 a new oil field was discovered and is being developed in Onondaga township, Brant county. The field also produces some gas; but owing to the character of the productive formations, the composition of the oil, and the rapid decline of the gas pressure, the pool does not promise as long a life as that of the older fields.

While the former oil pool in Romney township, Kent county, has been abandoned, a large gas production has been developed in this and in Tilbury and Raleigh townships, and is used to supply domestic consumption in Kent, Essex, and Lambton counties. A little gas is still piped from the vicinity of Dutton and utilized in Kent county.

Productive Formations.—The gas from the Welland, Haldimand, Norfolk, and Elgin County fields is all found in the Clinton and Medina formations, at depths varying from 500 feet in Welland county to 1,400 feet in Bayham township in Elgin county. The Tilbury-Romney pool, however, produces gas from just below the Big Lime, in depth from 1,425 to 1,450 feet. The Clinton and Medina formations west of Chatham are too broken and shaly to contain oil or gas.

Gas Production and Pressures.—In both Caistor and Canborough townships in Haldimand county the rock pressure averages 200 pounds, while the wells produce from 46,000 to 800,000 cubic feet per day. At Selkirk the pressures are about the same, although originally the initial pressure was near 500 pounds. The wells average less than 200,000 cubic feet initial production. A few small gas wells at Middleport and Caledonia average from 40 to 130 pounds pressure, with correspondingly small production. The six gas wells at Delhi, Norfolk county, produce 2,000,000 cubic feet per day, and have a rock pressure of 375 pounds, this having been initially over 500 pounds. The pressures in the Simcoe pool were initially from 560 to 650, although they have declined to about 350 pounds at present. The wells range in production from 15,000 to 500,000 cubic feet per day. A similar condition is true of the Vienna pool in Bayham township, Elgin county, although the initial pressures here were as high as 780 pounds, with correspondingly high production. The field has been drawn upon for only a year, since the completion of the pipe line to Tilsonburg. These fields all produce from the Clinton and Medina formations. The Tilbury-Romney pool in Kent county produces about 15,000,000 cubic feet per day from approximately 110 producing wells. The pressure in this district is about 600 pounds.

Production and Abandonment of Oil Wells.—The oil production in Lambton county, coming from the famous Oil Springs and Petrolia pools, amounted in 1912 to about 200,000 barrels. Production is decreasing regularly, and wells are being abandoned from the outer edge of the pool inward. In the Petrolia pool about 4,000 wells are still producing, as against 7,000 in 1910. The abandonment has been at a slightly less rate in the Oil Springs pool. No water problem has developed, and this field exhibits the comparatively rare phenomenon of an oil pool declining from the single cause of the exhaustion of the underground supply. No new wells are being drilled in Lambton county. The Bothwell pool in Kent county is exhibiting similar characteristics. The field still produces from 2,500 to 3,000 barrels per month, and shows no sign of exhaustion, although no new wells are being drilled. At Dutton, some oil is still being produced from the Medina formation, but the pool is on the decline and no new production is taking its place.

Wells in the new field in Onondaga township, Brant county, for which large predictions were made, have declined rapidly. The oil comes from a close, fine-grained sand, and since the gas is being drained from the pool rapidly, the production of the oil wells is declining, although the average is kept up to some extent by drilling new wells. In 1912 the production of this field was about 2,500 barrels of oil per month, and about 10,000,000 cubic feet of gas per month was being used in Brantford and the vicinity from this pool. The initial rock pressure of 235 pounds when the pool was discovered two years ago has declined to 175 pounds. The oil wells have an average production of one barrel of oil per day, all being pumpers. Wells are spaced too closely in most parts of the pool. A plant for the recovery of gasoline from the casing-head gas of this pool has been erected, but in July, 1912, it had not been operated.

PLANS FOR COMPLETION OF REPORT.

Office work is now being carried on by both of the authors as continuously as possible without interfering with other necessary work, and it is hoped the complete report may be ready for the press within a few months. Although this summary report contains no illustrations the complete monograph on "The Petroleum and Natural Gas Resources of Canada" will contain numerous illustrations of the fields, of methods employed in the business, and also maps showing distribution of petroleum and natural gas fields, pipe lines, refineries, and other data of importance. Quite a number of well records have been collected from various parts of the Dominion, and these also will be included under the respective fields. Some mention will be made of the possibilities for petroleum in the northern provinces of the Dominion, which have never been tested and which are not mentioned in this summary report.