

OIL AND GAS IN
ESSEX COUNTY, ONTARIO

By P. L. Garvey



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1941

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By P. L. Garvey

A thesis submitted in partial fulfillment
of the requirements for the degree
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HISTORY OF DEVELOPMENT

In the vicinity of Oil Springs and Petrolia, Ontario, oil springs and seeps were known to the early white settlers and Indians (2). A Mr. W. H. Williams in 1858 had the honor of drilling the first well in Enniskillen Township near Oil Springs, Ontario. It was not only the first producing well in Ontario, but also the first on the North American continent. Natives who learned of the ease with which a "spring pole" drill could be set up, drilled to a depth of one hundred feet just to watch oil pour out from the bosom of the earth. The creeks and swamps near the town of Oil Springs were flooded with oil. The oil blackened trees up to a height of several feet. The creeks carried the oil out to and formed a film on Lake Erie. Later the oil became ignited and an estimated 5 million barrels were destroyed.

The County of Essex has been fairly well prospected for oil and gas, and two important fields have been found.

The Kingsville gas field was discovered in 1888 (6) and lies in the southern part of Gosfield Township. This field proved to be one of the largest gas producing fields in Ontario, with much of the gas sold to surrounding communities and large cities. This field began with a production of 5 to 10 million cubic feet of gas per day, and yielded $25\frac{1}{2}$

billion cubic feet of gas in 1896, but only 3 billion cubic feet in 1900. Wasteful methods of production resulted in early exhaustion of the gas, or the flooding of the wells by salt water, which necessitated their abandonment. The life of the wells in this field, although short, has been longer than wells in the oil fields. Some legislative measures were set up to conserve the gas supply, but these measures came too late to prevent exhaustion of the gas in the Kingsville gas field. The drilling methods consisted of primitive cable tool and a "spring pole" arrangement, as these were the universal methods of the time.

The second field of importance is located in Mersea Township north of Leamington, from which town the field takes its name (2, p. 57). It was discovered in 1904, and has produced both oil and gas. It has a north-south trend, and is about 8 miles long and $\frac{1}{4}$ to 2 miles in width. It had a very short life, and reached its peak production of oil in 1906. By 1910 it was largely abandoned. Production from the wells varied according to reports, from 5 to 2000 barrels per day. The wells had a long life if produced at the rate of a few barrels per month, but otherwise their life was short.

A few small fields are rather obscurely reported in the literature. The Belle River field in Maidstone Township was opened in 1913, and until 1918 25 wells produced 2,200 barrels of heavy and "dead" oil (2, pp. 58-59). No further drilling was done, and the field has been temporarily abandoned.

The Comber field is located in Tilbury Township West. This field appears to be an extension of the Leamington field. The writer has found only a few wells reported, but gas and oil were produced in such minor amounts that the field was not further drilled. In the north-central part of Gosfield Township a shallow field was developed. The oil occurred at the contact of the drift and the bed rock below (7). Several wells were drilled, but as far as the writer can ascertain from the available well logs, little oil or gas was actually obtained.

A well located on Lot 33 Concession 3 Malden Township, had an initial daily production of 200,000 cubic feet of gas. This township should be further developed before much can be said regarding its future possibilities.

GENERAL STRATIGRAPHY

The following is a description of the formations that have been penetrated by the drill in western Ontario. These are outlined in the accompanying chart.

Trenton limestone (Ordovician)

The Trenton as far as known is a gray to dark gray shaly limestone. It is semi-crystalline, and certain beds are argillaceous. In Colchester South Township two wells penetrated the Trenton. The well on Lot 64 Concession 1 went into the Trenton to a depth of 270 feet, and found it to be a white and dark gray limestone (7). In the well on Lot 78 Concession 1 of the same township, 830 feet of Trenton was drilled through, and consisted of a white and dark gray limestone (7). In Mersea Township on Lot 1 Concession 1 the Trenton was penetrated to a depth of 825 feet. It was found to be a gray limestone with intercalated shale beds at the base. The Trenton was penetrated to a depth of 428 feet in a well located on Lot 32 Concession 1, Gosfield Township South. This was a hard and dark limestone. In Anderdon Township, Lot 7 Concession 1, the Trenton was penetrated to a depth of 174 feet, and was described by drillers as a hard gray limestone. According to the logs available, the base of the Trenton has been reached by only 3 wells, and they

Table of Formations

Period	Name of Formation	Kind of Rock	Thickness	
Pleistocene	Drift	Clay and sand	20-100'	
Devonian	Detroit River	Tan sugary limestone, black shale and pieces of chert	45-113'	
	Sylvania Sandstone	Limestone and pure quartz grains like granulated sugar	35-200'	
Silurian	Bass Island	Gray dolomite and shale Some mineral water	100-215'	
	Salina	Great thicknesses of interbedded blue-gray shale and argillaceous magnesian limestone, overlain by gray to buff limestone containing less magnesia and argillaceous material	210-440'	
	Guelph	Gray to buff thick bedded to massive dolomite somewhat sugary. Porous and crystalline.	215-410'	
	Rochester and Clinton	Gray limestone and shale quite massive. Some pink limestone in upper part	0-35'	
	Medina	Cabot Head	Gray shale limestone and gray shale. Some red shale	20-125'
		Manitoulin	Fine grained hard light blue-gray dolomite	5-15'
		Queenston	Red shale slightly sandy	100-260'
Ordovician	Richmond	Marine limestone and shale		
	Lorraine	Gray and blue gray shale with bands of calcareous sandstone and impure limestone	200-350'	
	Utica	Utica	Brown, black brittle bituminous shale very hard to distinguish contact with Lorraine formation	120-235'
		Collingwood	Beds of limestone and shale each 1 foot in thickness	20-60'
	Trenton	Gray limestone slightly shaly Semi crystalline and granular and bituminous and argillaceous in places	174-831' ±	

show the Trenton to be about 830 feet thick. The thickness estimated by Malcom (3) for the Trenton was over 600 feet. His description of the formation as he observed it at Manitoulin Island, and at Montreal, Quebec, is strikingly similar to the logs of the wells in Essex County. Foerste (1) says that in eastern Ontario there is considerable shale in this formation. This statement differs somewhat from Malcom (3) and the drillers' logs (8) where the Trenton has been penetrated and reported as limestone.

Utica formation (Ordovician)

The Utica formation is divided into two members, a lower called the Collingwood member, and an upper, the Utica member. From the information obtained from the same wells that penetrated the Trenton limestone, the Collingwood member is mainly a black, brown, and gray shale with some limestone. It ranges from 20 to 60 feet in thickness. Malcom (3) in his description of the Collingwood member, says that at Ottawa, Ontario, it is 25 to 50 feet thick with alternating black bituminous limestone layers about 1 foot in thickness. He further states this member to be highly calcareous. Foerste (1) thinks that there is possibly a difference in age between the lower Canacian black shale and the typical Utica formation of New York, as faunas are decidedly different, and suggests the Canadian black shales to be older.

The Utica member is a brown to black shale, ranging from 120 to 235 feet in thickness as observed in the drilling records (7). Malcom (3) describes the Utica member at Ottawa, Ontario, as brownish-black, black, brittle and bituminous with some bituminous limestones in places. He groups the Lorraine and Richmond formations with the Utica, and estimates them to be 585 to 605 feet in thickness in Essex County.

Lorraine formation (Ordovician)

The Lorraine formation consists of gray-blue limestone and shale with beds of hard shale (called "shells") in the drillers' log on the well located on Lot 64 Concession 1 of Colchester Township South (7). A similar description is given for the Lorraine formation in the log of the well located on Lot 78 Concession 1, Colchester Township South (7). The log of the well located on Lot 1 Concession 1, Mersea Township, calls it a gray shale (7), and the log of the well on Lot 32 Concession 1, Gosfield Township South, south gray shale (7). Malcom (3, p. 24) says that the Lorraine formation consists of gray and bluish-gray shales enclosing bands of calcareous sandstone and impure limestone at irregular intervals. His observations were made in stream cuts along the northern shores of Lake Ontario, and at Montreal, Quebec. He says that the Lorraine formation varies greatly in thickness, with a range of 220 to over 2000 feet. The drillers in

many of their logs have grouped the Richmond and Lorraine formations together, and this furnishes little data by which to establish individual thicknesses. Therefore, from the logs observed, the writer has grouped the above mentioned formations into a unit ranging from 200 to 350 feet in thickness.

Richmond formation (Ordovician)

From the well logs of Lot 32 Concession 1, Gosfield Township South; Lot 64 Concession 1, Colchester Township South; Lot 78 Concession 1, Colchester Township South; and Lot 7 Concession 1, Anderdon Township (7); the Richmond formation was observed to consist of gray limestone and shale. The Lorraine formation evidently grades upward into the Richmond, as no sharp point of contact can be observed in the logs. The Richmond formation was, therefore, grouped with the Lorraine formation as stated above, and the two are estimated to have a combined thickness of 200 to 350 feet.

Medina formation (Silurian)

In Essex County the Medina formation is divided into three members, which from bottom to top are as follows:

Queenston member. This member consists of a red shale slightly sandy. In all the deep wells in Essex County this member is represented. It ranges from 100 to 260 feet in

thickness. Malcom (3) calls it red shale and further states that in a well in Welland County, Ontario, it is approximately 1000 feet thick. Foerste (1) says that this member is a red clay, and is somewhat barren of good identifying fossils.

Manitoulin member. This member was found to be present in a well drilled on Lot 17 Concession 7 in Colchester Township North (7). It consists of a hard fine grained, light, blue-gray dolomite. It is represented in the logs of other wells in Essex County, and ranges from 5 to 15 feet in thickness. Malcom (3) describes the same lithology for this member, but he found it to range from 25 to 50 feet in thickness on Manitoulin Island where it crops out.

Cabot Head member. This member was found to be present in the well on Lot 17 Concession 7 in Colchester Township North (7). It consists of a red and gray shale with some interbedded limestone. It ranges from 20 to 125 feet in thickness. Malcom (3) states that he observed this member at Cabot Head, and it consisted of gray shale, and limestone and gray shale in alternate layers with the presence of some slabs of red sandstone.

Rochester and Clinton formations (Silurian)

The Rochester and Clinton formations are composed of massive gray limestones and shales. Some pink limestone occurs in the upper part of each formation. These formations have

been recognized in a well drilled on Lot 17 Concession 7, Colchester Township North (7). Together they range from a few inches to 35 feet in thickness. They may be absent in places. Malcom (3) has observed the Clinton formation to be about 6 feet thick near the Niagara River. The Rochester shale where he observed it on the Niagara River, ranges from $2\frac{1}{2}$ to 70 feet in thickness. Williams (5) describes the Rochester formation near Niagara Falls as a fissile, dark gray shale containing calcareous beds.

Guelph formation (Silurian)

The Guelph formation is a gray to buff colored massive dolomite and limestone somewhat porous and crystalline. It appears to be a sugary white and light brown limestone in the upper part. Logs of the Malden No. 1 well located on Lot 33 Concession 3, Malden Township, and the well located in Colchester Township South located on Lot 83 Concession 1 (7), and many other wells throughout Essex County, Ontario, reveal the same lithology as given above. The Guelph has several outstanding characteristics, namely: crystalline texture, porous and sugary in the upper part, and the presence of gas and salt water flows. This formation ranges from 215 to 410 feet in thickness. Malcom (3) estimates that the Guelph at its minimum is 160 feet thick and is lenticular in shape, thinning to the southwest and northwest. His observations were taken along the Grand River where the Guelph lies

exposed. Stauffer (4) in a record of an incomplete well 6 miles southeast of Ridgetown in Harvard Township, Ontario, shows the Guelph formation to be possibly a dolomite and very difficult to drill. Williams (5) states that the Guelph on weathering is light gray or cream colored, generally has a porous saccharoidal texture. In a well near Niagara Falls the Guelph formation was found to be approximately 140 feet in thickness. Other wells show a range up to 240 feet in thickness in the vicinity of Niagara Falls.

Salina formation (Silurian)

The Salina formation as observed in the Malden No. 1 well located on Lot 33 Concession 3, Malden Township (7) consists of tan and gray interbedded limestone and black and gray shale with chert and gypsum. The above well gives an estimated thickness of 440 feet for the Salina. In the Bondy No. 1 well located on Lot 83 Concession 1, Colchester Township South, the Salina formation consists of brown and gray limestone and gray shale (7). This well log shows a thickness of 489 feet. From the logs (7) of the wells the Salina formation ranges from 210 to 440 feet in thickness. Malcom (3, p. 35) says that the Salina formation in the Buffalo, New York, quadrangle consists of great thicknesses of interbedded blue and gray shale with argillaceous magnesian limestone overlain by gray to buff limestone containing less magnesia and argillaceous matter. The average thickness of the Salina formation as determined from 10 wells was

approximately 390 feet. Williams (5) states that this formation contains gray shale, dolomite, salt and gypsum beds. In Anderdon Township he shows a columnar section for a well south of Canard River on Lot 30 Concession 1. This section shows the Salina to be about 500 feet in thickness.

Gypsum beds are widespread in the Salina formation, but the southeast limit of the Michigan basin salt beds is approximately along a line running from Amherstberg to Belle River. The Salina formation thickens from 400 feet in Essex County to over 1900 feet near Bay City, Michigan, as revealed in the recent deep test at Kawkawlin of Gulf Refining Company.

Bass Island formation (Silurian)

The Bass Island formation consists of interbedded tan sugary limestone, chert or cherty limestone, gypsum and some black shale. This formation also yields a flow of mineral water in many wells. The writer had access to cuttings of 4 wells in Malden Township, which penetrated the complete Bass Island section. The Bass Island consisted of tan limestone with chert, gypsum and black shale. Malcom (3) says the Bass Island formation consists of dolomite, limestone and sandstone, but gives no definite thickness for it. Stauffer (4) discusses the controversy over the age of the Bass Island formation. Some geologists think it Devonian, but he says that the fauna probably falls within the Silurian according to the present definition of the system. Williams (5) in his

columnar section shows the Bass Island formation to be 330 to 375 feet in thickness along the Detroit River. He states that it consists of light buff dolomite, white sand, lime cement and light buff cherty limestone.

Sylvania sandstone (Devonian)

The Sylvania sandstone consists chiefly of beds of rounded grains of pure clear quartz sand. The grains are medium to medium fine in size. Some chert occurs probably in limestone beds which are found at irregular intervals in the sand in different wells. The sand is very poorly cemented. The Malden No. 1 well, located on Lot 33 Concession 3 of Malden Township, shows 200 feet of the Sylvania. The well located on Lot 7 Concession 1, Anderdon Township, shows 290 feet of Sylvania (7). Stauffer (4) says that the Sylvania is approximately 305 feet in thickness as observed from a log of a well near Sarnia, Ontario. Williams (5) in a columnar section of a well on Lot 30 Concession 1, Anderdon Township, shows the Sylvania to be about 174 feet in thickness. Malcom (3) says that the Sylvania sandstone is a remarkably pure, sparkling aggregation of incoherent quartz grains, and by drillers it is often likened to salt or granulated sugar. From 10 wells in Essex County he determined the Sylvania sandstone ranged from 10 to 100 feet in thickness. The very small figures are the result of measuring only the lower part of the Sylvania due to the removal of the upper part by erosion prior to drift deposition.

Detroit River formation (Devonian)

The Detroit River formation as identified under the binocular from cuttings of 4 wells in Malden Township consists of tan sugary limestone, black shale and pieces of chert. Stauffer (4) in a record of the Sucker Creek Test Well located on Lot 7 Concession 6, Anderdon Township, shows the Detroit River formation to be brown dolomite with some limestone, and 260 feet thick. Partial thickness immediately below the drift in wells in Malden Township range from 45 to 113 feet.

Drift (Pleistocene and Recent)

The drift ranges from 20 to 100 feet in thickness. Most wells drilled in recent years in southwestern Essex County with which the writer is familiar penetrated with ease a drift composed almost entirely of clay. Malcom (3) states that the drift contains clay, sand, gravel, and boulders, but the writer cannot verify the existence of gravel and boulders.

DECIPHERMENT OF PRINTED RECORDS OF WELLS

The old logs of the wells in Essex County show various types of rock in the terminology of the driller, or in terms of geologic parlance of the time. In these logs a few repeated terms given by the drillers have been interpreted as follows:

1. "Sharp sand". A cherty limestone that rapidly dulls the drill bit.
2. "White sand". A limestone or dolomite bed that drills fine and probably denotes the top of the Guelph formation.
3. "Shells". An extra hard bed of shale in a soft shale series.

If the old record of a well was poor or obviously faulty in one part, it commonly contained a significant horizon marker in another that could be computed back to the top of the Guelph, the surface chosen for contouring. Graphic strip logs were very helpful in deciphering the reliable parts of the logs from the erroneous or absent parts. Horizon markers of special value are as follows:

A red shale is noted by all drillers in wells that penetrated it. To this red shale the writer has given the name Queenston in correlating it with the observed Queenston by Malcom (3) near the Niagara escarpment. The base of the Queenston formation is noted by the sudden change from a red

shale to a gray-brown and black shale of the underlying Richmond formation.

The top of the Guelph formation has been found from binocular observations to be a porous dolomite. The origin of the porosity is obscure from records at hand. It may be due to solution below an old erosion surface or to secondary dolomitization. The porosity is mentioned in nearly all the old well logs. The beds resting above this porous dolomite, from binocular observation of well samples and from old well logs, are interbedded, gray-blue shale and limestone. This shows a definite lithological change between it and the porous dolomite formation below and may represent an unconformity.

The base of the Sylvania sandstone has been taken as the base of the lowest sand bed in the sand and limestone series. This probably is not at the same stratigraphic position in each well because of inferred lensing out of the sands. In regional structural contouring, however, the variation in stratigraphic position will introduce no serious error.

STRUCTURE OF ESSEX COUNTY

Over eighty old well records that contained structural information of value in contouring were found in the literature. Data on ten more recent wells were furnished the writer by A. J. Eardley. Cards upon which the logs are typed are contained in a pocket at the end of the report. By means of the logs a structure contour map has been prepared and is presented as part of this report. Most of the logs are distributed over the southern townships of Essex County. Only a few are available for the northern townships. No records at all were found for Sandwich Townships South, West and East, Maidstone Townships North and South, Rochester Townships North and South, for the northern part of Colchester Township North, and the northeastern part of Anderdon Township.

The top of the Guelph formation was chosen for contouring because most of the old wells bottomed a few feet in the formation. Even though lithologic descriptions are very poor or faulty in the old logs a depth measurement is significant, especially if compatible with adjacent wells.

The contour map (see map in pocket) shows two pronounced structural trends, viz., north-south anticlines and synclines in the eastern part, and northwest-southeast anticlines and synclines in the southeastern part.

The features of the north-south structures are as follows:

An anticlinal structure extends from Kingsville to Belle River, Ontario. The axis pitches from Belle River southward and from Kingsville northward to form a saddle in the north-central part of Gosfield Township North. This saddle region is contoured as a small dome because several shallow wells produced oil from the Salina (?) formation. Near Belle River the dip of the flanks is approximately 150 feet per mile. The anticline appears to split into two anticlines and a syncline at Kingsville producing a wide area of gas accumulation. The development along the east-west trending shore line of Lake Erie produces an east-west trending field, but such a direction is not indicative of an east-west anticlinal fold.

Another north-south anticlinal structure extends northward from Leamington, Ontario. A closure of about 50 feet along the axis occurs between Leamington and Comber and marks the site of the old Leamington oil field. Only a few logs are existent in this area, but maps showing the extent of the field help to define the structure. The beds dip away from the anticline near Leamington at approximately 50 feet per mile, but near Comber, the dip is about 200 feet per mile. Near Comber another small closure is believed to exist along the axis.

The features of the northwest-southeast structures, as well as can be deciphered, are as follows:

In southwestern Essex County one large anticlinal structure is separated from a smaller anticlinal structure by a

narrow and shallow syncline. The pitch of the anticlines and syncline is to the northwest towards the Michigan basin at approximately 25 feet per mile. The beds dip away from the anticlines at about 50 feet per mile in the southern part to approximately 150 feet per mile in the northwestern part. Towards the eastern end of the larger anticline, another anticline trending northwest-southeast merges with it. The structural high created by this merger extends apparently out under Lake Erie.

The area of northwest-southeast trends is a continuation of similar ones in the Michigan basin. It is difficult to trace the strong Howell structure, however, from Michigan across the Detroit River into Canada. The Howell structure seems to lose relief to the southeast and may possibly be continued by the anticlinal structure that crosses the Detroit River north of Amherstberg. The problem is one requiring special study.

RECOMMENDATIONS

The writer suggests drilling in the following places.

1. The central part of Colchester Township South in Concession 1. The high produced by the merging of the two anticlinal structures looks favorable for oil accumulation.

2. The Belle River structure. Hume (2) states that oil was obtained from the Onondaga (Detroit River of this report) limestone which lies just below the surface drift. The available logs on this field show drilling only on the flanks of the anticline, without any deep wells drilled to the Guelph formation. This should warrant further study and possible exploration.

3. Further field investigation in north-central Gosfield Township might indicate the advisability of drilling to the Guelph there. So far as the writer can determine from the available literature, only shallow wells have been drilled into the Salina (?) formation here.

4. Some 50 miles east of Leamington a large flow of gas was recently hit on drilling into the Trenton limestone. A well was drilled in the south end of the Leamington field to the Trenton but was reported dry. According to the writer's structure map this well was not located in good position on structure and, hence, should not seriously retard further exploration on the Leamington structure with the Trenton as

the objective. Other Trenton wells have been drilled in Essex County, one on record in the Kingsville field, but all have been reported dry. These seeming contradictory findings suggest the value of more careful searching of the literature and interviewing of people who may have private records of the old wells.

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STRUCTURE CONTOUR MAP OF
ESSEX COUNTY, ONTARIO

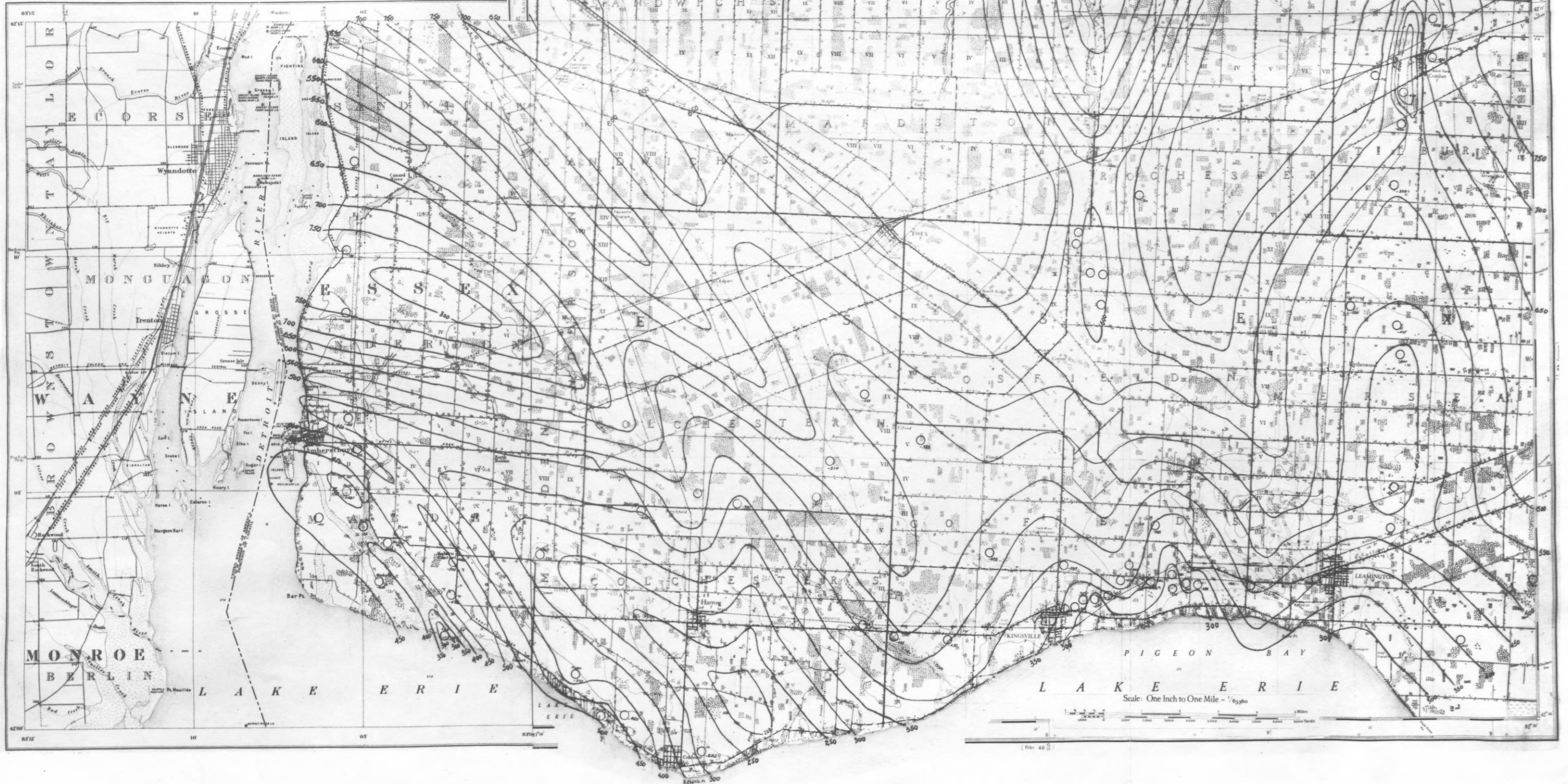
by P. L. Garvey.

Contours on top of Guelph, recognized by major gas and oil producing beds, or by large salt water flow, or by white sand, or white limestone, or white dolomite, or by name "Guelph" or "Niagara".

TOPOGRAPHIC MAP

ONTARIO
AMHERSTBURG SHEET

CANADA 1 INCH TO 1 MILE



Scale: One Inch to One Mile = 1/63,360

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