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The University of Michigan, Ph.D., 1971
Geography

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# THE GEOGRAPHIC, HISTORIC AND POLITICAL FACTORS INFLUENCING THE DEVELOPMENT OF CANADA'S CHEMICAL VALLEY

by
Elwood John Clark Kureth

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Geography)
in The University of Michigan
1971

Doctoral Committee:

Professor George Kish, Chairman
Professor Gerald S. Brown
Associate Professor James D. Clarkson
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In gathering material for this paper, numerous individuals were involved whose efforts provided invaluable assistance. I would be remiss if I did not acknowledge their significant contributions.

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The bibliography contains the names of many people with whom I corresponded. The list is too long to be presented here, but I wish to acknowledge their suggestions and thank them for their interest.

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"The city of Sarnia provides a striking example of the importance of geographical location and chance in the growth and development of an industrial city."

E. R. Rowzee, President
Polymer Corporation

# CHAPTER I

## EVOLUTION OF THE PETROLEUM INDUSTRY IN LAMBTON COUNTY

The purpose of this study is to present an analysis of the factors that led to the establishment of Canada's largest petrochemical center in Sarnia, Ontario. This study will examine the pertinent geographical, historical and political elements that proved conducive to the development of such a chemical complex.

The influence of the early oil discoveries in Lambton County and the subsequent evolution of a major oil refinery complex in that area forms the first subject for discussion. The expansion of this complex into Canada's largest single refinery provided the basis for the site and ensuing construction of Canada's first petrochemical plant, the government owned Polymer Corporation.

The federal and provincial governments of Canada supported the construction of the world's longest oil and gas pipeline system; this in turn had a profound impact on the spatial development of Sarnia's Chemical Valley. The catalysts used by the government, the Crown Corporations were instrumental in both resource development and transportation and in the final processing of the raw material.

Examining the principle of self-perpetuation and the subsequent integration of the "valley," the validity of the concept that the chemical industry is its own best customer is demonstrated.

Canada's National Oil Policy divided Canada into an eastern and western oil market with only that portion of Canada east of the Ottawa River having access to the cheaper foreign crude oil. An analysis of this policy and its influence on Sarnia is an integral part of the study.

A major problem for all Canadian industry is the small domestic market. It is therefore necessary to investigate the effect of this encumbrance on the chemical industry of Sarnia in light of low tariffs, high cost materials, lack of economies of scale, high labor costs and strong foreign competition.

To add to these problems, Sarnia is presently faced with competitive developing "regional" petrochemical centers. A discussion of their growing importance to Canada and their consequent effect on Sarnia provides the basis for an over-all examination of the Canadian petrochemical industry.

Geography as well as history has played a key role in the notable similarity of the economic and political structure of Canada and the United States. Industrial development in these two great nations has had much in common; industrial development in one nation has meant parallel development in the other. Almost always however the spatial growth of industry in the United States has had a much greater impact on the Canadian than has the impact of Canadian expansion on the American economic structure. American interests, simply by their scope of investment, have overwhelmed the Canadian industry over the past decades. Capital from the United States carried the American investor north of

the border and the development of the Canadian economy in many instances hinged on the amount of this American investment.

It is indeed ironic that the preceding statement applies to the petroleum industry of Canada. The magnitude with which the American oil industry developed within a few years after the discovery of oil by Drake in Pennsylvania in 1859, has all but obscured the fact that the first commercial oil well in North America was located in Oil Springs, Ontario and not Titusville, Pennsylvania.* "Colonel" Edwin Drake is unquestionably the name most associated with early oil developments rather than James Miller Williams, the man who actually dug the first commercial oil well in 1858 in Oil Springs, Ontario and who rightfully should be called the "Father of the North American Oil Industry."[1] Yet petroleum publications when referring to the early days in the oil industry seldom, if ever, mention James Williams and Oil Springs, Ontario. This is unfortunate, for the credit due this man and his colleagues for their early exploits in the oil industry deserves recognition. Without men like James Williams, and the ensuing development of the petroleum industry in Lambton county, one wonders if Canada's Chemical Valley would have evolved into the dynamic complex that it is today.

As previously indicated, the first oil well in North America was located in Oil Springs not far from the city of Sarnia (Figure 1). The well was 50 feet deep and approximately seven by nine feet square. This well produced over 350,000 gallons of crude oil in the first two years of operation. The crude oil was shipped from Oil Springs over extremely

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*The world's first commercial gas well was also located in this area. It was in Essex County just a few miles south of Oil Springs.

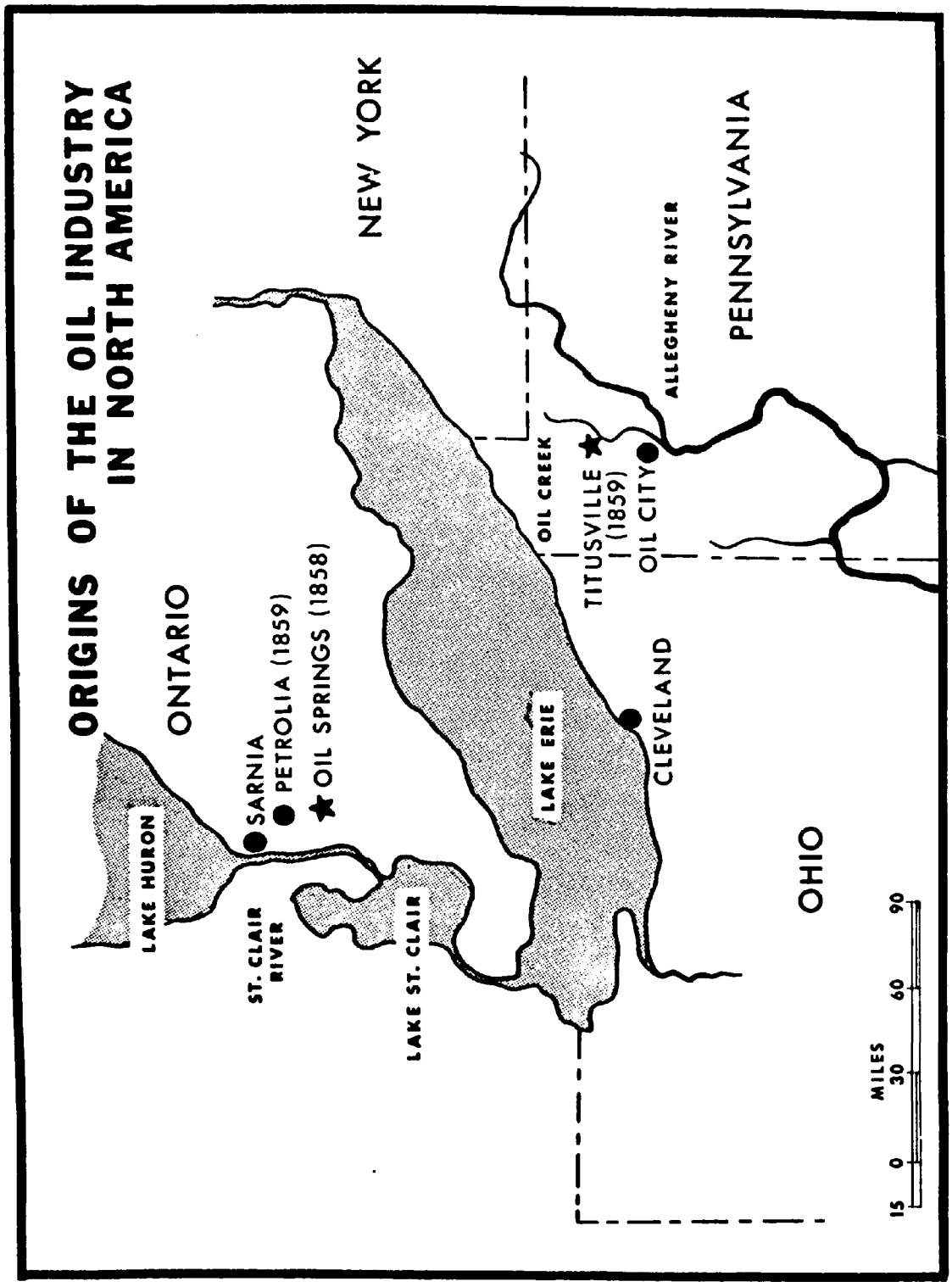

ORIGINS OF THE OIL INDUSTRY
IN NORTH AMERICA
ONTARIO
NEW YORK
PENNSYLVANIA
OHIO
LAKE HURON
ST. CLAIR RIVER
LAKE ST. CLAIR
LAKE ERIE
SARNIA
PETROLIA (1859)
OIL SPRINGS (1858)
OIL CREEK
TITUSVILLE (1859)
OIL CITY
ALLEGHENY RIVER
CLEVELAND
MILES
15 0 30 60 90

FIGURE 1

rough roads to Wyoming or Wardsville and from there by railroad to the Williams' refinery in Hamilton.[2] Although Williams' first refinery was located at the site of his oil well, near Oil Springs, the decision to move the refinery to Hamilton was dictated by a desire to be close to the consuming market.

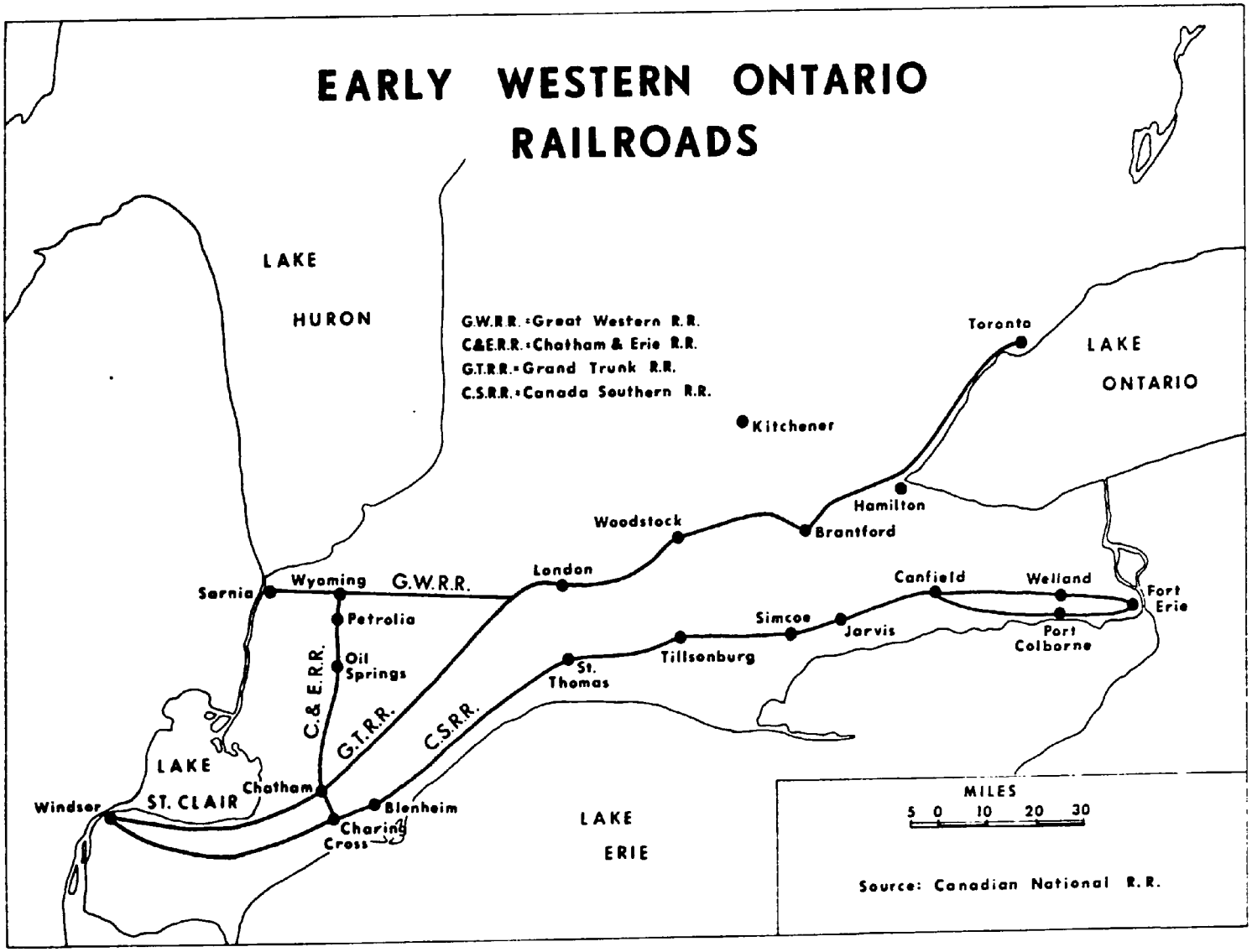
However, this distance from the source of production to the market confronted the producers with numerous problems; among them the desire to make the operation profitable. Oil was worth thirteen cents per gallon or a little less than five dollars per barrel at Wyoming, the nearest point on the Great Western Railroad where crude could be loaded; but the cost of hauling the oil by wagon to Wyoming from Oil Springs was from four to six cents a gallon a between one-third to one-half of the sales price.[3] This fact made it obvious to the oil producers that the site of production--with regard to the transportation routes--created an economic issue. New oil pools were discovered quite rapidly resulting in a state of chaos for the oil economy of that area. Production often outdistanced refining capacity, and market demands of the crude were not constant. This created a system with little equilibrium; as a consequence, prices and profits fluctuated considerably. Operators without sufficient capital could not remain in business and many failed.

Of all the problems, poor transportation was still the major deterrent to profitable operations in Oil Springs. This would discourage refiners from establishing in Oil Springs and Petrolia; instead, Sarnia, with its access to the much cheaper water routes of the Great Lakes, would become the alternate choice.

Oil operations expanded to the north of Oil Springs with the discovery of a new field near Petrolia. Within a short period of time oil was being produced there in great quantities. Unfortunately, the town of Petrolia had been bypassed by the Great Western Railroad when it went through from London to Sarnia (Figure 2). They did not build a spur line to Petrolia because the railroad feared a sudden collapse of the oil industry in Petrolia would doom the spur line to perpetual poverty.

However, the oil producers, aware of the transportation problems of Oil Springs, concluded that if they did not have a spur line at least two problems would constantly confront them. First would be the problem of storage at the well head. Production by 1866 was so great that the refineries could not find barrels or storage tanks to accommodate the tremendous output. Hundreds of thousands of barrels of oil drained away in the nearby creeks and rivers. As a result, in the summer of 1866 the hulls of lake boats were fouled with oil.[4] This terrible waste was an important reason why Petrolia oil men wanted a railroad spur to their field. In addition, they wished to eliminate the necessity of having to haul oil over quagmire roads that all too often turned out to be shallow surface streams. Therefore, the oil men raised over $50,000 and built a spur line from Wyoming to Petrolia thereby linking the refineries of London, Woodstock, Hamilton, Toronto, and Sarnia with the oil field of Petrolia.[5] It was not long after the construction of this railroad spur that the oil men sold their interests in this very profitable spur line to the Great Western Railroad for the original cost of construction. They would soon regret this move.

FIGURE 2


EARLY WESTERN ONTARIO RAILROADS
LAKE HURON
G.W.R.R. = Great Western R.R.
C&E.R.R. = Chatham & Erie R.R.
G.T.R.R. = Grand Trunk R.R.
C.S.R.R. = Canada Southern R.R.
Toronto
LAKE ONTARIO
Kitchener
Hamilton
Brantford
Woodstock
London
Wyoming
G.W.R.R.
Sarnia
Petrolia
Oil Springs
C.&E.R.R.
G.T.R.R.
C.S.R.R.
Canfield
Welland
Fort Erie
Simcoe
Jarvis
Port Colborne
Tillsonburg
St. Thomas
LAKE ST. CLAIR
Windsor
Chatham
Blenheim
Charing Cross
LAKE ERIE
MILES
5 0 10 20 30
Source: Canadian National R.R.

As in Oil Springs earlier, the oil refineries of Petrolia at times operated on a very narrow profit margin and making a profit necessitated careful management. Acts of collusion between the refineries of Hamilton, London, Toronto, Sarnia, and Woodstock with the Great Western Railroad appeared to be designed to curtail all refining activities in Petrolia, which had a sizeable refining capacity. These distant refineries combined to depress the price of crude oil, a feat which was not too difficult because the refining capacity was greater than market demand. This was accomplished by establishing a set price among themselves and, as a unit, refused to pay more. Usually this price was well below the wholesale price agreed upon before the refineries elected these disruptive maneuvers.

To counter this, the oil producers of Petrolia constructed another refinery in Petrolia, the Home Oil Works, which handled over 3,000 barrels per day. Along with the other refineries already there this made Petrolia the largest refining center in Canada. However, the refineries in the other cities had worked out a deal with the Great Western Railroad whereby the railroad would charge more for hauling refined oil out of Petrolia than they would charge for hauling crude oil from the local Petrolia refinery. Since the Great Western Railroad was at this time the only link to the other refinery cities of Ontario, it was apparent that the oil producers were in a poor economic position.

Solutions of all sorts including the construction of a pipeline were suggested, but the only action taken to remedy the situation was to request that a new and competing railroad come to Petrolia. This would happen eventually, eliminating the monopoly of the Great Western Railroad whose original plan--also that of the "united" refineries--was to force

down the price of refined crude in Petrolia and put out of business some of the refining operations there. It is interesting to note that monopolies in production and transportation were common economic problems in the early development of the oil industry in the United States, too.

By 1870 Petrolia had surpassed Oil Springs as the leading oil center in Canada. A contributing factor to this had political overtones. Initially, both Oil Springs and Petrolia were significant producers of oil; however, it must be noted that many of those individuals working in the oil fields in Ontario were American--primarily from Ohio and Pennsylvania.[6] The Fenian Raids* against Fort Erie by United States Irishmen provked a dispute that made war between Canada and the United States seem inevitable. This situation induced those Americans working in Oil Springs to return home as soon as possible. Since most of the Americans with an oil background were working in Oil Springs and not at Petrolia, their departure along with declining production had a very depressing effect on Oil Springs. Thus as Petrolia prospered, Oil Springs fell behind and never again regained the stature in the oil industry that it had enjoyed prior to the Fenian Raids.[7]

Today Canada's Chemical Valley of Lambton County is a complex of diverse chemical producers. It would be remiss if it was not noted that Lambton County's first chemical industry was also associated with the oil industry as are today's chemical giants.

In order to increase output of an oil well which was decreasing in production, a popular method had been devised in the United States.

---

*A group of Irish-Americans dedicated to the establishment of an independent Irish Republic planned a raid on Canada hoping to exchange the portion they captured for Irish independence.

This was to "shoot" the well with a considerable amount of nitroglycerine in an obvious attempt to rejuvenate the well. For some time the chemical had been imported from the United States. It was a highly explosive chemical and very costly to import; because of this, a Mr. Bradley decided to manufacture this chemical in Petrolia and eliminate costly expense. This early attempt to establish a chemical industry in Lambton County was aborted when the plant blew up soon after construction and with it, the only chemical industry of the county was destroyed.

The Canadian oil industry was growing, but it was meeting severe competition from the burgeoning American oil industry. One company in particular, the Standard Oil Company, by 1872 controlled over one-fourth of the total capacity of the refining industry of the United States where it had been made known that Standard intended to capture the bulk of the nation's refining capacity.[8] Standard Oil's major interests were located in Cleveland, Ohio, on the south shore of Lake Erie. To the oil producers in Ontario, just behind the north shore of Lake Erie, this oil giant posed a very real threat. It was fairly obvious that Standard Oil was conducting sales in Canada through branch offices of domestic affiliates and was, in effect, competing with Canadian refiners.

Nevertheless, the oil industry of Canada was making some progress. There had finally been developed a clean kerosene that could compete with the "sweet" oil of Pennsylvania.[9] One price had been established for the domestic market and a lower one for the foreign market. This was done so as to be competitive with the United States in the overseas markets. Since the domestic market was small--a problem that plagues Canadian industry to this day--it became necessary to expand

foreign sales, if the industry was to grow. Behind a federal tariff to protect the domestic market from American intervention, and with a growing European market, the future appeared bright for the Canadian oil producer.

Despite this optimism the market for Canadian kerosene collapsed when huge reserves of oil were discovered in Pennsylvania, and a resultant drop in price made it unprofitable for the Canadian operator to compete with such a volume competitor.[10] During the reconstruction period in the United States vast amounts of new capital were thrown into the western Pennsylvania oil fields. Oil production soon flooded the Canadian and world markets and Petrolia oil producers found their foreign market closed. In addition, the United States government terminated partial free trade with Canada and this affected the oil men of Petrolia in an adverse manner.

New domestic government regulations did not help matters. The new regulations regarding the specific gravity of kerosene meant that less kerosene could be obtained from a barrel of oil.[11] Actually, it required some 15 percent more crude oil to manufacture the same amount of kerosene, which in turn increased transportation costs. As John D. Rockefeller demonstrated early in his quest for a petroleum empire, transportation costs are the most readily available prop to crumbling profit margins.[12] With this fact in mind, the refineries in London requested the London City Council to put up $20,000 to construct a pipeline from Petrolia to London. This would allow the refineries to be closer to the market and have the added advantage of cheaper transportation costs. However, this request for funds to build a pipeline was

turned down by the Council. They had had enough of the "smelly" oil refinery development in their town.

It was apparent even at this early date, 1880, that the oil men recognized the advantage of pipeline transmission, but with the city's refusal to grant funds for the construction of the Petrolia-London pipeline the possibility of the establishment of a refinery complex of any dimension in London was ended. It is a matter of conjecture, but one could surmise that had the city council decided to construct the pipeline, London could well have been the center of a huge refinery-petrochemical complex like the one that exists in Sarnia today.

Expansion was necessary to meet the growing domestic demand and a newly created oil company called Imperial Oil was formed attempting to meet the domestic demands and counteract the strong American competition. The company had been formed in London but when funds for the pipeline were refused, their operations had moved to Petrolia. The Petrolia site was ideal because not only was it the area of production of crude oil, but a second railroad had reached Petrolia. This line was the Sarnia, Chatham and Erie and with this extension of a competitive line to Petrolia, the Great Western Railroad immediately reduced its rates and ended discrimination against oil shipments from Petrolia.[13]

Imperial Oil was also encouraged to locate in Petrolia when the city fathers granted Imperial free taxes for five years. With this subsidy, Imperial built the largest and most modern oil refinery in Canada.[14] So competent was this refinery that in a short time Imperial Oil was able to undercut, ala Rockefeller in Ohio, all of its competition. As a result, Imperial became the only major refinery in Canada.

By 1884, Petrolia was the unquestioned oil capital of Canada. North America's first oil exchange was opened for business there and shares of oil could be bought and sold by investors.[15] United States oil producers had raised the price of crude oil so high that it became profitable to ship oil to the United States in spite of the American protective tariff. Petrolia and the Lambton County oil fields prospered.

Meanwhile, American oil companies had become increasingly interested in the southern Ontario oil fields. The giant Standard Oil had been growing slowly in Canada and in 1889 it purchased the Bushnell Refinery Company Ltd. of Sarnia. The knowledgeable people at Standard Oil recognized Sarnia as a desirable location based on its ease of access to the Great Lakes.

When the Canadian government lowered the tariff on American petroleum products in the early 1890's, tremendous pressure to expand was put upon the Imperial Company of Petrolia.[16] The lowering of the tariff by the government placed the financially weaker Canadian oil companies in a very unpromising situation. With easier access to the Canadian market by the American petroleum industry, competition for the domestic markets became intense.

By 1895 Imperial Oil had started a campaign in search of the needed capital to accomplish its planned growth. After an intensive search to find the additional capital in Canada and Great Britain, the company was forced to reconcile itself with the facts as they existed at that time. No money of the magnitude needed was available from sources other than the United States. Thus Imperial Oil was forced to turn to her leading competitor Standard Oil for funds. On July 1, 1898,

an agreement was reached whereby Standard Oil would supply the needed capital for the expansion of Imperial Oil in exchange for the controlling interest in the company.[17]

With this new acquisition, Standard now had 75 percent of the oil business in Canada. Within a few months, Standard moved its facilities from Petrolia to Sarnia.[18] The town that had once been the oil capital of Canada was now without a refinery and was never again to experience the prosperity associated with the flamboyant oil industry.

The American Division of the Standard Oil Company had previously established a refinery in Cleveland because it recognized the advantage of a site near water. In the same way, economics dictated the move to Sarnia. It was this expert analysis of the advantages gained by the refinery with the superior location--both to markets and transportation facilities--that enabled Standard to overwhelm its competition in both Canada and the United States. The move to Sarnia made the Sarnia refinery of Imperial Oil the largest in Canada, and so it remains today.

To maintain the refinery at Sarnia, Imperial constructed a pipeline from Petrolia to Sarnia and supplemented this source of petroleum with oil from Ohio since by 1912 the demand for petroleum products had exceeded the capacity of the local oil fields. Initially this crude oil from Ohio came by barge traffic on the Great Lakes system. Thus by utilizing local crude oil, plus some imported crude, the refinery was able to produce the necessary 900 barrels per day considered adequate for the domestic markets of Ontario.[19] Very soon this production was to fall far short of demand. With the increased use of the automobile around 1912, the market for petroleum products would expand dramatically.

For Imperial Oil, as for the other refineries, the automobile meant that new techniques on how to maximize gasoline production were necessary. The new demand required the refining capacity to be increased and more crude oil be made available. To meet the demands for more petroleum, a 153 mile, six inch pipeline was laid from Cygnet, Ohio, to Sarnia, linking Sarnia with the Mid-Continent Oil fields of the United States.[20] This increased the supply of crude oil for Imperial and allowed it to expand the refinery at the Sarnia location. It was apparent at this time that the local oil fields of southwestern Ontario could not meet the new demands placed upon them. Hence Canada, the nation where crude oil was first commercially produced, was now dependent upon a foreign source. It should be noted at this time that there was no legislation that impeded the movement of oil from a foreign source into Canada. In later years, this policy will be modified and have an effect on the Sarnia refineries.

By 1914, Imperial was the only refiner of oil in Sarnia. When Imperial moved to Sarnia from Petrolia in 1898, no refinery remained in the area. However, the citizens, politicians, and local businessmen of Petrolia wanted a refining industry in their community to provide employment for those whose jobs had been terminated with the departure of Imperial Oil. The people decided that they should form a company owned and operated by Canadians.[21] In 1902, the Canadian Oil Refinery Company of Petrolia was established and although most of the crude oil had to be brought in from Toledo, Ohio, to Petrolia--first by tank car and later by pipeline--Petrolia was back in the oil business on a moderate scale.

For the next few years, the company achieved some success and operated a number of service stations over much of Ontario.

In spite of a determined effort by the officers of this new company, the problems of capital to be used for expansion and improved marketing facilities proved to be the undoing of the independent status of the Canadian Oil Company. The company declared bankruptcy in 1908 and National Refining Company of Cleveland, Ohio assumed control of the now defunct company. Once again, control of a Canadian oil company had passed into the hands of an American concern.

It was apparent by this time that the secret to success in the cut-throat oil industry in the early 1900's depended on two factors. The first and most important was capital; the second was the ability to modify output to meet changing market demands.[22] An industry, in order to succeed, had to be viable with regard to changing times. To this end foreign capital seemed destined to control the future of the Canadian oil industry. As for Lambton County, the only source of capital was south of the border. This was a very discouraging state of affairs for the Canadian oil man. Then in 1938, an event took place that to many Canadians was the most important happening in Canadian history.

The depression had hit hard at the economies of both the United States and Canada, but the United States economy suffered the most. As a result, in 1938 control of Canadian Oil was returned to Canada with the purchase of the interests of the National Refining Company by Canadian interests. The wheel of economic fortune had completed a full cycle. Again there was a fairly strong independent Canadian oil producer in Lambton County, although in the not too distant future the

Canadian Oil Company, in a move dictated by economic competition, would be forced to move to the banks of the St. Clair River just below the Sarnia location of Imperial Oil. Petrolia once again would lose its refinery.

As of 1938, the Chemical Valley of Canada was non-existent. The factors that would lead to the development of Canada's largest chemical complex took form when Japanese conquests eliminated the rich plantations of southeast Asia as a source of natural rubber. The industrial metamorphosis that was to occur in Lambton County was initiated by a federal decision to build a fully integrated synthetic rubber plant there. The rationale to build in Sarnia was based partly on the location of Canada's major oil refinery, Imperial Oil. Here then was the basis for the construction of such a plant and with it the dynamic growth of Canada's petro-chemical industry. The orientation of the complex was thus predetermined by the location of Canada's major oil industry that began in Oil Springs and moved eventually to the more optimum location of Sarnia.

Footnotes

[1]"Number One Oil Well Was Located in Canada," Canadian Chemical Processing, 39 (December, 1955), 8.

[2]"Canada's First Oil Refinery," Canadian Chemical Processing, 39 (January, 1955), 42.

[3]Carl Gray, The Great Canadian Oil Patch (Toronto: MacLean-Hunter Ltd., 1970), p. 42.

[4]E. R. Rowzee, "Sarnia, the Birthplace of Canada's Petro-Chemical Industry," Chemistry and Industry, 33 (December, 1949), 863.

[5]C. B. Whipp and E. Phelps, Petrolia--1866-1966 (Petrolia: Petrolia Historical Association, 1967), p. 8.

[6]Gray, The Great Canadian Oil Patch, p. 52.

[7]Ibid.

[8]H. F. Williamson and A. R. Daum, The American Petroleum Industry (Evanston: Northwestern University Press, 1970), p. 689.

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[18]C. H. Caesar, "Contributions of the Petroleum Industry to the Sarnia Petro-chemical Complex," Paper given at Third Annual Conference of Canadian Research Management Association, Sarnia, Ontario, November 2, 1965.

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[21]R. M. McPherson and R. W. Ford, A History of the Chemical Industry in Lambton County (Sarnia, 1961), p. 40.

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"Polymer was incorporated in 1942 and given the responsibility to build and operate a 41,000 long tons per year synthetic rubber plant at Sarnia. This plant was the Canadian contribution to the 3/4 billion dollar wartime synthetic rubber program in North America."

E. J. Buckler, Vice-President
Polymer Corporation

## CHAPTER II

## CREATION OF PETROCHEMICAL INDUSTRY

With the advent of the war in Europe, the Canadian government became acutely aware of a situation that could have disastrous repercussions on the Canadian war effort, the shortage of rubber. To expedite this matter the government created the Fairmont Corporation, a crown corporation, whose function was to purchase and sell such materials as crude and synthetic rubber. In Canada a crown corporation is an institution with corporate form brought into existence by action of the Government of Canada to serve a public function. The intent of this corporation was to acquire a stockpile of crude rubber in order to be prepared for an impending emergency. In 1940 the federal government agreed to grant the Fairmont Corporation adequate funds to stockpile 18,000 tons of crude rubber.[1] At the same time, the Fairmont Corporation and the thirteen Canadian rubber companies had concluded an agreement whereby the rubber companies would act as storage agents for this government corporation. As prospects for a Pacific war became more ominous, the Canadian Government authorized the Fairmont Corporation to increase its reserve supply of crude rubber from 18,000 to 50,000 tons.[2]

By late 1941 when negotiations between the United States and Japan had seriously deteriorated, the purchasing agents of the Fairmont Corporation became extremely active and had arranged for considerable

purchases of rubber from Malaya, the Dutch East Indies, and Ceylon. Several thousands of tons of rubber from the Far East were either in transit or awaiting shipment when the war in the Pacific started with the Japanese attack on Pearl Harbor on December 7, 1941. A good deal of the rubber destined for Canadian ports did not arrive. Shortages of this commodity became a grim reality instead of a mere possibility. The last crude rubber from the Far East reached Canada in September, 1942, and from that time on over 95 percent of the natural rubber producing areas of the world were no longer available to Canadian or American rubber purchasers.[3]

In conjunction with the United States, the Canadian Government had by early 1942 taken several steps to solve this very pressing problem regarding rubber. With the access to natural rubber producing areas no longer available, it became necessary to produce synthetic rubber. Conferences between the leading members of the Canadian defense agencies and their opposite numbers in the United States resulted in the decision to construct a number of rubber producing plants in the United States and Canada.

As a part of the Allied master plan, but entirely at the expense of the Canadian Government, it was decided to build a rubber plant in Canada that would produce GR-S and Butyl rubber. GR-S is a general purpose rubber. GR means Government Rubber and the suffix "S" stands for styrene. Butyl rubber is a special purpose synthetic rubber made from isobutylene and a small amount of isoprene. The plant for production of GR-S and Butyl rubber was to have the capacity to meet the wartime demand created in Canada. To accomplish this objective, another Crown

Corporation, Polymer Corporation Limited, was incorporated in February 1942 under letters of patent issued under the Companies Act.[4] The Order in Council authorizing the Polymer project indicated an agreement between the Crown and Polymer directing the Corporation to acquire, construct, install, and establish the necessary land, buildings, machinery, equipment, and plant for the manufacture, production and storage of synthetic rubber. It was also agreed that the company shall operate the plant in such a manner as the Government shall direct.[5]

Among the many problems facing the Polymer Corporation was the fact that the corporation did not have the technical knowledge which would allow them to produce synthetic rubber. The Germans and Russians had synthetic rubber programs as did several companies in the United States.* Only one, Standard Oil, which had acquired the right in 1939 to develop German Buna rubber in the United States, had developed techniques concerning the manufacturing and fabrication processes suitable for making synthetic rubber. In 1941 Standard Oil was in a position to produce synthetic rubber on a major scale but had not done so because it was not economically feasible at that time.

The Canadian Government authorized Polymer to enter into agreements with three companies, on a management-fee contract, whereby Polymer paid all operating costs, co-ordinated the operations of the three

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*Under the new National Socialist government's "Four-Year Plan" adopted in 1933 to make Germany self-sufficient, synthetic rubber received increased attention. By 1935 the production of Buna-S in Germany had reached 35 tons per month. In the spring of 1937 production of the German Government-subsidized Buna-S had reached 5000 tons per year.

In Russia the manufacture of synthetic rubber was started in 1933, and by 1939 production had reached the level of 75,000 tons a year, obtained by the polymerizations of butadiene by metallic sodium.

companies, supervised the finances of the operation and paid to the operating companies a certain amount for each pound of rubber produced.[6] The three companies that had the knowledge to produce the ingredients essential to the manufacture of synthetic rubber were:

(1) The St. Clair Processing Corporation Limited, a subsidiary of Imperial Oil which was incorporated on September 12, 1942, to produce hydrocarbons, ethylene, and isobutylene and butadiene, making the butyl rubber and operating the steam, power and water facilities.[7]

(2) Dow Chemical of Canada Limited, a subsidiary of Dow Chemical of Midland, Michigan, which was to produce styrene. The formation of this company resulted from an approach late in 1942 by a Polymer representative who asked Dow to produce styrene on behalf of the Canadian Government.[8]

(3) Canadian Synthetic Rubber Limited, which was a subsidiary of the following four Canadian rubber companies: Dominion, Firestone, Goodrich and Goodyear. This company was to operate the co-polymerization unit to combine butadiene and styrene for production of a general purpose rubber.[9]

The choice of these three companies to produce synthetic rubber was a shrewd move on the part of the Canadian Government. In the United States, the parent companies of the four Canadian rubber corporations as well as the Standard Oil Development Company were already producing or engaging in development work in the synthetic rubber field. By these means Polymer was able to short-cut the usual periods of experimentation and familiarization with production problems and techniques, and to jump

almost overnight into full scale production.[10] Polymer would have access to the technical processes already developed by the parent companies. The Dow Chemical Company, for example, had been in commercial production of styrene since 1937 and consequently was relied on most heavily for the styrene part of the rubber program.[11] Since styrene makes up about one-quarter of synthetic rubber, development of this plant became imperative.

Consequently, the Canadian Government, through the Polymer Corporation, established the only fully integrated rubber plant in North America. The plant was unique in that, of the twenty to be constructed in North America, it was the only one erected under the synthetic rubber program to produce not only the two main types of synthetic rubber, but also the chief components, butadiene and styrene for Buna-S and isobutylene for Butyl Rubber. Some of the twenty plants produced butadiene but did not manufacture Buna-S. Some were projected to make only styrene, while others produced styrene and butadiene. This full integration of a synthetic rubber plant was to have a direct bearing in the dynamic post war growth of the now evolving "chemical valley."[12]

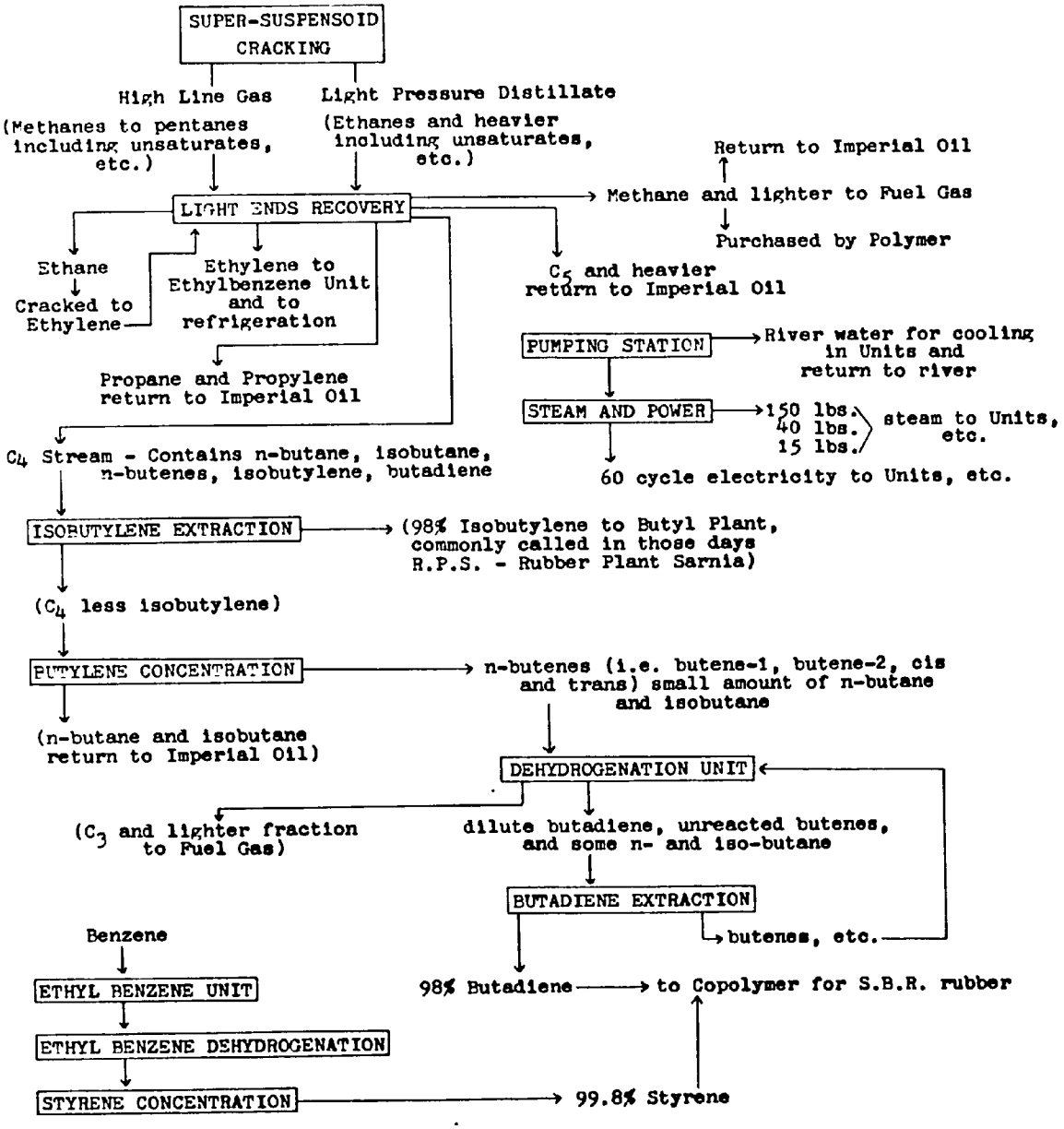
To illustrate what is meant by a fully integrated rubber project, an examination of the Polymer Corporation is necessary. Since the projected construction indicated that this plant would be composed of ten "factories," an analysis of these units reveals the significance of the term "integrated" (see Figure 3). These ten factories include:

(1) Supersuspensoil Cracking Coil.

This unit is an ingenious adaptation of a standard refining thermal unit. The suspensoid cracking operation was an outstanding contribution to petroleum technology. Of great

FIGURE 3

## POLYMER CORPORATION FLOW CHART




Source: E. Crockett

importance is the fact that suspensoid cracking, and its improvement, supersuspensoid cracking, form the keystone without which it is doubtful whether Canada would have been able to embark on its wartime synthetic rubber program and without which, in turn, Canada would have had no petrochemical industry.[13] This operation increased the capacity of the refinery and made it possible to supply the proposed rubber project with the requisite amount of feed stock.

(2) The Light Ends Recovery Unit.

This is a fractional distiller in which the hydrocarbon streams from Imperial oil are broken up into these components: ethylene, propylene fuel gas and a butane-butylene cut, containing isobutylene. These are essential feedstocks in the production of rubber.

(3) The Isobutylene Extraction Unit.

The isobutylene is separated in the Extraction Unit from the liquified butane-butylene cut, by treatment with acid. The isobutylene is extracted by absorbing it in sulfuric acid of such strength that it will not absorb other components of the mixture to any significant degree. Absorbed isobutylene is then liberated from the acid extract by treatment with steam. Isobutylene is one of the two primary raw materials required in the manufacture of Butyl Rubber. The other raw material is isoprene.

(4) The Butylene Concentration Unit.

This unit separates and concentrates the butylene necessary for making butadiene, one of the two major ingredients in Buna-S

rubber. The isobutylene extraction unit supplies the isobutylene--free hydrocarbons which are fed to the Butylene Concentration Unit in which normal butylenes required for butadiene are removed.

(5) The Butadiene Unit.

The Butadiene Unit is composed of two separate sections: one carries out the dehydrogenation, i.e., the removal of hydrogen from the molecule, while the other unit permits the concentration of the butadiene.

(6) Styrene and Cumene Section.

The Styrene Unit comprises four sections: the Ethyl-benzene, the Cumene, the Styrene Cracking, and the Styrene Finishing Unit.

Ethylene from the Light Ends Recovery Unit is piped to the Ethyl benzene-Cumene building. The benzene is acquired by Polymer from the coke ovens at Sault Ste. Marie and Hamilton, Ontario, and is transported by lake tanker to this unit during the summer months. Because of the frozen lakes and rivers in winter, it is necessary to store the benzene in tanks that have enough capacity to supply the plant during the winter season, although in an emergency rail tank cars could be used. In this section the ethylene is reacted with benzene over a catalyst to produce ethyl-benzene.

Styrene Cracking Section.

The second important step in the manufacture of styrene is the dehydrogenation of ethylbenzene, which is accomplished in this unit.

Styrene Finishing Unit.

The third and final step in the purification of the crude dehydrogenated material containing 35 to 40 percent styrene is done here.

(7) Buna-S Unit.

A co-polymerization unit composed of two identical parallel units operating independently makes up the Buna-S unit. The two identical units combine styrene and butadiene to produce Buna-S Rubber.

(8) Butyl Rubber Unit.

In this unit isobutylene is built up into complex molecules with a small amount of isoprene to form Butyl Rubber.

(9) Steam and Power Plant.

In addition to the other units, Polymer was to construct what would be one of the largest steam plants in all of Canada. At Polymer this steam would be used primarily in the making of synthetic rubber and in powering the electrical equipment which makes the plant function. This unit would consume over 400,000 tons of coal annually.

(10) Pumping Station.

Pumps utilize about 150,000,000 gallons of water per day. The water is required for processing synthetic rubber. The choice of location of this plant would have to take into consideration the need for large amounts of water for manufacturing processes.

The site selection for this new synthetic rubber plant was another major decision of the federal government. There were numerous

factors to be considered. Butadiene, the key hydrocarbon in the production of synthetic rubber and the main raw material in Buna-S, could in theory be made from coal, grain, oil, or natural gas; therefore, these raw materials could serve as basic sources of supply.[14] A decision to manufacture butadiene from grain alcohol would result in the locating of a plant near the source of grain production. The United States program called for about 90,000,000 bushels of grain per year in order to produce 242,000 tons of butadiene or about 35 percent of the entire butadiene requirement for their program.[15] Those plants processing butadiene from grains were located as close to the sources as possible. In Canada, a decision to use grain could mean that a western location would be considered.

After considerable investigation on the part of the Federal research agencies, it was decided to use petroleum as a basis for the manufacture of butadiene.* In addition, petroleum is a liquid comprising an almost infinite series of different molecular combinations of hydrogen and carbon which could be used in the synthetic rubber process. Thus as far as plant location is concerned, with relation to accessibility of petroleum, the Minister of Munitions and Supply had at least three possible choices of location (Figure 4). The possible sites were:

(1) The Turner Valley in Alberta--the site of Canada's only major domestic oil supply at that time.

(2) The Montreal area--a site where some refineries had been constructed and where crude oil could be brought by way of the

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*Standard Oil had developed a process whereby butadiene could be processed by direct catalytic conversion of refinery butylene.

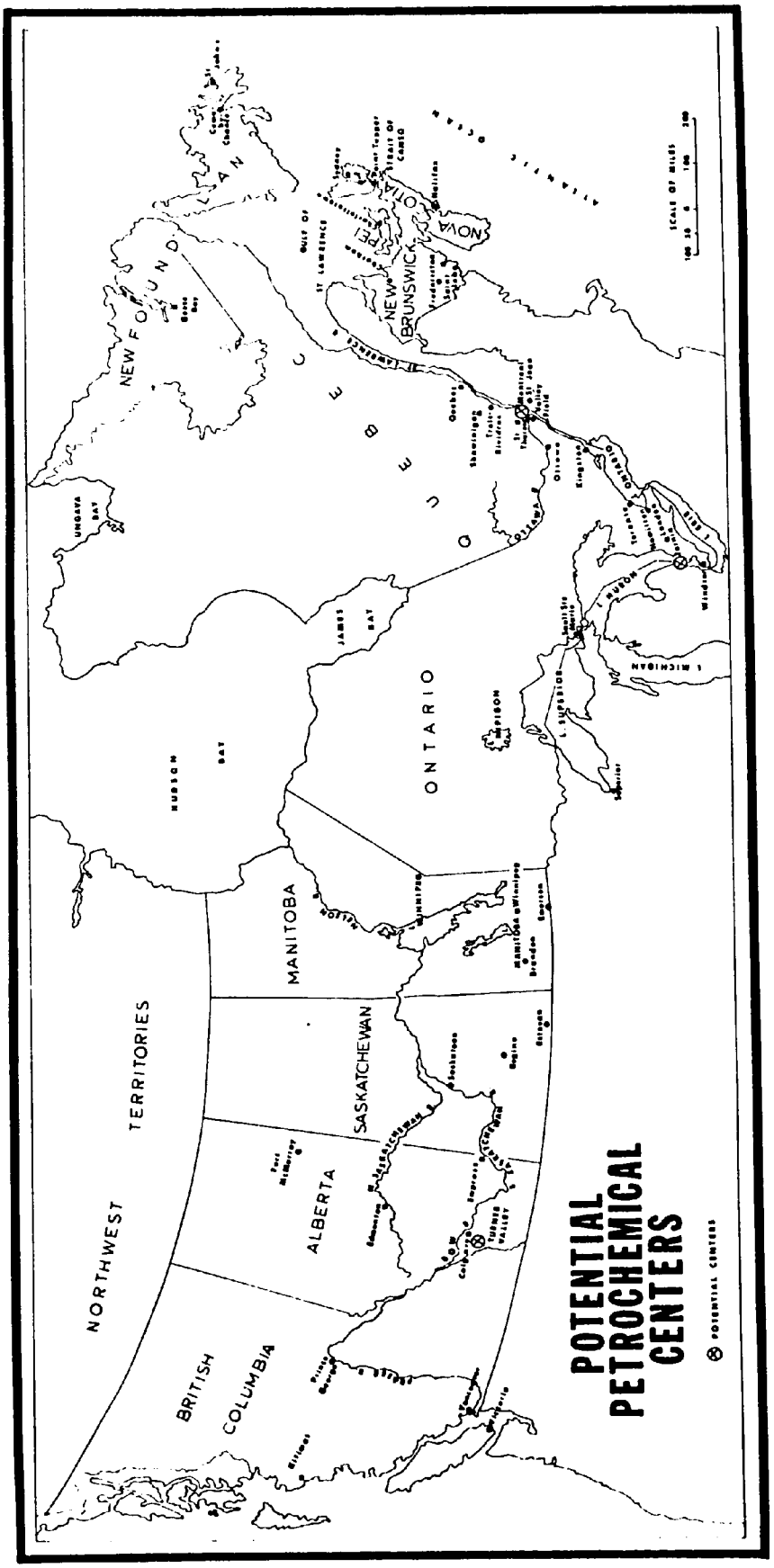

POTENTIAL
PETROCHEMICAL
CENTERS
⊗ POTENTIAL CENTERS
NORTHWEST
TERRITORIES
BRITISH
COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
QUEBEC
NEW BRUNSWICK
NOVA SCOTIA
P.E.I.
NEWFOUNDLAND
HUDSON BAY
JAMES BAY
UNGAVA BAY
GULF OF ST LAWRENCE
ATLANTIC OCEAN
SCALE OF MILES

FIGURE 4

St. Lawrence from foreign sources, or by way of Montreal-Portland pipeline (also dependent upon foreign sources).

(3) The Sarnia area--the site of Canada's largest refinery which had access to the Mid-Continent Oil fields of the United States.

When considering these three sites, one aspect of plant location can be excluded. Under wartime conditions--such as those existing in 1942--the market is a non-essential factor. Hence, when a site is selected, the geographic concept of plant location with regard to markets does not necessarily fit into the decision making process. Of obvious consequence, however, is the fact that one would not want to locate too close to the war zone.

In considering the Turner location in Alberta as a possible site for the Polymer Corporation, those who wanted a plant based on Canadian crude oil would argue for this site. A refinery complex existed there and the plant would have a controllable source of crude oil. Comparing the Turner Oil Field to other producing areas in Canada, this site was the source of Canada's largest domestic supply as of 1942.[16] (Table 1 figures represent imperial gallons.)

TABLE 1

CANADIAN OIL FIELD PRODUCTION--1938-1942

| | Turner Valley | Other Alberta Fields | Ontario Fields | New Brunswick | N.W.T. | Total |
|---|---|---|---|---|---|---|
| 1938 | 6,159,641 | 50,964 | 172,631 | 19,276 | 22,855 | 6,425,377 |
| 1939 | 7,259,242 | 38,382 | 206,379 | 22,799 | 20,191 | 7,546,993 |
| 1940 | 8,180,191 | 40,710 | 187,644 | 22,167 | 18,633 | 8,449,345 |
| 1941 | 9,537,221 | 78,100 | 159,368 | 31,459 | 23,664 | 9,829,712 |
| 1942 | 9,701,719 | 139,535 | 145,000 | 24,879 | 82,424 | 10,095,457 |

But lessening the chances of this site being developed were the following factors:

(1) The supply of crude oil was limited and very possibly could not meet the demand.

(2) This oil contained a high percentage of sulfur and this would involve additional expensive processing.

(3) The available supply of fresh water did not meet the projected demand.

4) Primary producers of essential materials that were needed for synthetic rubber, i.e., benzene, were located in Ontario and thus would be remote from this site.

(5) The processors of synthetic rubber were located in the Toronto area and they also were quite removed from the Turner Valley.

Considering the above factors the federal government decided against the Turner Field site.

The Montreal site seemed to offer some advantages with regard to the possible site for the Polymer plant:

(1) There was plenty of fresh water available.

(2) A refinery complex existed in the area.

(3) The site had access to foreign crude shipped by way of the St. Lawrence. But this route was closed for a portion of the year; therefore, any thought of using this site would involve the construction of huge storage tanks capable of holding millions of barrels of oil during the winter season. However, in addition to the St. Lawrence route, the Montreal area could also be serviced by the Montreal-Portland pipeline. Both of

these routes would be dependent upon a foreign source of crude oil that had to be delivered at least part of the way by the Atlantic sea route. There was constant danger of enemy interference with these shipping lanes, so delivery of the crude with regard to a specific volume could not be guaranteed.

Whenever the government considered both of these sites, the conclusion was that (1) The Turner Valley did not have enough petroleum for the projected plant, and (2) The source of petroleum for the Montreal site could not be guaranteed. The third site possibility, Sarnia, was then analyzed and selected as the site for the construction of the Polymer Corporation. Sarnia was selected for the following reasons:

(1) Canada's largest oil refinery, Imperial Oil, was located there. It had a reliable source of crude oil because of a pipeline to the Mid-Continent Oil Fields of the United States.

(2) In the manufacture of synthetic rubber, huge quantities of water are required. At Sarnia, the water from the St. Clair River was available. In addition, the range of water temperatures from 34°F in the winter to 70°F in the summer was ideal for the cooling units involved in making rubber.[17]

(3) The Sarnia site is located between Sault Ste. Marie, Ontario and Hamilton, Ontario. In both of these cities coke is manufactured and benzol is a by-product. Thus benzol which is an essential ingredient of ethyl-benzene, needed in the production of styrene, is available. Styrene, along with butadiene, is basic to the synthetic rubber program.[18]

(4) Large amounts of brine are needed in the manufacture of synthetic rubber. The entire area of Sarnia is underlain with salt and the brine is readily available. It can be obtained cheaply from the Dominion Salt Company of Sarnia.[19]

(5) The Sarnia site is not far from Kitchener, Hamilton, and Toronto. Here all of the Canadian rubber processing factories are located. This means that the raw rubber would need to be shipped a relatively short distance for processing. Polymer makes the raw rubber, but does not process it.

(6) The site had access to water, rail and road transportation. Products can be imported and exported by means of these excellent facilities.

(7) Coal needed for the operation of the power plant is available from nearby Ohio ports. Though the coal would have to be stockpiled due to a closed navigation season in winter, in the event of a demand for more coal on an emergency basis, the supply could be augmented by rail delivery.

Thus the Canadian Government, in cooperation with the United States rubber program, had a projected plant and a new site. The next step would be to build this complex. It was realized that initially Polymer would have to rely on the United States for certain components, machines and parts, and essential materials in order to begin the production of rubber. If present laws regarding movement of goods and materials back and forth across the border continued, the construction would be delayed. Therefore, prior to plant construction, the Deputy Minister of Munitions and Supply of Canada met with the Executive

Director of the Economic Defense Board of the United States. The results of the meeting were that legislative and administrative barriers, including tariffs, import duties, customs and other regulations or restrictions of any kind which prohibited, prevented, delayed or otherwise impeded the free flow of necessary materials between the two countries should be suspended or otherwise eliminated for the duration of the war.[20] Thus the international border, for all intents and purposes, did not exist technically. Materials and equipment needed for the construction of Polymer moved freely into Canada in accordance with the agreements reached between the two governments. The fact that this facilitated the rapid construction of the plant is unquestioned.

The selection of Sarnia by the federal government as a site for the Polymer Corporation changed the economic complexion of the region. The wartime development of the "chemical valley" was matched by an even greater expansion of the petrochemical industry during the post-war period when development was in part based on key federal decisions regarding the government-owned Polymer plant. Just as the term polymerization refers to the process whereby a long chain of repeating units are made by chemically linking a large number of small molecules together, so too will the "chemical valley" polymerize. It is an old adage of the chemical industry that it is its own best customer. Sarnia's petrochemical evolution can be attributed to the establishment of the synthetic rubber industry which provided the catalyst needed for the other plants to "react" around the "primate" complex.

## Footnotes

[1]J. Kennedy, History of the Department of Munitions and Supply, King's Printer and Controller of Stationery, Vol. 1, 1950, p. 345.

[2]Ibid.

[3]Ibid., p. 346.

[4]The letters are reproduced in Minutes on Public Accounts, 1960-61, p. 436.

[5]C. A. Ashley and R. G. H. Smails, Canadian Crown Corporations (Toronto: The Macmillan Company, 1965), p. 229.

[6]L. A. McLeod, Growth of a Petrochemical Complex, Paper given at Third Annual Conference of Canadian Research Management Association, Sarnia, Ontario, November 2, 1965, p. 10.

[7]The Canadian Petrochemical Industry, Shell Oil Company, Chemical Division, p. 5.

[8]Don Whitehead, The Dow Story (New York: McGraw-Hill, 1968), p. 139.

[9]C. J. S. Warrington and R. V. Nicholls, A History of Chemistry in Canada (Sir Isaac Pitman & Sons, Ltd., 1949), p. 157.

[10]McLeod, Growth of a Petrochemical Complex, p. 9.

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[12]John L. Smart, The Growth of a Petrochemical Complex, Paper given at Third Annual Conference of Canadian Research Management Association, Sarnia, Ontario, November 2, 1965, p. 133.

[13]E. R. Rowzee, "Sarnia, The Birthplace of Canada's Petrochemical Industry," Canadian Chemicals and Process Industries, 33 (December, 1949), 864.

[14]D. W. Huke, Introduction to Natural and Synthetic Rubber (New York: Chemical Publishing Co., 1951) p. 53.

[15]Gustav Egloff, "Synthetic Rubber from Petroleum," The Rubber Age, 52 (December, 1942), 223.

[16]Kennedy, History of the Department of Munitions and Supply, p. 157.

[17]A. L. Foster, "Sarnia Plant Is Complete Rubber Factory," The Oil and Gas Journal, 42 (March, 1944), 62.

[18]Canadian Petrochemical Industry, Chemical Division, Shell Oil Company. (Toronto: Ryerson Press, 1956), p. 3.

[19]Rowzee, "Sarnia, The Birthplace of Canada's Petrochemical Industry," p. 21.

[20]James Warren, Wartime Economic Co-operation: A Study of Relations Between Canada and the United States (Toronto: Ryerson Press, 1949), p. 28.

"Regarding future growth of the chemical industry in Canada, undoubtedly the major stimulus will continue to be from the large-scale development of synthetics which supplement and displace natural products."

L. Hynes, President
Canadian Industries Limited

# CHAPTER III

## EXPANSION OF CHEMICAL VALLEY

The decision of a corporation to expand its facilities is always a challenging experience. A decision of this kind can lead to a more profitable operation or, on the other hand, could result in over extension of the facilities to the extent that the corporation could experience financial disaster. In making such a decision, numerous factors must be evaluated. The methods may vary, but generally the following factors have to be considered: annual sales volume, equipment cost, unit price, fixed and variable costs, tax rates and minimum acceptable return. If a corporation cannot nail down some positive figures with regard to these factors then seldom, if ever, will it expand. Since most investments are largely irreversible, and since the consequences usually extend well into the future, it is vitally important that the decision basis encompass a careful examination of what the future holds in store.[1] At the end of World War II, the Polymer Corporation was faced with the problem of expansion.

The Polymer Corporation was manufacturing synthetic rubber. In 1945, synthetic rubber was still not regarded by many in the rubber producing industries as equal in quality to natural rubber. In fact synthetic rubber still had to prove its worth to the world rubber market. With this in mind and to appreciate the problems facing the Canadian

synthetic rubber industry (Polymer) it is necessary to examine the position of the natural rubber industry before the war. In 1941, the major areas of natural rubber production were located in the Far East (Table 2).

TABLE 2

1941 WORLD RUBBER PRODUCTION[a]

| | Long Tons | Percent of Total |
|---|---|---|
| Netherlands East Indies | 635,981 | 42.1 |
| Malaya | 575,000 | 38.0 |
| Ceylon | 102,351 | 6.8 |
| Indochina | 50,000 | 3.3 |
| Siam | 45,000 | 2.3 |
| India | 14,000 | .9 |
| Other Far East | 12,000 | .8 |
| South America and Mexico | 25,000 | 1.7 |
| Africa | 17,000 | 1.1 |
| | 1,511,332 | 100.0 |

[a]A. McFadyean, "History of Rubber Regulation 1934-1943," Canadian Chemistry and Process Industries, 3 (June, 1946), 49.

With the conclusion of the war there was little doubt that these areas would soon be active, producing regions. Though the Asian regions had sustained major disruptions in production during the war, and most of the plantations had suffered damage, the figures in Table 2 indicate potential production. Prior to the war these regions had supplied the

world's demand in rubber. A synthetic rubber producer would have to consider these regions as sources of future competition.

Even with all the problems related to the war, production resumed in 1945 (the year that the war ended) and by 1946 the natural rubber producing areas of the world had made a rather dramatic recovery (Table 3). Production increased by about 700,000 tons in one year.

TABLE 3

EXPORTS OF NATURAL RUBBER[a]
(Long Tons)

| | 1945 | 1946 |
|---|---|---|
| Netherlands East Indies | 4,250 | 212,500 |
| Malaya | 51,607 | 367,942 |
| Ceylon | 95,184 | 101,080 |
| Indochina | 1,033 | 135,449 |
| Siam | -- | 21,000 |
| South America | 27,234 | 20,000 |
| Africa | 53,606 | 45,000 |
| Total | 250,000 | 940,000 |

[a]"Canada Ranks Among Leading Producers for Natural Rubber," Canadian Chemicals and Process Industries, 30 (June, 1946), 50.

The potential of the world's rubber producing areas was estimated by E. G. Holt of the Canadian Office of Domestic Commerce to be nearly 2,000,000 long tons annually. This potential could be doubled merely by converting plantations to high yield trees, but the process would require many years and extensive financing.[2] The time factor was significant in that the world demand could not wait for this development

of new plantations. This was to the Polymer Corporation's advantage.

The establishment of a high yield plantation could pose a real threat to synthetic rubber producers. This is best shown by the achievements of the Rubber Research Institute of Malaya. Prior to the Japanese invasion of the area the Research Institute had subjected plants to test tapping trials at an early age and discovered that these plants promised at maturity as high as 3,000 to 5,000 pounds of rubber per acre. Considering that the first trees introduced into Malaya yielded on the average of 300 pounds of rubber per acre, this achievement is remarkable.[3] If yields of this order were to become typical of all rubber plantations, then the synthetic rubber industry would face a real battle for control of the world rubber market.

In assessing the market regarding the requirements for rubber it was suggested that the rubber demand could be broken down into four general areas:

(1) Uses where synthetic rubbers are superior, e.g., insulations, gasoline hoses and transmission seals.

(2) Uses where synthetic rubber will be continued for reasons of national interest, e.g., Canadian synthetic rubber industry.

(3) Where either natural rubber or general purpose synthetic rubber is usable and choice will depend on economic factors, e.g., tires, tire products, motor mounts.

(4) Uses for which natural rubber is absolutely necessary,[4] e.g., adhesives, textile backing, rubber thread.

Based on this analysis, about 75 percent of the total demand could be supplied by either synthetic rubber or natural rubber. Thus if

a synthetic rubber industry wished to penetrate the peacetime rubber market, the producers would have to demonstrate varying degrees of superiority of synthetic rubber over natural rubber. The challenge was to prove to industry that synthetic rubber was not simply an item developed to meet the wartime emergency, but was a viable product able to withstand the competitive resurgence of the natural rubber industry.

In 1945, the government-owned Polymer Corporation of Sarnia was forced to make a key decision. What should be done with the synthetic rubber plant at Sarnia? Should the plant be dismanteled or shut down? Should the plant be sold to private interests? Or should the plant be retained by the government, and production continued on a peacetime basis. An analysis showed that for at least a financial break-even the plant would have to be operated at design capacity--41,000 long tons of rubber production per year--which would require export sales of half of the total production.[5] The domestic market of Canada could consume only 20,000 tons per year. At this time it seemed doubtful that synthetic rubber products could withstand competition from natural rubber either in terms of quality or in price.[6] To many people in government, peacetime prospects for Polymer Corporation appeared dismal. Nevertheless, the government accepted the decision of the Board of Directors of Polymer when the Board recommended that the plant continue to operate in peacetime and continue as a Crown Corporation.

There were important factors to consider with regard to the decision by Polymer to stay in operation during the immediate post-war period. Most important to Polymer was the position of the government-owned United States synthetic rubber plants. As mentioned previously

the United States had erected during the war a huge synthetic rubber industry with a large potential producing capacity. If the United States decided to compete with Canada for export markets, i.e., Europe, then Polymer would have little chance to succeed. But the United States found itself in a rather awkward position regarding post-war development of its synthetic rubber industry. The major rubber producing areas of the world were in the hands of the American allies of World War II, i.e., Great Britain, France and the Netherlands. The United States government had no intention of offending these allies. Therefore the United States synthetic rubber industry was not an important exporter of synthetic rubber to the European markets and did not appear to offer a challenge to Polymer, if Polymer did seek the European markets which were, of course, essential to the success of the post-war development of the Corporation.

A second major factor that was destined to assure a positive decision to continue peacetime operations at Polymer, and had a very significant bearing on the decision of the federal government to accept the analysis of the Board of Directors of Polymer, was the strong assertion that this plant (Polymer) would be the catalyst for a potential petrochemical industry. Since the government was interested in developing a complex of this type, this reason alone may have sufficed in deciding to continue at Polymer. In many of the other industrially advanced nations, the development of a petrochemical industry was regarded as a sign of twentieth century industrial development. The Canadian government did not wish to relegate itself to a position where it would be dependent upon outside sources for the products of this new industry.

Thus the vital decision to continue to produce at Polymer was made and a three point program was developed. The program instigated included:

(1) the establishment of a strong research and development program aimed at diversification and increased productivity.

(2) the drive to establish world-wide export markets.

(3) the seeking of additional revenue by local sale of by-products and utilities such as water, steam and power.

Although all parts of the program would have an impact on the growth of the "chemical valley," the third point of the program is extremely important in the spatial development of the region. A commitment to a program whereby hydrocarbon feedstocks such as refinery gas, ethane, propane and butane would be available to other industries and, in addition, an authorization of the sale of power to local concerns provided an incentive for industrial growth in the area. As was pointed out earlier, the power plant of Polymer had tremendous potential and with this power available to industry a major obstacle to industrial development would be overcome. The fact that a company intending to build in the vicinity of Polymer did not have to invest in a power plant offered a prime opportunity for the future development of the area.[7]

Export markets of Europe presented an excellent opportunity for the Polymer Corporation. A world wide shortage of rubber existed in 1945 and Polymer was in a position to exploit this market demand. The capacity of the world's synthetic rubber plants as of 1945 was 1,300,000 long tons of which 1,100,000 long tons were in the United States. Estimated consumption in 1945 was 1,500,000 long tons which would in theory

require all of the synthetic output plus the total natural rubber output of over 200,000 long tons.[8] Since the United States did not wish to become involved in the exportation of synthetic rubber in 1945, the market opportunities were apparent for Canadian synthetic rubber. The analysis of the market for synthetic rubber in Canada indicated that half of the production of Polymer could be marketed within Canada, but the rest would have to be exported. The European markets offered the corporation a golden opportunity to sell their surplus rubber. Polymer soon negotiated contracts with businessmen in several European nations and the markets of Europe absorbed most of Canada's surplus of synthetic rubber (Table 4).

TABLE 4[a]

CANADA RUBBER EXPORTS--1946
(Long Tons)

| | Buna-S | Butyl | Total |
|---|---|---|---|
| United Kingdom | -- | 200 | 200 |
| Denmark | 625 | 4 | 629 |
| Finland | -- | 5 | 5 |
| France | 2,521 | 50 | 2,571 |
| Italy | 2,862 | 9 | 2,871 |
| Spain | 571 | -- | 571 |
| Norway | 397 | 57 | 429 |
| Sweden | 2,315 | 42 | 2,357 |
| Switzerland | 354 | 75 | 429 |
| Belgium | 614 | 11 | 625 |
| Czechoslovakia | 325 | -- | 325 |
| Austria | 689 | -- | 689 |

[a]"Canada Ranks Among Leading Producers of Rubber Goods," Canadian Chemistry and Process Industries, 30 (May, 1947), 430.

Canada, normally the sixth largest importer of raw rubber--behind the United States, United Kingdom, Japan, Germany and France--became a world leader in the exporting of rubber and rubber goods. By 1952, Polymer was producing rubber equal to the amount obtained from some 20 million rubber trees on a South Pacific plantation.[9]

The success of the government decision to continue manufacturing synthetic rubber at Polymer is revealed by Table 5. In addition to rubber production, the chart also indicated Polymer's success in chemical production in the post war years. Sales of Ethylene and Styrene were increasing quite rapidly.

TABLE 5[a]

POLYMER'S RUBBER AND CHEMICAL PRODUCTION--1945-1952

| | Rubber Production (millions of pounds) | | Chemical Production (millions of pounds) | | |
|---|---|---|---|---|---|
| Year | Butyl Type | Butadine Type | Ethylene | Styrene | Sales |
| 1945 | 10.6 | 77.7 | 7.1 | 16.0 | $29,461,000 |
| 1946 | 22.3 | 79.0 | 6.4 | 17.8 | 24,307,000 |
| 1947 | 27.4 | 88.4 | 9.4 | 28.0 | 30,501,000 |
| 1948 | 12.9 | 76.1 | 10.4 | 29.4 | 17,267,000 |
| 1949 | 18.8 | 75.7 | 20.8 | 35.4 | 21,564,000 |
| 1950 | 17.8 | 88.9 | 31.4 | 43.4 | 26,010,000 |
| 1951 | 30.3 | 102.0 | 42.7 | 57.6 | 35,293,000 |
| 1952 | 34.3 | 114.4 | 46.8 | 69.4 | 45,418,000 |

[a]"Polymer Makes Rubber and Money," Canadian Chemical Processing, 36 (August, 1952), 62.

The significance of these figures should be examined with the the fact that since 1946, natural rubber had regained a considerable portion of its former market. Productivity of natural rubber was

estimated to exceed demand within a relatively short period of time, i.e., around five to ten years, and this could have a profound impact on the price of rubber. Even without this problem evolving, natural rubber was available at prices as much as 10 percent below those for synthetic rubber.[10] While this fact had to be faced by the Polymer Corporation, the company had one very important advantage. Polymer could make rubber to meet the specific needs of the industry, i.e., the component parts of the rubber could be altered to give the rubber differing characteristics and because of this the uses for the rubber could vary considerably.

The Polymer decision to sell power and chemical by-products was a significant factor in Dow Chemical's decision to build in Sarnia. Dow Chemical of Canada Limited, originally incorporated at the request of the Canadian Government to design, build and operate a styrene plant for Polymer Corporation, acquired property adjacent to the Polymer plant. Dow's first independent operation in Canada was to involve the company in the manufacturing of its famous plastic, Styron, which is made from styrene. Actually Styron is manufactured in three steps. The first stage involves the mixing or reacting of two parent materials, ethylene and benzene to form ethyl benzene. The second step involves the "cracking" of ethyl benzene to form crude styrene and the third stage results in the purification of the crude styrene.[11] The benzene used in the process originates in Sault Ste. Marie, Ontario, produced as a by-product of coke manufacture. The ethylene used is piped in from Polymer.

Dow Chemical recognized the potential of the Sarnia area as a chemical production center. Prior to locating in Sarnia, Dow had made a survey of suitable plant sites in Eastern Canada. It was attracted to

Canada by the access to the United Kingdom's market via the Empire Trade Preference Agreement.[12] The domestic Canadian market also presented opportunities for Dow.

The selection of Sarnia as the site of the Canadian based plant was predicated upon the following factors:

(1) Raw material in the form of salt beds was available at reasonable depths below the surface. Since salt is the main raw material in the production of chlorine and caustic soda, this provided Dow with a local source of an important mineral. In addition to salt, hydrocarbon feedstocks in the form of refinery gas, ethane, styrene, propane and butane were readily available from nearby sources.

(2) Transportation facilities in the Sarnia area included excellent railroad, highway and water routes. This provided Dow with access to the markets of populous Ontario and Quebec.

(3) Utilities such as steam and water could be purchased from the Polymer Corporation making it possible for Dow to put off construction of these costly facilities, permitting Dow to invest in more lucrative areas.[13]

With Dow's decision to continue independent operations in the Sarnia area, the economic and spatial growth of the region began to take form. Dow negotiated with Polymer to purchase the excess ethylene for the manufacture of Styron. With production progressing in a satisfactory manner, Dow could consider expansion of the Sarnia facilities. The building of a glycol plant seemed possible due to the fact that excess ethylene from the government owned plant was available.

Canada's glycol requirement had increased considerably since the war. An analysis of the market revealed that a demand for the manufacture of glycols existed in Canada. Her peacetime requirements of ethylene glycol were estimated at three million gallons and Dow Chemical of Canada Limited was prepared to supply the greater part of the country's needs.[14] The raw materials utilized by Dow in the production of glycols are:

(1) Ethylene--which, as indicated, was supplied by Polymer.

(2) Chlorine--which was purchased from Canadian producers in the area.

(3) Calcium oxide--which was obtained from Beachville, Ontario, not far from Sarnia.

With a cold climate such as is found in Canada, the main use of ethyl glycol is as an antifreeze. However, ethylene glycol can also be marketed in such diverse products as dynamite, shampoo and chewing gum.

As a result of the decision of the Dow Corporation to manufacture ethylene glycol, further expansion was literally forced upon the company by the shortages of the three raw materials so vital to its production. When Dow constructed the glycol plant, the design capacity called for 30,000 pounds per day of ethylene. This was the maximum amount deemed necessary based on market demand for glycols. However, the government owned Polymer plant insisted that Dow take all of its ethylene or none. This figure amounted to 45,000 pounds per day. The design capacity was increased to handle this new amount. Original capacity of the new glycol plant was a million and a half pounds per month. In less than one year production was up to three million pounds

per month.[15] With this volume of production, Dow was well on its way to meeting the market demand in Canada.

However, with the construction of the glycol plant, Dow encountered pressing problems involving the supply of raw materials to make glycols. First, as mentioned earlier, the government had insisted that Dow take all of its ethylene. That this caused an expansion of the plant has also been mentioned. But the problem with the ethylene was that it was never delivered in uniform quantities, and it was usually a case of famine with only an occasional feast. Although there was an adequate source of lime only a few miles away it was hard to convince the suppliers to expand production to satisfy the needs. When the glycol plant was projected, Dow had no intention of supplying its own chlorine.[16] But Dow could not obtain enough chlorine from Canadian sources and was thus forced to import from the United States. The cost of this chlorine was high and Dow realized that a new source of supply had to be developed to permit successful financial operation of its Canadian facility.

With these supply problems, Dow had no choice but to expand its Sarnia facilities again. During the summer of 1948, construction of a multi-million dollar Chlorine and Caustic Soda Plant was begun. The plant was designed to produce 50 tons of chlorine and 55 tons of caustic soda each day.[17] The raw material for the manufacture of chlorine comes from two salt wells 45 feet apart and drilled to a depth of about 2,700 feet.[18] Above this level lie the extensive salt formations that extend under the northern part of Ohio, Southwestern Ontario and a large portion of eastern Michigan. These two wells are joined together underground and

by the process of forcing water down one shaft and up through the other to the surface, Dow has a source of a saturated brine solution. At the surface at the brine testing plant, the solution is treated with chemicals to remove impurities. From there the brine goes to the Chlorine Plant where Dow removes by electric current chlorine and sodium, the components of the brine solution. Thus the chlorine that is one of the principal raw materials needed by Dow in the manufacture of glycols is available from its own controlled source.

This resulted in a cheaper raw material--a controllable supply of chlorine and the opportunity to sell any excess chlorine to other Canadian manufacturers. Dow converted the sodium into sodium hydroxide (caustic soda). Caustic soda is useful as one of the strongest and least expensive alkalies; therefore, it is an important chemical reagent in the manufacture of rayon, pulp and paper, mercerized cotton, reclaimed rubber, soap and petroleum products.[19]

Neither the chemical industry nor the progressive chemical plant ever seem to be in balance. Dow was faced with still another problem as the company expanded into this new venture. Along with the production of monoethylene glycol, a certain amount of ethylene dichloride was also produced. Since solvents had unusual market opportunities in Canada, and as carbon tetrachloride was not made in Canada, Dow found itself in the position of being able to secure markets for its ethylene dichloride. This meant that Dow would expand into the solvent business. As the operating rate of the glycol plant would not produce enough EDC to meet the demand, a new solvents plant costing over $9,000,000 was constructed. The principal products manufactured are carbon tetrachloride,

perchorethylene and trichlorethylene. All these products could be used in the dry cleaning industry. The present facilities at Dow could provide all of the principal raw materials required for the new plant.

Thus Dow's continued expansion and diversification in the "chemical valley" resulted in the rapid spatial development of the area. By 1950 the embryo of a petrochemical industry that originated in the immediate post war years was now blossoming into Canada's major chemical complex. The federal government's decision to continue the Polymer plant had created, as the government had hoped, a growing and dynamic chemical industry. Further diversification was now only a matter of time.

## Footnotes

[1]S. J. Hilton and A. L. Peterson, Risk Analysis, Paper given at the 20th Canadian Chemical Engineering Conference, Sarnia, Ontario, October 20th, 1970, p. 2.

[2]E. G. Holt, "Long-term Outlook for Natural Rubber," Canadian Chemicals and Process Industries, 30 (June, 1946), 50.

[3]Editorial, Canadian Chemistry and Process Industries, 30 (June, 1946), 2.

[4]Holt, "Long-term Outlook for Natural Rubber," p. 51.

[5]Otto Scott, "Polymer of Canada," Rubber World, 5 (March, 1966), 24.

[6]E. J. Buckler, "Canadian Case History--Polymer Corporation Limited," Research Management, 6 (May, 1963), 291.

[7]B. B. Hillary, Research Director of Dow Corporation of Canada, Personal Communication, March 25, 1971.

[8]"Synthetic Rubber," Business Week (July 7, 1945), p. 68.

[9]"Polymer Makes Rubber and Money," Canadian Chemical Processing, 36 (August, 1952), 62.

[10]The Canadian Petrochemical Industry, Chemical Division (Shell Oil Company), p. 9.

[11]Dow Maple Leaf, Dow Chemicals of Canada Limited, 1 (September, 1947), 6.

[12]John Smart, "Chemical Valley--An Integrated Chemical Complex," Paper given at the 20th Chemical Engineering Conference, Sarnia, Ontario, October, 1970, p. 4.

[13]J. Hacking, Assistant Vice-President Public Relations, Dow Chemical of Canada, Personal Communication, July 23, 1970.

[14]A. W. J. Dyck, "Ethylene Glycol Produced in Canada," Canadian Chemicals and Process Industries, 31 (March, 1948), 219.

[15]"The First Ten Years," Dow Chemical of Canada Limited, September, 1951, p. 8.

[16]Ibid., p. 18.

[17]Dow Maple Leaf, p. 3.

[18]"Salt Wells Provide Raw Material for New Chlorine Plant," Dow Maple Leaf, 2 (September, 1948), 7.

[19]"Look to Dow for Chlorine Caustic," Dow Maple Leaf, 3 (November, 1949), 8.

"The advent of Alberta oil will be of great importance to Sarnia. Here Canadian Oil and Canadian chemical plants will together build up an all-Canadian petrochemical industry."

J. R. Nicholson, Vice-President
Polymer Corporation

# CHAPTER IV

## DEVELOPMENT OF ALBERTA OIL

Prior to 1947, 85 percent of Canada's crude oil requirements were met by importing oil from foreign sources. Most of this oil came from the United States and Venezuela. The oil from the United States entered Canada by means of pipe lines to the Sarnia and Montreal areas while that shipped into the prairie provinces arrived by railroad tank car. Canada's coastal refineries, in the Maritimes and in British Columbia, received their oil by way of tankers: the east coast was supplied with oil from the Gulf Coast of the United States and Venezuela, whereas the British Columbia refineries received oil from the southern California oil fields or from Venezuela via the Panama Canal. In all, domestic oil production in Canada in 1946 amounted to only 21,000 barrels per day, while imports exceeded 200,000 barrels per day.[1] This contributed to Canada's deficit balance of trade and worked an economic hardship on a nation the size of Canada.

In the search for oil in Canada, large amounts of capital had been invested with very discouraging results. Since 1860, with the exception of the Turner Valley Oil Field in Alberta, no major oil discovery had been made in Canada. By 1946, production of the Turner Oil field had dropped from its peak of 11,000,000 barrels per annum in 1930 to a mere 6,000,000 barrels in 1946.[2] One factor contributing to the

decline in production was the extreme demand placed on this field during the war years. With national orders for oil and oil products increasing every day, it was apparent that the Turner Oil Field--supplemented by other smaller fields in Alberta--would not be able to meet even the requirements of the western prairie provinces in the near future.

As a result, Imperial Oil of Canada, as well as the other oil companies, had three options:

(1) The oil industry could turn to the development of synthetic fuels, i.e., hydrogenation of coal or the hydrocal process involving natural gas.

(2) The industry could develop foreign fields and remain totally dependent on foreign crude oil.

(3) The industry could invest more millions in the exploration of potential Canadian oil fields. Three companies in Canada--Imperial Oil of Sarnia, McColl-Frontenac of Montreal, and Canadian Gulf Oil of Toronto--were involved in this program in Alberta in 1946.

Regarding the first alternative, Canada had considerable coal deposits in the Maritime provinces, i.e., Nova Scotia, New Brunswick and Newfoundland, as well as extensive deposits in the western areas of Canada, particularly in the province of Alberta. Since the technique involved in the hydrogenation of coal would use five tons of coal to produce one ton of gasoline, the processing plants should be located near the source of the raw material. This could have severe repercussions on the refinery development of the Sarnia area. Theoretically, a program of this nature could eliminate the demand for outside sources of

crude oil. Various grades of oil may be produced by hydrogenation of coal and the quality may be controlled by the choice of catalyst and reaction conditions in the liquid phase stage.[3] The costs involved in processing the coal, however, are higher than those involved in processing crude oil. In the United States this process indicated that unlimited quantities of premium motor gasoline could be produced, but at a cost to the consumer of four to five cents a gallon more than he was now paying.[4]

Since Canada had extensive deposits of natural gas, the other synthetic process contemplated in the manufacture of gasoline and oils was the hydrocal process. This is designed to use natural gas in the production of synthesis gas--a 3:1 mixture of pure hydrogen and nitrogen. From the synthesis gas, by catalytic process, gasoline, liquid hydrocarbons, oxygen and hydrogen could be manufactured. From a daily throughput of 64,000 cubic feet of natural gas it is possible to produce 5,888 barrels of gasoline; 1,200 barrels of diesel oil; and 150,000 pounds of crude alcohols. Oxygenated compounds would consist mainly of acetaldehyde, acetone, ethyl, propyl, butyl, amyl, and heavier alcohols.[5] Associated with the process, however, was the question of natural gas reserves. Alberta had large known reserves, but were these reserves large enough to permit the processing of natural gas on an economically profitable basis.

There was also the question of transportation: would the gas be shipped east in its natural state to the Ontario refineries for processing, or would the natural gas be processed in the west and the refined product sent east. In either case, the impact on Sarnia would be dramatic.

However, Imperial Oil, with its huge refinery at Sarnia, did not favor the synthetic processes. Yet in 1946, Canada was an oil starved nation and the synthetic processes offered an alternative to the lack of major oil fields in Canada. While apparently disavowing the synthetic process technique, Imperial concentrated its efforts in the quest for oil in Alberta. Finally, after 133 consecutive dry holes, the determined efforts were rewarded. In 1947, Imperial struck oil at a number of places indicating Canada had a major oil discovery. It is interesting, albeit ironic, that the oil was discovered in the rocks of the Paleozoic era, an era that according to geologists was one in which Canada was a barren, dry wasteland with no vegetation to speak of. Nevertheless, it is a fact that here, in this Paleozoic formation, Imperial discovered a major source of oil.

As a result of this doscovery, exploratory activities of other companies increased. When the Leduc discovery was made, only three major oil companies were active in Alberta: McColl-Frontenac, Canadian Gulf Oil, and Imperial. Within a relatively short time these three were joined by California-Standard, Socony-Vacuum, Stanolind Oil and Gas, Armerda Petroleum, and many smaller American and Canadian companies.[6]

These new companies provided a fresh and dramatic impetus to the search for oil in Alberta. The oil company had to lease its land from either the province or from private land owners called freeholders. Crown leases amounted to over ten million acres by September of 1947 and it was at this point that the role of the provincial government of Alberta became of paramount importance. This role is obvious if one considers the position of the provincial government. The sub-soil

rights belonged to the Crown in land granted to settlers after October 31, 1887 unless mineral rights were specifically mentioned. In essence, the province of Alberta was a successor to the federal government with regard to such matters and was therefore the owner of all oils, gas and other minerals which might underlie lands settled since 1887.[7]

The exploring oil concerns therefore had to deal with the province of Alberta. The vast majority of leasing contracts had to be made with the provincial government. This leasing policy had caused some initial concern for the oil industry. The basic reason was the Social Credit Party of Alberta which at this time controlled the province. Socialization of industry was a problem of grave concern. However, in recent years the Social Credit Party had become an advocate of free enterprise in the oil industry. This was very encouraging to the men in the oil industry. Not only was the position of free enterprise advocated, but a policy of welcome to foreigners and foreign capital was established. An American investor was on equal footing with a Canadian subject insofar as laws, rules and regulations pertaining to leasing of Crown oil lands were concerned.[8]

The position on the part of the provincial government of Alberta was favorable to Canadian and American oil interests. For a fee of $250 and a deposit of $2,500, an approved oil prospector could secure a reservation of all prospecting rights not to exceed 1,000,000 acres.[9] In addition, the leasing procedures of the province were designed to intimidate the land speculator. The company or individual who sought to lease undeveloped lands for profit motives alone was discouraged by the requirement that the company or individual lease the land to carry out

exploratory programs within ninety days after the issuance of the leasing permit. The lessee was required to submit a program relating to test drilling, geological reconnaissance, or core drilling. Under these requirements, the land speculator would have difficulty meeting the government leasing demands.

Another significant factor that promoted exploration was the policy of the Alberta Department of Lands and Forests of permitting credits of up to one half of the expenditure that the company undertook in its search for oil. These credits could be applied towards land rental. When oil is discovered, the producer may either pay a royalty of 12 1/2 percent, or base his payments on a sliding scale of between 5 and 18 percent under an established formula.

"Crown Royalty on oil produced from Crown land in Alberta is the square root of the average daily production for the month, with a minimum of 5 percent and a maximum of 15 percent of the selling price or fair value at the time and place of production with a minimum of 3/4 cent per 1,000 cubic feet."[10]

In accordance with the leasing program of the province of Alberta, Imperial Oil of Sarnia acquired leases amounting to a 2 1/2 million acres. The company had hopes of making new oil strikes based upon the information gained from the Leduc discovery. It was only a short time before Imperial found more oil; Husky Oil Canada Limited, Shell Oil and others did the same. The problem of a 20,000 barrel a day deficiency in crude oil that existed in the prairie provinces prior to Leduc was eliminated by early 1948. The immediate problem confronting Imperial Oil was how to get oil to its eastern refinery in Sarnia.

Although the government of Alberta took no steps to control the flow of oil out of the province, the question of how much oil could be produced by each well fell under the jurisdiction of the Oil and Gas Conservation Board of Alberta. In 1951, when the production of oil exceeded markets available, a procedure for allocating oil production to market demand was initiated; it is still in force.[11] The significance of these regulations as far as the Sarnia refinery development was concerned was that if the government regulates the allowable flow of oil per well, refinery facilities of Sarnia and its ensuing expansion would be dependent upon the provincial policies of Alberta. In other words, proration of production of oil by the Alberta Oil and Gas Conservation Board could diminish the volume of flow of oil eastward to a point where refining in eastern Canada would be dependent upon the policies of the Board.

The obvious market for Alberta oil is the prairie provinces, but Saskatchewan's Social Credit government, government that in the past had frightened away risk capital, was now encouraging this capital. The government reversed its previous policy and embarked on a program designed to encourage oil exploration, even offering exploration permits more liberal than those in Alberta. Within a year after Leduc, over 38,000,000 acres of Saskatchewan crown oil and gas permits had been issued to private investors. By 1950, 8 million dollars was spent on development of Saskatchewan leases, and in 1951, the year of the great play in oil, over 18 million dollars were spent. In this year the Coleville-Bakken pool was discovered, becoming one of the largest black oil fields on the continent.[12] This activity, along with the rapidly expanding oil production in Alberta, meant that the available supply of oil

far exceeded the demand of the prairie province markets thus creating a demand for new markets. In addition to the oil discoveries in Alberta and Saskatchewan, oil production in Manitoba surpassed local consumption and oil from the province was transported east by way of the I.P.C.

At the time of the discovery at Leduc, the huge refinery at Sarnia was importing oil from the United States. Other small refineries in Ontario were doing the same. If crude oil from western Canada could be transported to the Sarnia area at a low enough cost, the prairie provinces could be competitive with the producers of the Mid-Continent Oil Field of the United States. The development of such a transportation system would mean expansion of the facilities at Sarnia along with the chance to capture a greater portion of the Ontario market. This was Imperial Oil's goal, and with its growing oil reserves in western Canada it was a program that Imperial intended to implement.

The disposition of Canadian Oil Refineries--as of December, 1948 (Table 6) indicated by a report from Dominion Bureau of Mines--shows the refining capacity of Canada's eastern refineries to be extensive by western standards.

The western oil producers saw the eastern refineries and markets as ideal outlets for their crude oil. Of particular significance to the western oil producers was the Sarnia area of Ontario, and the Montreal site in Quebec. With the recent discoveries in Alberta and Saskatchewan, the prairie provinces had a potential free flow production of crude oil to supply the entire Dominion of Canada. This self-sufficiency in oil would not necessarily mean that Canadian refineries would use Canadian oil for their production of refined products. Apparently, the most

TABLE 6

CANADIAN OIL REFINERIES--1948

| Operator | Location | Crude Oil Capacity (bbl/day) |
|---|---|---|
| Alberta | | |
| Imperial | Calgary | 8,500 |
| Imperial | Edmonton | 20,000 |
| British American | Calgary | 6,500 |
| Gas and Oil Refinery | Hartell | 2,000 |
| Husky | Lloydminster | 7,500 |
| Excelsior | Lloydminster | 1,500 |
| Vermillion Refining Co. | Vermillion | 1,200 |
| British Columbia | | |
| Imperial | Ioco | 12,000 |
| Standard of B.C. | Burnaby | 8,350 |
| Shell | N. Burnaby | 5,00 |
| Manitoba | | |
| Anglo-Canadian | Brandon | 2,300 |
| North Star | St. Boniface | 4,500 |
| Saskatchewan | | |
| Imperial | Regina | 15,000 |
| British American | Moose Jaw | 5,500 |
| Saskatchewan Co-op | Regina | 2,000 |
| Nova Scotia | | |
| Imperial Oil | Halifax | 34,000 |
| New Brunswick | | |
| N.B. Oilfields | Weldon | 300 |
| Northwest Territories | | |
| Imperial | Norman | 1,100 |
| North West | Norman | 850 |
| Ontario | | |
| Imperial | Sarnia | 53,000 |
| McColl-Frontenac | Toronto | 12,000 |
| British American | Clarkson | 10,000 |
| Canadian Oil | Petrolia | 4,000 |
| Trinidad Leaseholds | Port Credit | 5,000 |
| Burlington | Hamilton | 600 |
| British American | Toronto | 14,300 |
| Goderich Petroleum | Colborne | 4,000 |
| Quebec | | |
| Imperial | Montreal | 37,000 |
| McColl-Frontenac | Montreal | 40,000 |
| British American | Montreal | 30,000 |
| Shell | Montreal | 14,000 |

economic disposition of western oil in the continental pattern would appear to be by pipe line into the north central United States and Ontario.[13]

An economic analysis of the oil situation in Canada shows that in terms of the distances involved, Alberta oil could scarcely hope to compete at Halifax with oil brought by tanker from Venezuela, the Gulf ports of the United States or from the Middle East. During the summer, oil comes directly from Venezuela to the Montreal refineries via the St. Lawrence River; in the winter months the oil is transported by tanker to Portland, Maine, and Montreal receives it via pipe line from there. In both instances, cheap foreign crude could undersell domestic crude. On the west coast, Vancouver could be supplied by tanker carrying foreign crude oil cheaper than by domestic crude oil delivered by pipe line from Alberta.[14]

The construction of a pipe line system extending from the oil fields of Alberta to the Great Lakes had been proposed by Imperial Oil soon after the Leduc discovery. The company envisioned a line extending from Edmonton to Lake Superior at which point the crude oil would be transferred to one of Imperial's large lake tankers and transported to its refinery in Sarnia. In anticipation of such a development, the company had increased potential output of the Sarnia refinery to 53,000 barrels a day. Expansion of the facilities at Sarnia made this refinery the largest in Canada.

Without the approval of the federal government, a pipe line from Alberta to Sarnia could not be constructed. Without the cooperation of the Alberta Oil and Gas Conservation Board, the value of such a project

could be defeated if, by prorationing of oil, the volume would be insufficient to warrant construction of the line. There was little chance that the Oil and Gas Conservation Board would make such severe restrictions; nevertheless, it was a possibility.

Actually, prorationing is a negative approach to oil field development. Something had to be done to maintain hopes for the wider market on which exploration and development depends. This was the hope of the Imperial Oil refinery in the "chemical valley." Growth and development of this region depended upon access to the domestic source of crude oil. Not only would this present the Imperial Oil refinery complex of the "chemical valley" with an opportunity to expand, but there was the possibility that other refineries would locate there also. Both federal and provincial decisions would have an important bearing on the expansion of the region.

In this regard, economics dictated policy. With continued exploration and discovery, new fields were discovered with startling rapidity. These new discoveries led to a market supply in excess of prairie province demands. The oil companies looked to the more distant markets with greater anticipation as known oil reserves continued to grow. However, the problem of synchronizing exploration, drilling, refinery capacity and transportation facilities continued to be extremely challenging. The problems reflected those of the century-old fields of Oil Springs, Ontario in the early days of development.

The money that could be allocated by the oil companies for transportation could be spent more profitably for exploration since oil reserves are the basis for the construction of a pipe line. For the

western oil producers, this juggling of priorities with regard to capital investment was the basis of concern when construction of the pipe lines was proposed. Yet it was evident that a form of transportation other than railroads had to be considered. Crude oil shipped by railroad to Sarnia could not compete on a cost basis with oil piped to Sarnia from the American oil fields. The pipe line seemed like a logical alternative to rail transportation.

Alberta and Saskatchewan presented the Dominion with adequate reserves. Reserves of the Redwater, Alberta, field alone were estimated at 800,000,000 barrels, while Leduc's potential reserve was 300,000,000 barrels. Alberta alone could provide adequate reserves, but Saskatchewan deposits were also quite extensive. The two provinces could provide oil in such quantities that movement of the oil out of the prairie provinces was mandatory; a larger market had to be found.

The problems confronting the construction of the pipe line were complex. First, obtaining federal approval of an interprovincial line was only the beginning. This would require legislation similar to that passed for the railroads. Since the federal government had no objections to the eastward movement of oil, it quickly enacted the Federal Pipe Line Act in 1949.

The pipe line company sponsored by Imperial Oil, the Interprovincial Pipe Line Company, as well as four other pipe line companies, were incorporated by special acts of Parliament. With this federal approval, construction of the Interprovincial Pipe Line (I.P.L.) began. The federal sanction of the I.P.L. was of vital importance if the crude oil was to be moved to the eastern portion of Canada. Without this approval,

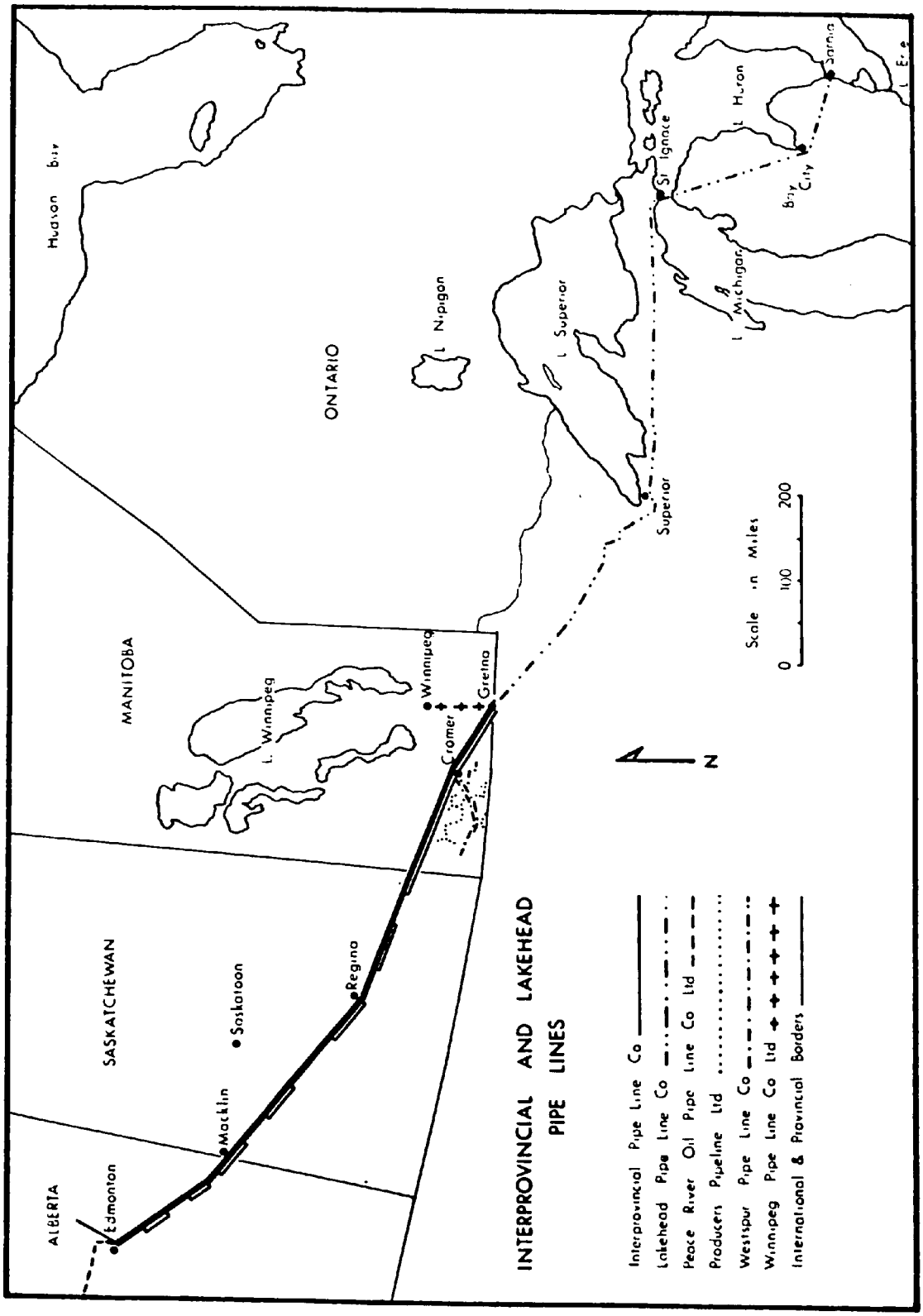
the oil could not have been transported eastward by means of a pipe line. The crude could have been moved by rail, but costs would have been considerably higher.

The initial plan of the Imperial Oil Company was to build a line from Edmonton, Alberta to Regina, Saskatchewan--approximately 450 miles. However, this plan was soon modified to extend beyond Regina to the Great Lakes region. As a result of this new project, the Imperial Oil Company had to decide on the selection of a port city on the Great Lakes that would become a terminal for the eastern end of the pipe line. Nationalism decreed that this terminal be a Canadian city. Economics dictated a route via the United States to an American city on Lake Superior (Figure 5).

Imperial Oil decided on the American route because it was shorter and would cost less to construct. It was agreed that Superior, Wisconsin would become the Great Lakes outlet for I.P.L.; this caused great political controversy in Ottawa. The decision to build the line to an American city would greatly influence the route of the natural gas pipe lines destined for eastern Canada in the next few years. Of particular interest at this time was the speed with which approval was granted by the United States Federal Power Commission to the I.P.L. subsidiary, the Lakeland Pipe Line Company, to deliver oil through the United States to Sarnia.

The eastern terminal of the I.P.L., Superior, Wisconsin, would have to be equipped with extensive storage facilities due to seasonability of navigation. The refinery complex at Sarnia initially accepted the idea of a line terminating at the lake, but Imperial Oil did not

FIGURE 5


ALBERTA
SASKATCHEWAN
MANITOBA
ONTARIO
Hudson Bay
Edmonton
Macklin
Saskatoon
Regina
Winnipeg
Gretna
Cromer
L Winnipeg
L Nipigon
L Superior
Superior
St Ignace
L Michigan
L Huron
Bay City
Sarnia
L Erie
N
Scale in Miles
0
100
200
INTERPROVINCIAL AND LAKEHEAD PIPE LINES
Interprovincial Pipe Line Co
Lakehead Pipe Line Co
Peace River Oil Pipe Line Co Ltd
Producers Pipeline Ltd
Westspur Pipe Line Co
Winnipeg Pipe Line Co Ltd
International & Provincial Borders

see the construction of these storage facilities as a solution to the problem of handling oil transferred from Alberta to its Sarnia refinery during the winter season. It was economically more feasible to build a pipe line from Superior to Sarnia rather than construct more storage tanks at both cities.[15]

The impact of such an extension of the pipe line on Sarnia could have significant bearing on the growth of the region. Industries that used petroleum and its by-products would find it economically expedient to locate in Sarnia if the pipe line was extended.

In the final analysis, economic success or failure hinged on the amount of production permitted by the Alberta Oil and Gas Conservation Board. Their policies regarding production per well was of vital importance to this project and to the "chemical valley." The cost of oil transportation by pipe line is proportional to the volume of oil handled by the line. Therefore, the most economical line would be the one just adequate to carry the peak throughput from fully developed production.[16] In the case of the Sarnia refinery complex, the cost price set by refineries in Sarnia for crude oil has always been equated to how much a barrel of oil from the United States would cost laid down in Sarnia.[17] The amount of throughput would thus affect the price of the oil delivered to Sarnia.

Under the powers granted to the Alberta Conservation Board as of 1949, the Board could control all phases of oil and gas production, including proration as to market demand, proration between fields and pools within the province and restriction of production to prevent physical waste.[18]

With the report by A. I. Levorsen, Dean of the School of Mineral Science at Stanford University, that the discovered reserves in western Canada were estimated at 1,077,400,000 barrels and the minimum undiscovered reserves several times that amount, the Conservation Board and the government of Alberta were no longer wary of insufficient reserves to meet future western requirements. Provincial approval regarding the volume of throughput indicated by I.P.L. as necessary for the success of the project, was granted.

With the completion of the pipe line to Sarnia, the "chemical valley" was now provided with a direct line to the western oil fields. The delivery rate at Superior, Wisconsin, of 115,000 barrels per day--of which 83,500 barrels per day went to the Sarnia refinery complex (this was in excess of the 55,000 barrels per day received by the refinery by tanker) resulted in further expansion of the Sarnia facilities. The oil not handled by Sarnia was shipped by tanker to the refinery complex in Clarkson, Ontario, near Toronto.[19]

The Sarnia Imperial Oil refinery had a 10-inch to 12-inch pipe line to the Toronto-Hamilton area called the Sarnia Products Line. As of 1952, this line was capable of delivering 39,000 barrels per day of products refined from western crude, i.e., gasoline and fuel oils (Figure 6). This area was also served by the 10-inch Trans-Northern Pipe Line originating in Montreal with a capacity of approximately 40,000 barrels per day. By adding intermediate pumping stations, the capacity of this line could be increased to 75,000 barrels daily. Nineteen refined petroleum products including gasoline, fuel oils, and diesel fuel could be transported through this line.[20]

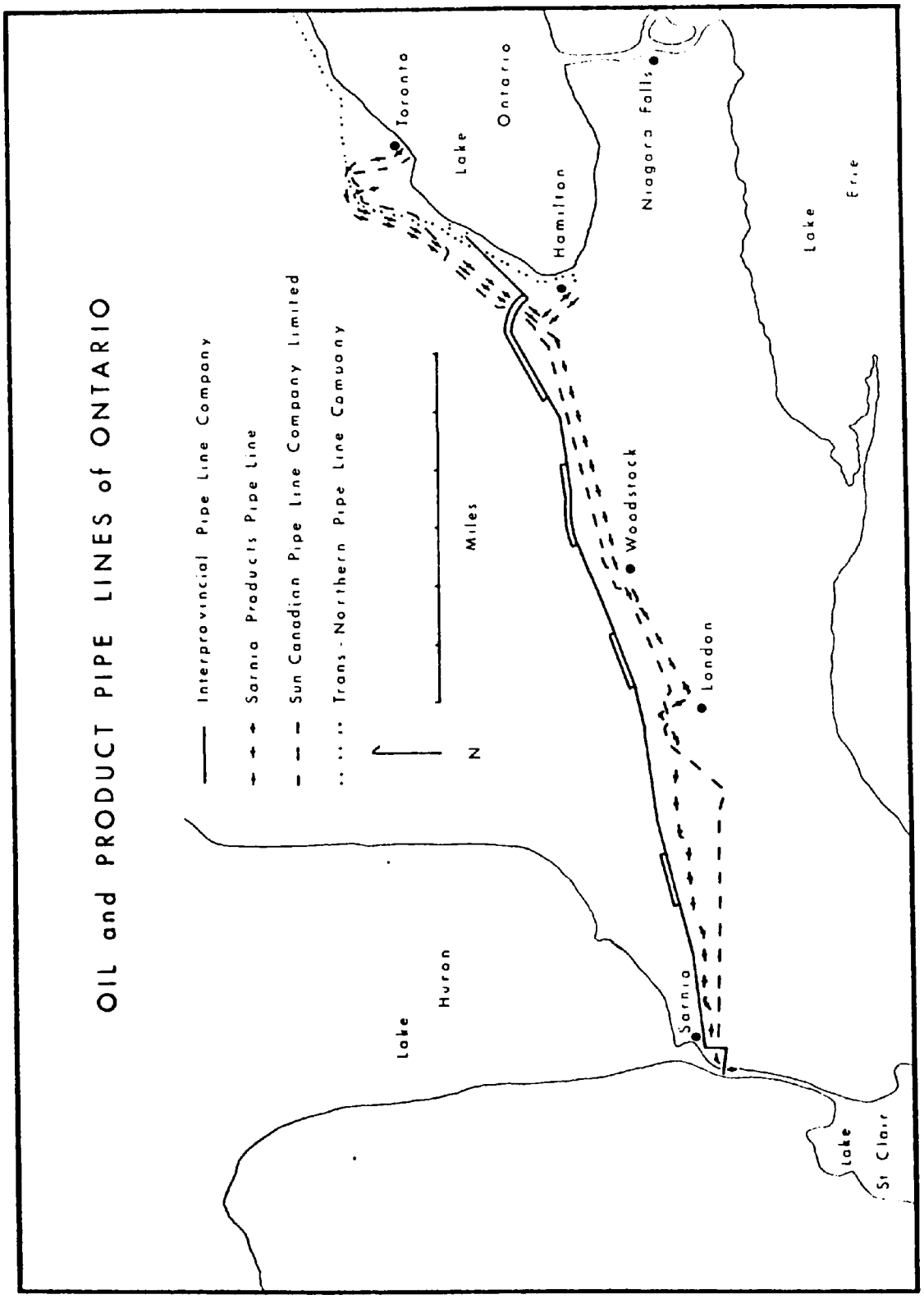

OIL and PRODUCT PIPE LINES of ONTARIO
Interprovincial Pipe Line Company
Sarnia Products Pipe Line
Sun Canadian Pipe Line Company Limited
Trans-Northern Pipe Line Company
Miles
N
Toronto
Lake
Ontario
Hamilton
Niagara Falls
Lake
Erie
Woodstock
London
Sarnia
Lake
Huron
Lake
St Clair

FIGURE 6

The refined products of the Trans-Northern Pipe Line are made from foreign crude. Foreign crude oil is cheaper than domestic. As a result, the refineries in Montreal have access to a cheaper raw material than the refineries at Sarnia. Consequently, it was difficult for the refineries using domestic western crude oil to compete with refineries using cheaper foreign crude oil for their refined products.

Without some kind of federal or provincial assistance, Imperial Oil and Sun Oil of Sarnia who also ship out of the "chemical valley" by means of an 8-inch pipe line would have difficulty in retaining a market in the Toronto-Hamilton area. (The source of Sun Oil's crude oil was the Mid-Continental Oil Field until 1957 when the company switched to western Canadian crude.) The Sun Oil refinery was put "on stream," that is began processing of crude oil, in the chemical valley in 1953. The influencing factors in locating this refinery in Sarnia were: (1) availability of water and electric power, (2) the existence of nearby chemical companies which would buy the by-products, (3) the highly populated southern Ontario market centering on Toronto.[21] Loss of this Toronto market would be detrimental to the growth of the Sun Oil plant; Imperial Oil would suffer similarly.

The Shell Oil company, which had acquired the property formerly owned by the Canadian Oil Companies Limited of Petrolia and which had moved its operation to the chemical valley in 1952, would not be affected in the same way that Imperial Oil and Sun Oil would. The Trans-Northern Pipe Line transported the refined products of McColl-Frontenac, British American and Shell Oil from Montreal to the Toronto area. Through the Trans-Northern Pipe Line, Shell Oil of Canada

(formerly Canadian Oil), using cheap foreign crude, had access to the Toronto market (Figure 7). The reasons for Shell locating a refinery in the Sarnia area were similar to those of Imperial Oil some years earlier. It was advantageous to locate where a company had access to a waterway since in 1952 there was no pipe line facility for bringing crude oil from Superior to Sarnia.[22] The refinery had contracted for a 5,000,000 barrel per year supply of Alberta oil for ten years, or approximately 20,000 barrels per day from the Redwater crude oil fields. Locating on a waterway offered low transportation costs. Also, the plant had been constructed with sufficient flexibility to provide for future expansion for the refinery and for the addition of petrochemical industries.[23] These factors, plus the desire to sell its by-products to the developing petro-chemical industry at Sarnia, were reasons for the decision to locate in Sarnia.

The refinery complex at Sarnia could not, and did not want to, compete with the Montreal based refineries with their obvious cost advantage. There were at least three solutions to the problem. The first would be to restrict the market area of the foreign crude oil. A second possibility would be to raise the tariff rates on imported oil to a point where the price would be the same as domestic crude. A third possibility would involve construction of the I.P.L. to the Montreal area.

A Royal Commission on Energy was appointed to study the problem. The findings of such a board could have had serious economic repercussions on the Sarnia refinery complex. If the Commission had recommended that Canada should permit unlimited use of foreign crude by Canadian

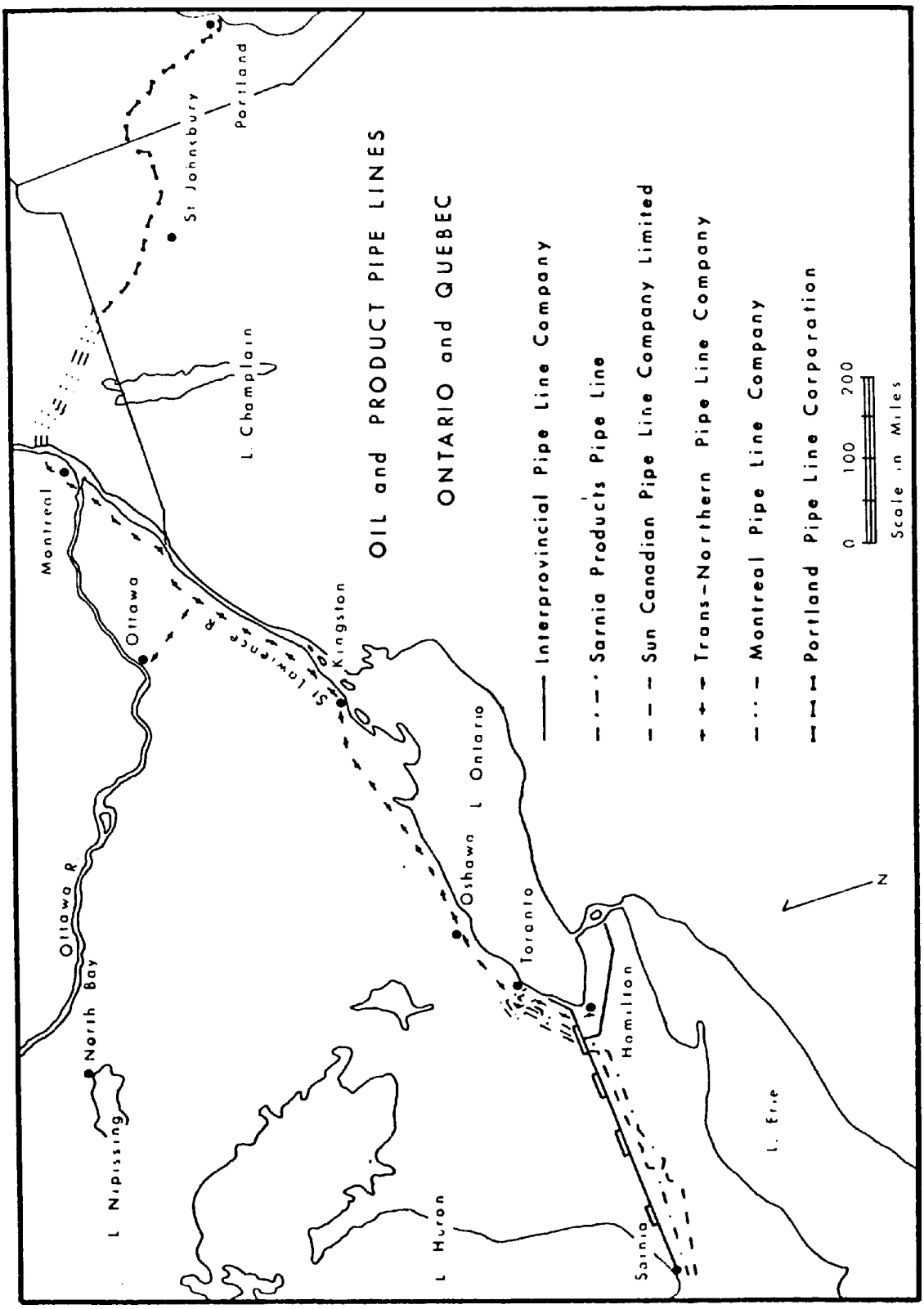

OIL and PRODUCT PIPE LINES
ONTARIO and QUEBEC
Interprovincial Pipe Line Company
Sarnia Products Pipe Line
Sun Canadian Pipe Line Company Limited
Trans-Northern Pipe Line Company
Montreal Pipe Line Company
Portland Pipe Line Corporation
0 100 200
Scale in Miles
N
Montreal
Ottawa
Kingston
Toronto
Oshawa
Hamilton
Sarnia
North Bay
St Johnsbury
Portland
L Champlain
L Ontario
L Erie
L Huron
L Nipissing
Ottawa R
St Lawrence R

FIGURE 7

refiners, then the domestic oil industry of western Canada would have had problems competing with the refineries of eastern Canada which were using foreign crude.

To Imperial Oil, a decision of this nature would have created problems for its program in western Canada and its refinery complex in Sarnia. As of December 31, 1958, Imperial Oil had over 26 million acres of land under lease with 2,242 producing oil wells in Alberta and Saskatchewan.[24] In addition, Imperial had part interests in the 1,900 mile Interprovincial Pipeline linking Edmonton and Sarnia; the 109 Westspur Pipeline Company which acted as a gathering system in south-eastern Saskatchewan designed to link this part of Saskatchewan with the I.P.L.; the Producers Pipeline Limited Company servicing the Carnduff and Glen Erven fields. In addition, Imperial was the sole owner of the Imperial Pipeline--a 349 mile crude oil gathering system for Alberta; the Winnipeg Pipeline, a line joining the I.P.L. at Gretna to the Winnipeg facilities; and the Sarnia Products Pipeline, 189 miles long serving the Toronto-Hamilton area. It would be to the advantage of the Imperial Oil Company and the Sarnia refinery complex to have a secure Ontario market for their western oils. With their large refinery complex in Montreal and their oil fields in South America it would also be advantageous to have an eastern market available for these oil interests.

The National Oil Policy, decreed by the federal government in 1961, was a policy designed to set aside for the domestic oil producer all Canadian markets west of the Ottawa River. Foreign crude oil could enter Canada but would only be processed east of the Ottawa River and sold in the markets of eastern Canada. Thus the western domestic oil

producers could market their oil products west of the Ottawa River with no competition from the processors of cheaper foreign crude oil. Imperial Oil expressed agreement with the policy.[25]

There was little doubt that the real concern of Imperial Oil was to secure: (1) the Ontario market for western crude oil and (2) market areas in the United States. It was estimated that the demand for Canadian crude would rise from about 400,000 barrels per day in 1958 to 800,000 barrels per day in 1967 and most of this increase would be found in Ontario.[26]

The Sarnia and Ontario refineries were major benefactors in the creation of the National Oil Policy. The refining capacity in Ontario would have to be increased so that it was sufficient to enable the Ontario market west of the Ottawa valley to be supplied substantially from Canadian crudes. This program would require in Ontario the displacement of the present imports of crude and a progressive reduction of foreign imports refined from foreign crudes in Montreal.[27]

The proposal to build a pipe line to Montreal from Alberta, thereby excluding foreign oil from this expanding refinery complex, had been suggested. The smaller, independent western oil producers favored this. However, the major argument against this proposal is that the cost of delivering the oil from Alberta would be about 35 cents per barrel more than the average laid down price which the Montreal refineries were paying for offshore crude.[28] The cost per barrel would be higher at Montreal than at Sarnia if western domestic crude oil was piped to that area. If some federal subsidiary was not offered, Montreal would be in a poor competitive position with respect to the Sarnia refinery

complex. However, the large refineries of Montreal were operated by Texaco (formerly McColl-Frontenac), Gulf (formerly British American), Imperial and Shell. These companies would not favor such a project involving additional costs in the use of western Canadian oil.

With the establishment of the National Oil Policy, the Ontario refineries, and Sarnia in particular, had the opportunity provided by the government action to expand their facilities and markets. Imperial Oil, Sun Oil and Shell took advantage of the policy and expanded facilities. Product movement by means of the Trans-Northern Pipe Line from Montreal to Toronto was finally terminated by October of 1963. Products refined from Canadian crude then commenced flowing eastward through the section of the line no longer available for the westward movement from Montreal.[29]

However, the responsibility for the implementation of the National Oil Policy rests with the oil companies themselves. In recent years (1969-70) there has been an accentuation of movement of the foreign-origin product into Ontario west of the Ottawa River. If this is permitted to continue, the incentive to further expand Ontario refinery capacity will be seriously diminished. "Such circumstances threaten both the prospects for growth in demand for Canadian oil in Ontario and the voluntary basis of the policy upon which that growth depends."[30] If this violation of the National Oil Policy was to continue unchecked, the markets for the Sarnia refinery complex would be subjected to the economic disadvantages that existed prior to the policy. The basic problem lay in a recent decision by the Exchequer Court of Canada that questioned the authority of the National Energy Board to

direct shipments of gasoline from point to point, either within a province or inter-provincially.[31] The decision in favor of the Cal Oil Inc. of Montreal opened a breach in the eastern border of the National Oil Policy. In its decision, the court stated that Cal Oil is entitled to import gas without restriction as to how it is to be marketed.

As an indication of the effect of the failure to accept the voluntary oil policy, several Ontario refineries had to resort to volume cutbacks on gasoline production that resulted largely from continuing heavy imports of gasoline into the Ontario market. The bulk of the gasoline comes from Montreal refineries which operate entirely on offshore crude oil imports, and is sold at a price of five to ten cents a gallon cheaper than domestic gasoline. All of this is to the detriment of the western crude oil producers and the oil refineries of Ontario which use more expensive domestic crude in their manufacture of gasoline.

In 1971, the Golden Eagle Refining Company brought its 100,000 barrels per day plant at St. Romauld, near Quebec City on stream. This company has numerous outlets in Ontario and might service them from the Quebec refinery. Gulf Oil's 60,000 barrels per day Point Tupper, Nova Scotia facility will soon be producing. Irving Oil's Saint John, New Brunswick plant doubled its capacity to 100,000 barrels per day and is scheduled to begin production soon. The significance of these projects is that total capacity of the eastern Canadian refineries is estimated to be 825,000 barrels per day set against a 1971 demand east of the Ottawa River of 690,000 barrels per day.[32] The Ontario markets look very inviting to these refineries.

While the government continues attempts to have the policy adopted on a voluntary basis, the National Energy Board chairman made it clear that if "voluntary efforts are not producing the results anticipated, then the government will take whatever further steps the circumstances may require to ensure the success of its policy, including the proclamation of Section 87 of the National Energy Board Act which provides for the regulation of imports and exports of oil."[33] Strict implementation of this policy will permit continued growth of the Sarnia refineries, whereas failure to enforce this policy could cause a stagnation in the development of the refinery complex and perhaps the complex would be relegated to a position of minor importance in terms of refining products for the eastern Ontario market.

## Footnotes

[1]Earle Gray, The Great Canadian Oil Patch (Toronto: Maclean-Hunter, 1970), p. 98.

[2]H. G. Cochrane, "Alberta Oil for Eastern Canada," The Petroleum Engineer, 21, No. 11 (1949), C-11.

[3]G. T. Perry, "Fuels and Lubricants from Sources Other than Petroleum," Canadian Chemistry and Processing Industries, XXIII, No. 7 (1948), 625.

[4]Oil and Gas Journal, 48, No. 19 (1949), 64.

[5]Perry, "Fuels and Lubricants," 626.

[6]World Oil, Section 2, July 1948, p. 59.

[7]Roy Leigh, "Oil Leasing Procedure in Alberta," World Oil, 128 No. 9 (1948), 213.

[8]Ibid.

[9]Ibid.

[10]Ibid., 214.

[11]Letter from Russell Patrick, Minister of Mines and Minerals in Alberta, Edmonton, March 10, 1971.

[12]Oil in Saskatchewan (Regina: Bureau of Publications, 1970), p. 44.

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[14]Ibid.

[15]D. G. Waldon, The Longest Oil Pipe Line in the Western World--Dusters and Gushers (Toronto: Pitt, 1968), p. 129.

[16]F. C. Whiteside, "Economic Sizing of Oil Pipe Lines," The Petroleum Engineer, Reference Manual (1949), D-3.

[17]Letter from A. J. Cote, Statistician for the Energy and Minerals Section, Dominion Bureau of Statistics, Ottawa, Ontario, April 19, 1971.

[18]"Conservation Board Controls Alberta's Production Allowable," World Oil, 124 (June, 1949), 236.

[19]"Petroleum Pipe Line Joins Montreal, Ottawa and Hamilton," Canadian Chemical Processing, 38, No. 1 (1954), 56.

[20]"Oil Keeps Pace with Canada," Canadian Chemical Processing, 38, No. 1 (1954), 56.

[21]Letter from G. A. Moore, Personnel and Training Coordinator, Sun Oil Company, Sarnia, Ontario, August 14, 1970.

[22]Letter from J. J. Corry, Personnel and Industrial Relations Supervisor, Shell of Canada Limited, Sarnia, Ontario, July 21, 1970.

[23]E. A. Smith, "New Refining on Stream," Canadian Chemical Processing, 36, No. 3 (1952), 46.

[24]John S. Porter, Moody's Industrial Manual of Investments (1959), 1,659.

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[26]Anthony Scott, "Policy for Crude Oil," Canadian Journal of Economics and Political Science, 27, No. 2 (1961), 273.

[27]George Hess, Statement on the National Oil Policy in the House of Commons, Ottawa, Ontario, February 1, 1961.

[28]Scott, "Policy," 274.

[29]Robert D. Howland, "Canada's National Oil Policy," Paper presented at the Annual Meeting of the Canadian Institute of Mining and Metallurgy, Quebec City, Quebec, April 25, 1966, p. 20.

[30]National Energy Board, Annual Report 1969, Queen's Printer for Canada, p. 11.

[31]Hyman Solomon, "Ottawa Looks for Ways to Avert a Longer Flow of Oil Imports," Financial Post (Toronto), August 22, 1970, p.

[32]"Petroleum Consumption," Oilweek, Feb. 22, 1971, p. 55.

[33]George Hess, "Canada's National Oil Policy," Paper presented at the Annual Meeting of the Canadian Institute of Mining and Metallurgy, Quebec City, Quebec, April 25, 1966, p. 3.

"The flow of natural gas through the Trans Canada pipeline will have important consequences for the Canadian chemical industry because the simplicity of the starting materials is an essential requirement for the production of large-tonnage chemicals."

Editor
Canadian Chemical Processing

# CHAPTER V

## IMPACT OF NATURAL GAS ON THE CHEMICAL VALLEY

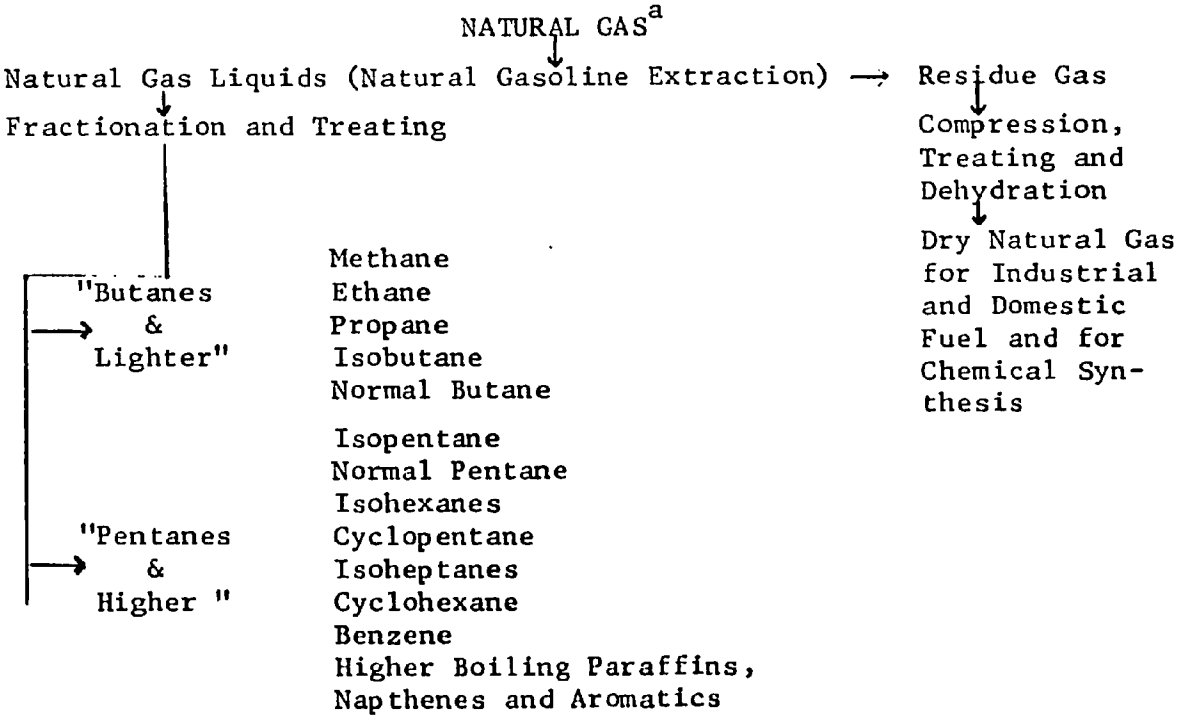
The technological advancements in the petrochemical industry in the 1950's were dramatic. Imagination and ingenuity were the bywords of the chemical industry. New uses for raw materials resulted in constant modification of plans made by petrochemical firms to develop new and diverse products. The industry was advancing at such a rapid pace that by the middle of the twentieth century it was virtually impossible for companies to keep their operations in balance. But in the petrochemical industry, imbalance is a sign of progress and expansion. All over Canada, changes were taking place; however, no changes were more explosive than those in Sarnia's "chemical valley."

With the arrival of the Interprovincial Pipe Line from western Canada, chemical diversification in the "valley" accelerated. New industries and chemical plants were built there and future development of more companies in the area was enhanced by the availability of crude petroleum from western Canada. The numerous feedstocks provided by fractional distillation proved to be a major factor in the choice of site selection. The "valley," already Canada's leading petrochemical center, was now becoming one of the major petrochemical centers in North America.

There was yet another raw material that could enhance the growth potential of the "valley:" natural gas. Development of numerous petrochemicals based on feedstocks derived from hydrocarbons and on other materials extracted from natural gas made the availability of natural gas an essential ingredient in the growth of a large petrochemical center. Since Sarnia was a growing chemical center in the 1950's, the demand for natural gas was apparent.

Natural gas is a prolific source of hydrocarbon feedstocks and hydrocarbons from natural gas are low in price.[1] The cost of hydrocarbon feedstocks was of prime importance to expansion of the "chemical valley." The wide variety of feedstocks that can be derived from natural gas is indicated by Figure 8.

FIGURE 8




[a]George Brunn, "Use of Natural Gas and Natural Gas Products in the Manufacture of Petrochemicals," Natural Gases of North America, II (Tulsa: American Association of Petroleum Geologists, 1968), p. 1,923.

These feedstocks serve in the manufacture of synthetic textiles, fibers or plastics, indeed they form the basis for these industries. Without these feedstocks, the development of the petrochemical industry would be impossible. Natural gas is thus a very important contributor to the growth of a petrochemical complex. In addition, it must be noted that natural gas is also an important source of energy and this factor cannot be overlooked when analyzing the importance of natural gas to a chemical complex.

Natural gas being important to the chemical industry, it becomes necessary to examine the location of the sources of natural gas, its reserves in Canada and the possibility of bringing this vital raw material to the Sarnia complex.

Natural gas is found in most of the provinces of Canada, but it is produced commercially only in Alberta, Ontario, Saskatchewan, Quebec and New Brunswick. The natural gas deposits in the latter three provinces are small while the reserves in Ontario are fairly large and in Alberta extensive reserves of natural gas are known to exist.

By the middle of the twentieth century it was obvious that the reserves in Ontario were not large enough to meet the growing domestic and commercial needs of the province. Ontario could seek greater amounts of natural gas from the United States, but this source was subject to export controls and could not be depended upon to meet the growing demands of Ontario. Although the United States' reserves were increasing, the rate of increase had been slowing down considerably. Gas shortages in the United States would most likely tend to curtail exports of gas; consequently, Ontario and most of the rest of Canada

had to seek other sources of natural gas. That source was Alberta.

In the province of Alberta, natural gas had been discovered as early as 1883. These gas reserves, found in the area of Medicine Hat, were so extensive that by 1904, the city had an adequate supply for heating the homes and lighting the streets in the city. Additional discoveries of oil lead also to new discoveries of natural gas. The Turner Oil Field, discovered in 1913, was responsible for an unbelievable waste of natural gas. It was burnt in such quantities that during the 1920's and 1930's, southern Albertans enjoyed a perpetual sunset watching this useless and unwanted commodity of natural gas being flared (burning off of the gas).

Control of Alberta's natural gas resources was vested in the Federal Government in Ottawa and Alberta's problems were not of national concern.[2] This was due to the fact that in the late 1920's and throughout the 1930's, there was no plan for distributing the natural gas beyond the borders of Alberta. For this reason Ottawa had little interest in the Alberta resource.

The indiscriminate burning of natural gas continued until 1938 when the province of Alberta established the Oil and Gas Conservation Board the powers of which were broad enough to require the gas field developers to adopt more scientific methods of oil and gas recovery programs. This prevented a good deal of waste; however, as a result of this burning it was conservatively estimated that perhaps one billion dollars in gas and oil was wasted.

In 1944, Canada's total production of natural gas was 45,067,158 thousand cubic feet of which 37,161,570 thousand cubic feet originated

in the province of Alberta; 7,082,508 thousand cubic feet in Ontario and the balance in New Brunswick, Saskatchewan and Quebec.[3]

In Alberta, where the largest reserves were known to exist, gas was used locally for domestic and commercial purposes. Only two industrial uses were made of the natural gas as late as 1944. The Alberta Nitrogen Company located in Calgary made explosives and fertilizer from the gas, the other outlet was a source of iso-butane by the Imperial Oil and British American refineries which utilized this product in their refining of gasoline. Actually, this could be considered the origin of the first petrochemical industry in Alberta. In future years the products of this Alberta complex would be in competition with the products manufactured in Sarnia's chemical valley.

However, in the early 1940's the uses for natural gas were not yet as diverse or as important as they were to become in the following decade. Since the reserves in Eastern Canada were relatively small and could not sustain the growing industrial and domestic requirements in the east, the need to transport Alberta's natural gas to the provinces of Ontario and Quebec became a matter of real concern.

The problems associated with the delivery of the natural gas to Ontario and Quebec were numerous and very complex. The concept of a pipe line to deliver the gas from Alberta to Ontario and other parts of eastern Canada was deemed to be the most feasible method of transporting natural gas. As a matter of fact, the transmission of natural gas has been termed the second most efficient movement of energy--exceeded only by the transmission of oil.[4] The construction of the Interprovincial Oil Pipe Line indicated that pipe line construction from western Canada

was not only feasible, but also the most practical method for transporting oil eastward. Natural gas presented a similar transportation problem.

While the method of transportation eastward was never a debatable point, several complex problems arose. Sarnia, along with the rest of eastern Canada, wanted natural gas, but they did not want to pay excessive costs. The problem lay in the size of a pipe line which would affect the volume of throughput. Volume was important for two reasons: the line had to be able to supply market demands, and the greater the throughput the sooner the transmission of natural gas would amortize the cost of the pipe line.

The investor was very conscious of amortization and had to be assured of a reasonable return on his investment. A cent reduction in transportation costs per thousand feet on a 500 million cubic feet per day throughput amounts of a $5,000.00 savings per day.[5] Since the capacity of the line varies as the square of the pipe diameter, a thirty-inch line would deliver only 9/13 the amount of a thirty-six-inch line if other conditions are the same.[6]

Delivery of large quantities of natural gas would have had the advantage of lower costs and this was what Sarnia was seeking. The petrochemical industries of the chemical valley were very much concerned with the amount of throughput that could be delivered at any given time. Not only were costs a factor, but the available volume of gas could determine the type of chemical operations that could be developed.

Volume of throughput is also of great significance to the producer. The greater the volume the greater the return, creating an

incentive to search for more gas. Without sufficient volume and adequate markets there is little desire on the part of the producers to seek new fields. Demand for the gas is essential to the growth of a healthy exploration program. If the sales volume is small, it is not profitable to invest in the search to prove new fields. Obviously then, the size of the pipe line and the volume of throughput are interrelated. These factors have great bearing regarding capital invested in the search for new reserves which in turn contribute to greater market potential.

This contributed to still another problem that had to be solved if the gas was to be piped eastward, the problem of proving reserves. Before natural gas could be exported from Alberta, the Provincial Government of Alberta had to be assured of reserves of gas adequate to meet the needs of the province. Actually, prior to July of 1949, the exporting of natural gas beyond Alberta's boundaries was forbidden by law.[7]

Naturally, this created a dilemma for the major oil and gas companies of Canada. The gas reserves in Alberta were growing beyond the provincial requirements as a result of recent discoveries. As far as provincial demands were concerned there was little need to develop new fields. Without adequate markets outside the province the gas companies did not have much incentive to invest capital for increasing proven reserves.

Without repeal of the legislation regarding the exporting of natural gas beyond the borders of Alberta, the natural gas industry of Alberta could stagnate. The "chemical valley" of Sarnia would not have access to this resource which would enhance the potential growth

prospects of this complex. Fortunately for the eastern interests, this law was repealed in the latter part of 1949. This marked the first in a series of moves made by the provincial government to permit the transmission of natural gas out of Alberta.

However, gas was not necessarily allowed to flow freely from the province because of this law. The Alberta Oil and Gas Commission had the authority to authorize the volume of flow of natural gas out of the province. This Board was influenced by the actions of the ruling provincial party--the Social Credit Party. Many of the members of this party were opposed to the movement of any gas out of the province and resolutions against the exporting of any gas was proposed until all the farms and small villages of the province had been supplied.[8]

There were other members of the provincial legislature who felt that it was the government's first and foremost responsibility to protect the interests and welfare of the people of the province. This statement was qualified by the resolution that only when natural gas reserves were considered to exceed Alberta's needs for the next thirty years (proven reserves must always be able to meet projected requirements within the province) would the government permit the surplus gas to be made available for use outside the province, with the understanding that Canadian requirements be given first priority.[9] The position of priority was to have a bearing on the route of a proposed line to eastern markets.

Before a single cubic foot of gas could leave the province, a planned program of continued exploration for new gas fields had to be presented to the board. However, there was no assurance given by the

Oil and Gas Conservation Board that unlimited amounts in excess of the thirty years supply could leave the province.

To illustrate the point regarding Canadian priorities, the Gulf Oil Company which owned what was considered to be the most extensive field in Alberta, Pincher Creek, was turned down when it requested a permit to export gas to the American northwest--the nearest large market. The Conservation Board insisted on Canada and Canadians having priority to the gas even though no other large markets existed for the natural gas. Sarnia agreed with this principle since it was believed that a pipeline would soon be constructed eastward to Ontario carrying Alberta natural gas.

In 1947, the Director of the Geological Survey of Alberta estimated the province had 1.4 trillion cubic feet of proven reserves, with the probability of an additional 2.2 trillion cubic feet. Later, in 1950, the proven reserves were estimated at 2.8 trillion cubic feet and the probable reserves to 4.2 trillion cubic feet.[10] Three years later, due to major new discoveries, the figure for proven reserves had risen to 11.5 trillion cubic feet. Alberta was now in a position to export gas and eastern Canada, Sarnia in particular, eagerly awaited it. But before Sarnia had access to the gas, there were still several barriers to overcome.

One of these barriers proved to be the selection of the route east. The Government of Canada sought an all-Canadian route while the gas interests in the west were interested in piping the gas eastward by the most economical route, the one which would follow the oil pipe line

across United States territory and enter Canada at Sarnia. This would benefit the growing petrochemical complex.

However, the Canadian government was committed to an All-Canadian route eastward. This would mean constructing a line north of Lake Superior through the Canadian Shield. This Shield has a complicated structure of igneous and metamorphic rocks that would make construction of a pipe line a very costly enterprise. It is also an area of Canada that is very sparsely populated, with little industry and offers few markets for the pipe line.

The gas producers of western Canada and the financial backers of the pipe line felt that it would not be economical to construct a line through the desolate wilderness of this isolated part of north Ontario. It would be much more practical to construct the line south of Lake Superior: the construction costs would be considerably less per mile and the distance to the large market centers of Ontario would be shorter. It was estimated that the all-Canadian line would cost forty million dollars more than across a United States territory route. The Government was accused of putting the "shackles of political expediency on the piping of Alberta gas into eastern Canada."[11]

The fact that the Trans Canada Pipe Line Company (the company awarded the contract to build the line to the east) did not construct a line parallel to the Interprovincial Pipe Line was due to politics and not sound economics. The nationalistic economic policy adopted by the federal government in this case had a very negative impact on both the American and Canadian financial institutions concerned with the financing of this project. In fact, the insistence of the federal

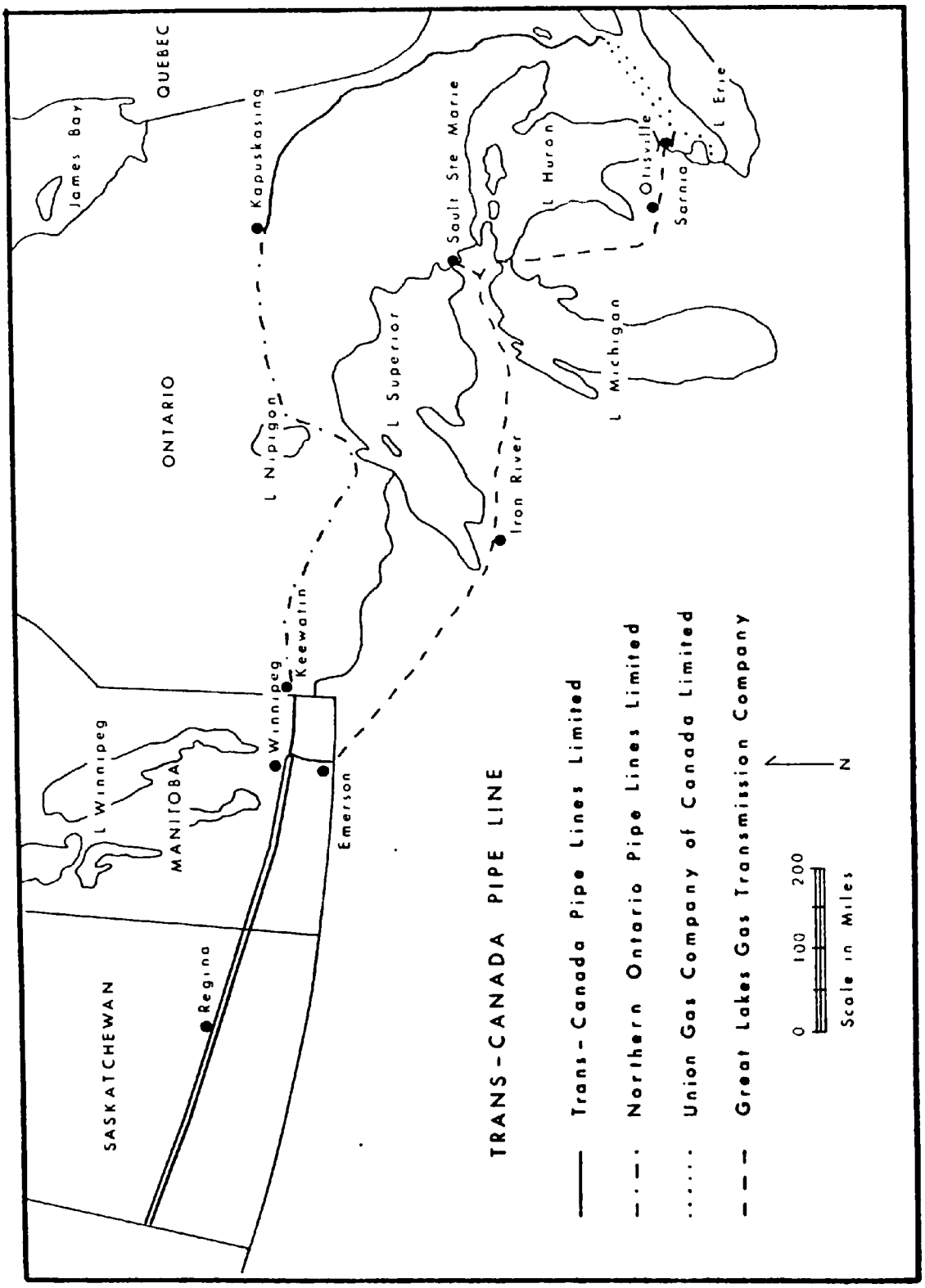
government that the all-Canadian line had to be constructed through northern Ontario had sufficient repercussions on the financial backers of this project to delay construction of this route at least one year until a compromise could be worked out on the financing of the northern Ontario route. There is no way to accurately measure the impact of this delay upon the development of the petrochemical complex in Sarnia.

Since the government insisted upon a northern route for the construction of the Trans-Canada gas line, and since private capital was reluctant to invest in a portion of a pipe line considered to be a financial burden, the solution to the problem rested with the government.

A crown corporation was established for the purpose of acquiring property for the construction of the Northern Ontario section. The Trans-Canada would then lease the line with an option to purchase when it was in a financial position to do so. This construction would take the form of a six hundred mile system from the Manitoba-Ontario border to Kapuskasing, Ontario (Figure 9) and leased to Trans-Canada on terms which would force Trans-Canada to purchase the line. Although the Ontario government had agreed to underwrite one quarter of the $130,000,000 costs, differences of opinion over interest rates resulted in the federal government assuming the entire financial burden involved in the construction of the line.[12]

Without the establishment of the crown corporation by the federal government, further delays in the construction would have conceivably occurred. With the impending shortage of natural gas in Ontario, it was imperative that this section of the pipe line be

FIGURE 9


QUEBEC
James Bay
Kapuskasing
ONTARIO
L Nipigon
Sault Ste Marie
L Huron
Orisville
Sarnia
L Erie
L Superior
L Michigan
Iron River
L Winnipeg
MANITOBA
Winnipeg
Kenora
Emerson
SASKATCHEWAN
Regina
TRANS-CANADA PIPE LINE
Trans-Canada Pipe Lines Limited
Northern Ontario Pipe Lines Limited
Union Gas Company of Canada Limited
Great Lakes Gas Transmission Company
0
100
200
Scale in Miles
N

constructed as speedily as possible and it was made so by the government's action.

Another of the early problems that plagued the transmission of natural gas eastward was the position taken by the American Federal Power Commission. The financial institutions behind the Trans-Canada: White, Weld and Co., Lehman Brothers of New York, Metropolitan Life, and the Royal Bank of Canada among others, had to be assured of major market outlets before they would provide Trans-Canada with adequate financial backing. They wanted assurances that they could connect the Trans-Canada pipe line with the pipe line facilities in the north-central United States and thereby assure themselves of an adequate market.

Various American companies submitted applications to the F.P.C. requesting permission to import Canadian natural gas. About twenty applications were involved, all of them relating directly or indirectly to the provision of natural gas to areas in the north-central and mid-western states of Wisconsin, Minnesota, Iowa and parts of Michigan, Illinois, Indiana and North Dakota.[13]

The major problem facing these gas companies at the time of the F.P.C. hearing was being able to assure the F.P.C. of a continuous supply of natural gas from Canada as well as providing that the Trans-Canada line would be constructed on a particular schedule. With the problem of adequate capital for construction of the Trans-Canada in question, the American companies could not give the F.P.C. a "yes" answer to either question.

About all the Mid-western Gas Company (one of the twenty companies involved and the one most likely to acquire rights to transport

Canadian gas into the United States) could exhibit was a permit from the Oil and Gas Conservation Board of Alberta to export gas in certain quantities and the assurance that the Canadian Board of Transport Commissioners had authorized the construction of a pipe line in Canada.[14] Failure to acquire the right of entry into the American markets would have a negative impact on the funding of the pipe line and hence its ultimate arrival in Sarnia.

It is somewhat ironic that just as American policies in the latter portion of the nineteenth century affected the rate of growth of the Sarnia area, so we see the impact of American policy again in the middle of the twentieth century. As in the nineteenth and early twentieth century, American finances played a key role in the development of the Sarnia area.

In the meantime, the Trans-Canada company--with support from the Canadian government for the construction of the uneconomical portion of the pipe line--had begun construction of the all-Canadian line. To have access to the Trans-Canada, Sarnia would have to use the facilities of the Union Gas Company which had a line from Toronto, one of the eastern terminals of the Trans-Canada, to Sarnia.[15]

This northern route of the Trans-Canada proved to be advantageous to the smaller developing industries of Northern Ontario, but the ever growing demands for natural gas in the Sarnia area and in eastern Canada required a larger throughput than was available via the northern route. Because of this Trans-Canada suggested the development of the Great Lakes Transmission project in 1964.

The Great Lakes Transmission project was to be a 971 mile, 36-inch diameter pipe line extending from the Trans-Canada system at Emerson, Manitoba through Minnesota, Wisconsin and Michigan, to a point on the St. Clair River near Sarnia, Ontario.[16] The construction of a gas line of these dimensions and with the line entering Canada near Sarnia could have an important bearing on the proliferation of the "chemical valley."

In the western part of Canada, the Trans-Canada Pipe Line was contributing to a rapidly growing chemical industry. In 1962, the Trans-Canada Pipe Line Company had signed an agreement with Pacific Petroleum for the construction of an extraction plant at Empress, Alberta. This plant could extract propane, butane and other liquids from over a billion cubic feet of gas daily.[17] The "chemical valley" wanted to develop chemical processes that also required extensive throughput of natural gas that was not available under present throughput conditions. The Great Lakes Transmission project would solve this problem, but again there were political problems to be faced.

There were those in Canada who did not want to see any extension of the Trans-Canada Pipe Line constructed in the United States. The Great Lakes Pipe Line Company was owned jointly by Trans-Canada and American Natural Gas. The opposition to the U. S. route was based on the fact that as this was a shorter route, eventually most of the gas coming from Alberta would go through the United States and possibly serve the American markets. In any event, it would detract from the importance of the all-Canadian route.

The northern communities of Ontario would benefit as the increased demand was met by looping the present line. Looping means a pipe line is constructed parallel to the original line. Construction projects in this part of Ontario bring prosperity to the local communities. These northern communities had the support of the Members of Parliament that represented this part of Ontario.

When Trans-Canada applied to the federal government for permission to build its Great Lakes project through a portion of the United States, their plan was summarily rejected.

Then, too, the position of the American F.P.C. was in doubt. There was reason to believe that the F.P.C. would approve the project because of a shortage of energy in the United States and this project could provide the U.S. market with an opportunity to acquire access to much needed power. Speedy approval by the F.P.C. would aid in the success of the company.

Thus the Great Lakes project, a project of great concern to the "chemical valley," had numerous barriers to clear before construction could begin.

The position of the Canadian government was vital to the success of the construction of the Great Lakes Project. A stand in favor of this project was important. The government was placed in an awkward position. The National Energy Board approved the Great Lakes project, but the responsibility for authorizing the construction of such a project would rest with the federal government. Two factors were very significant when approval or denial of the project was to be considered: first, the Members of Parliament from northern Ontario would oppose any

American route. Second, there was a fear of a repetition of the events of 1957 when the Liberal government of St. Laurent toppled because of a campaign waged around the economic nationalism theme in which the government was accused of favoring Americans when the Inter-provincial Pipe Line was constructed through the United States instead of the all Canadian route as had been proposed by some members of the Canadian government of the opposition party. This had caused the defeat of the Liberal government.

In August of 1964 the decision against the Great Lakes project was made public by the federal government, stunning the Trans-Canada and the Great Lakes Pipe Line Companies. The impact of such a decision was drastic as far as the chemical valley was concerned. Plans for future development of the area based on increased amounts of natural gas appeared to be doomed. If the Great Lakes project was not completed, the growth of the chemical valley would very likely be retarded.

However, the management of the Trans-Canada Company proved to be both aggressive and compromising. To assure construction of the Great Lakes project, Trans-Canada agreed to a proposal of the federal government: at all times over 50 percent of the natural gas from Alberta would be delivered to eastern Canada by way of the all-Canadian route and that by 1976 approximately 65 percent would be transmitted by the Canadian route.[18] This would lead to eventual looping of the northern route which was the goal of many Canadians who were concerned with its future expansion.

Pressure was also put on the federal government by the premiers of Ontario and Quebec who were concerned over higher energy costs in

these two provinces. In addition, the premiers of Alberta and Saskatchewan also indicated that they favored construction of the Great Lakes project.

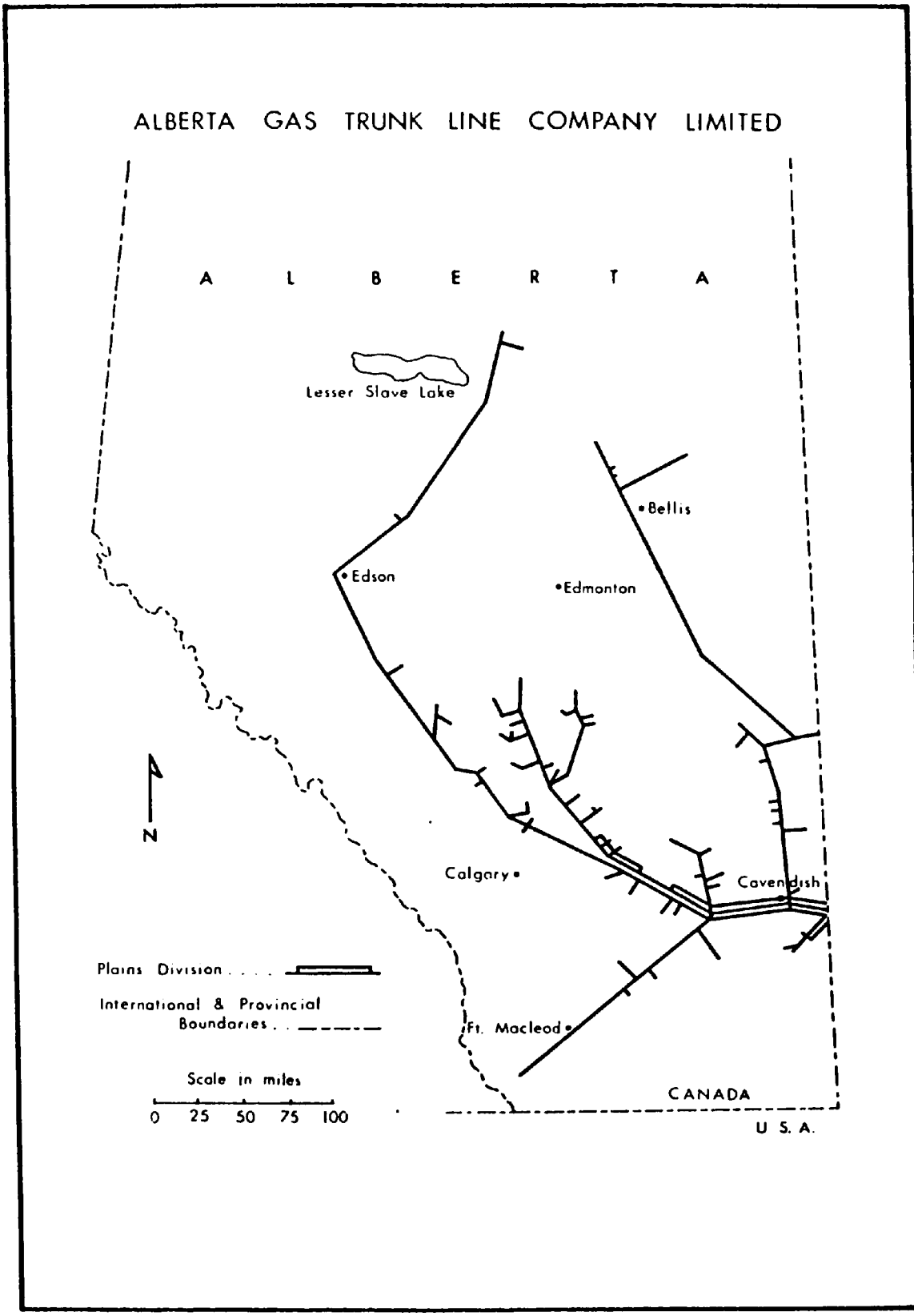
On the basis of the compromise by Trans-Canada Pipe Line--to increase the percentage of throughput of natural gas along the northern all-Canadian route to the point where looping of the pipe line would be required--and with the support for the project by the premiers of four provinces, the federal government relented, and reversed its position on the construction of the Great Lakes project.

In 1967, the Federal Power Commission in Washington gave approval for the construction of the project, despite vigorous opposition registered by several mid-western American gas companies. With this approval, the pipe line surmounted the final barrier and direct delivery by the facilities of Trans-Canada and by its half-owned subsidiary, Great Lakes, to the "chemical valley" was assured.

The roles of the provincial and federal governments were of paramount importance to the success of the pipe line projects. Without this assistance and cooperation the gas lines could not have been constructed.

Before concluding this discussion on the role of the government in support of the transmission of natural gas to eastern Canada, it should be noted that the gathering lines for the natural gas that was to be exported from Alberta are all under the control of a provincial corporation--the Alberta Gas Trunk Line Company Limited (Figure 10). The Trans-Canada does not enter Alberta; thus the control of the throughput of natural gas from Alberta is expedited by a provincial corporation.

FIGURE 10


ALBERTA GAS TRUNK LINE COMPANY LIMITED
A L B E R T A
Lesser Slave Lake
Bellis
Edson
Edmonton
N
Calgary
Cavendish
Plains Division
International & Provincial Boundaries
Ft. Macleod
Scale in miles
0 25 50 75 100
CANADA
U S. A.

Once again, the significance of the role of the government in industry in Canada is stressed.

The Great Lakes project's impact on the Sarnia complex was brought into focus with the construction of the new chemical industries in the area and the enlargement of some that were already there. A discussion of the impact of oil and gas on the area and the ensuing integration will be discussed in the following chapter. Of great importance is the fact that both the oil and gas pipe line contributed to the spatial development of the Sarnia complex.

Footnotes

[1]George Brunn, "Use of Natural Gas and Natural Gas Products in the Manufacture of Petrochemicals," Natural Gases of North America, II (Tulsa: American Association of Petroleum Geologists, 1968), 1,922.

[2]D. I. Istvanffy, History of the Petrochemical Industry in Alberta, Director, Bureau of Statistics, Department of Industry and Development, Government of Alberta, Edmonton, Alberta, 1963, p. 29.

[3]"The Natural Gas Industry of Canada," Canadian Chemical and Process Industries, 30, No. 4 (April, 1946), 51.

[4]John M. Hanley, "Natural Gas Transmission and Distribution," Natural Gases of North America, II (Tulsa: American Association of Petroleum Geologists, 1968), 1,843.

[5]G. S. Hume, "What Size the Pipe Line?" Canadian Chemical Processing, 40 (March, 1956), 35.

[6]"Bonding 2000 Miles to a Single Gas Grid," Canadian Chemical Processing, 38 (March, 1954), 38.

[7]"Alberta Gas May Be Exported after Domestic Needs Are Met," World Oil, International Section, 124 (September, 1949), 234.

[8]William Kilbourn, Pipeline (Toronto: Clarke, Irwin and Company, Ltd., 1970), p. 19.

[9]"Alberta Gas May Be Exported," p. 234.

[10]Charles Hay, Post-War Development of the Natural Gas Industry (Toronto: Pitt Publishing Company, 1968), p. 185.

[11]Kilbourn, Pipeline, p. 77.

[12]Letter from Donald M. Johnston, Secretary and Assistant General Counsel for Trans-Canada Pipe Line Limited, March 2, 1971.

[13]Hugh Aitken, "The Mid-Western Case: Canadian Gas and the Federal Power Commission," Canadian Journal of Economics and Political Science, XXV (Toronto: University of Toronto Press; May 9, 1968), 131.

[14]Ibid., 140.

[15]Letter from Donald M. Johnston.

[16]James W. Kerr, An Artery of Steel Pipe Spans a Nation, Dusters and Gushers, The Canadian Oil and Gas Industry (Toronto: Pitt Publishing Company, 1968), p. 213.

[17]Kilbourn, Pipeline, p. 177.

[18]Ibid., p. 180.

"A key factor in the petrochemical industry is the complementary interaction of the companies operating in this field."

John Smart, Vice-President
Dow Chemical Co.

# CHAPTER VI

## INTEGRATION OF CHEMICAL VALLEY

The integration of the chemical companies of the Sarnia area was and still remains a vital factor in the continued growth of the region. Without this inter-relationship there could be no efficient and economic petrochemical industry in the "chemical valley" (Figure 11).[1] Unquestionably there was a unique degree of cooperation between the companies of the valley and expansion there was based on a program of mutually advantageous resource utilization.

An analysis of the integration of the valley illustrates the principle of self-perpetuation. The expansion of the valley's industries is contingent upon the availability of chemicals or hydrocarbon feedstocks that are manufactured in the valley and provide the basis for the establishment of new industry.

To understand the factors contributing to the expansion of the area it is necessary to establish the time sequence of the entry of the companies into the valley (Table 7), discuss their reasons for locating in that region, and then evaluate their contributions to the growth of the chemical community. Figure 12 presents a diagrammatic view of the interchange of materials in the valley and permits a rapid appraisal of the integration of the chemical community.

FIGURE 11

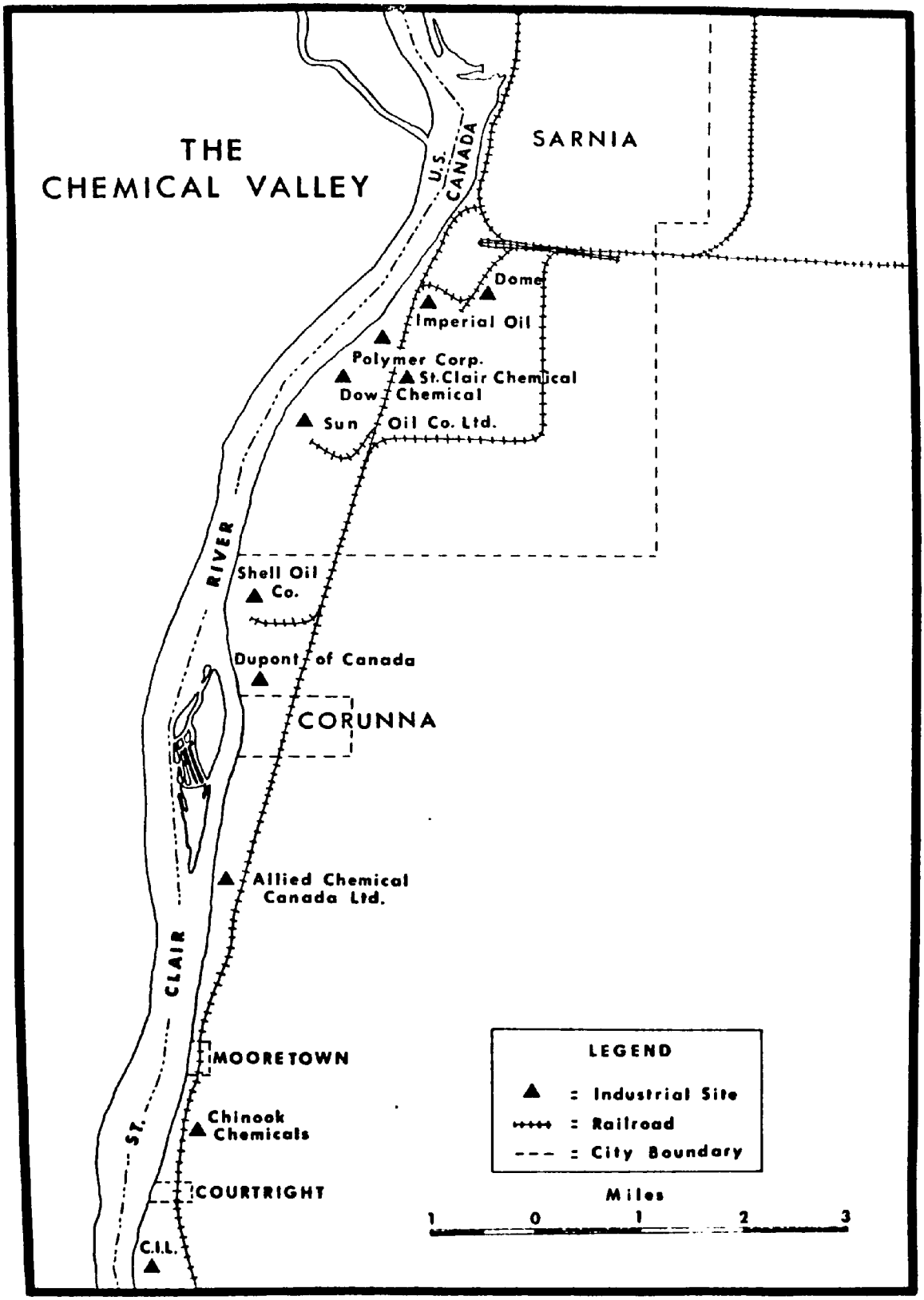

THE
CHEMICAL VALLEY
U.S.
CANADA
SARNIA
Dome
Imperial Oil
Polymer Corp.
St.Clair Chemical
Dow Chemical
Sun Oil Co. Ltd.
Shell Oil Co.
Dupont of Canada
CORUNNA
Allied Chemical Canada Ltd.
ST. CLAIR RIVER
MOORETOWN
Chinook Chemicals
COURTRIGHT
C.I.L.
LEGEND
: Industrial Site
: Railroad
: City Boundary
Miles
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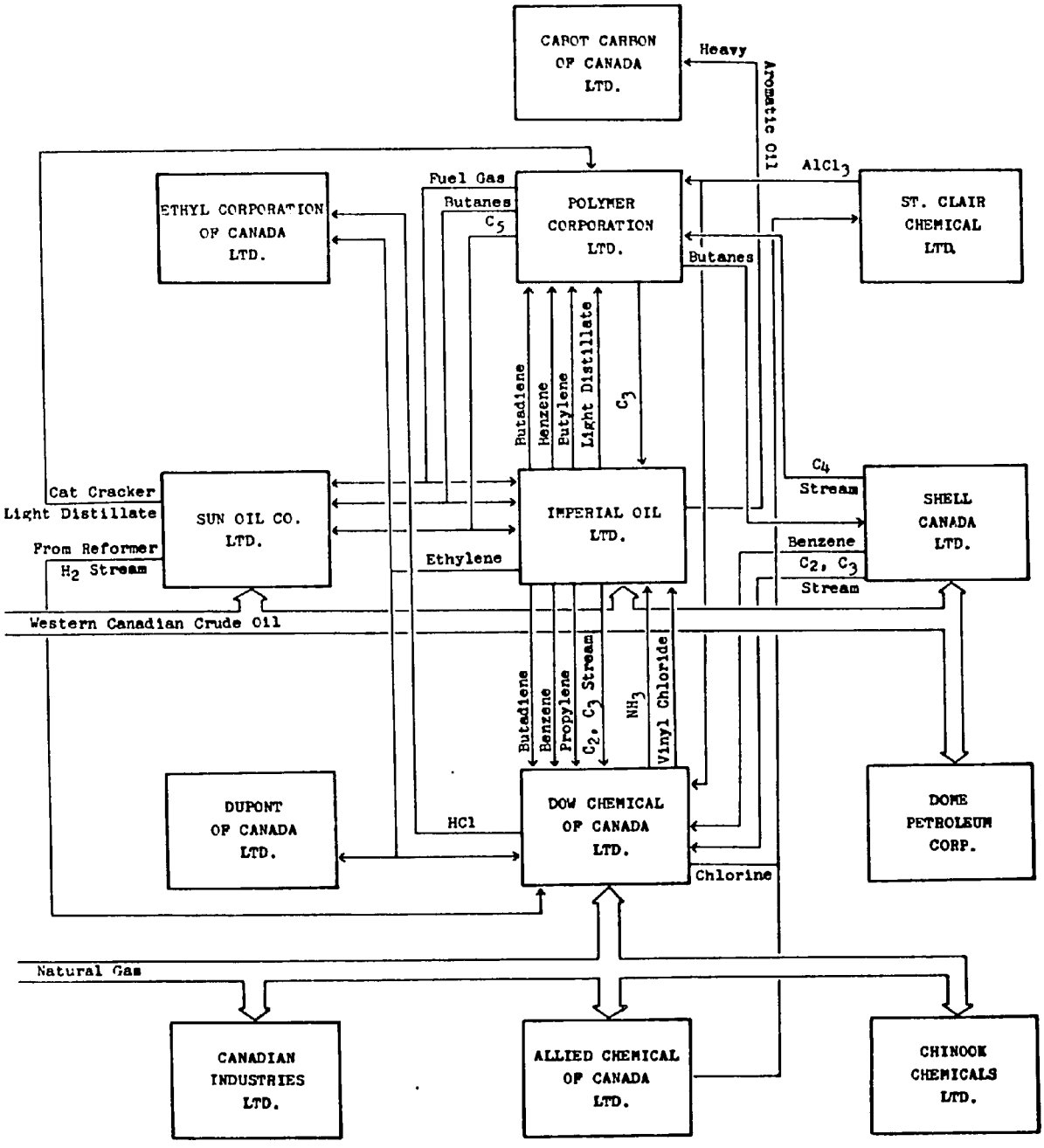
TABLE 7

CHRONOLOGICAL SURVEY OF THE COMPANIES OF THE CHEMICAL VALLEY AND THE MAJOR PRODUCTS OF EACH COMPANY

| Company | Date Established | Product Manufactured |
|---|---|---|
| Imperial Oil | 1897 | Petroleum and chemical products |
| Polymer | 1942 | Synthetic rubber and petrochemicals |
| Dow Chemical | 1942 | Industrial and agricultural chemicals |
| Shell of Canada | 1951 | Petroleum Products |
| Cabot Carbon | 1953 | Carbon black |
| Sun Oil Company | 1953 | Petroleum products |
| Ethyl Corporation | 1956 | Chemical processing |
| St. Clair Chemicals | 1960 | Anhydrous Aluminum Chloride |
| DuPont of Canada | 1960 | Plastics |
| Allied Chemical | 1963 | Toleune Diisocyanate |
| Canadian Industries Limited | 1965 | Agricultural chemicals |
| Chinnok Chemicals | 1965 | Specialized organic chemicals |
| Dome Petroleum | 1969 | Butane, Propane, condensates, isobutanes |

FIGURE 12

# CHEMICAL VALLEY INTEGRATION




SOURCE: CANADIAN CHEMICAL PROCESSING

The keystone to the development of the "chemical valley" was Imperial Oil. By 1967 this refinery complex had been expanded to such an extent that it was processing over 122,000 barrels of oil per day. Production on this scale enabled the refinery complex of Imperial at Sarnia to remain the largest individual refinery in Canada.[2]

However, Imperial's importance to the chemical valley was not based solely on its manufacture of gasoline and oil products. Imperial became the cornerstone of the young petrochemical complex in 1942 when it supplied all of the hydrocarbon feedstocks for the government owned Crown Corporation, Polymer. The Polymer Corporation could not have produced synthetic rubber if it had not had access to the hydrocarbon feedstocks of Imperial. No other refinery in Canada could have produced these raw materials in the volume needed by Polymer.

Just as Imperial was instrumental in the early success of Polymer, so it was in assisting the Dow Chemical Company when it came to Sarnia in 1942. Feedstocks used in the manufacture of styrene were shipped to Dow from Imperial. This integration of three independent companies, who still exchange feedstocks with each other, established the basis for the interchange of feedstocks in the area.

Through improved developments in petroleum technology due primarily to the technique of "cracking," the refinery was able to affect greater uses for its crude oil. "Cracking" is the breaking apart of complex hydrocarbons into simpler structures, by means of heat and pressure.[3] The result is large quantities of light hydrocarbons, formerly used for fuel only, now used in the manufacture of various chemicals. These light hydrocarbons provided a basis for the

development of other chemical firms whose production was based on these feedstocks. Then too, from its own point of view, the primary objective of a refinery is to maximize the potential of crude oil: produce the greatest quantity of commercially valuable products and reduce the output of commercially less attractive products to an absolute minimum.[4]

Demand for Imperial's hydrocarbon feedstocks grew as the companies expanded their facilities and new concerns moved into the area. Imperial was prompted to develop more extensive facilities for the production of ethylene, butadiene and other hydrocarbon monomers (starting materials for chemical synthetics). The company was on the threshold of a new endeavor.

Diversification and economics dictated a decision by Imperial to go into the petrochemical industry on a large scale. In the past, the processors of petroleum were identified by the skill with which they integrated the production, refining, and marketing of petroleum hydrocarbons. Entry into petrochemicals was an extension of the philosophy of maximizing the value of every refinery fraction.[5]

A petrochemical division of a refinery provides a "home" for some hydrocarbons not needed at the time in the refinery for the production of petroleum products.[6] The fact that Imperial Oil selected its Sarnia refinery as the site for its petrochemical division was based on several factors; however, the dominant one was that its best potential customers of hydrocarbons not utilized by Imperial would be Polymer, Dow, DuPont, and others in the immediate area. This was another excellent example of integration.

In addition, the establishment of a petrochemical division by Imperial Oil had other advantages. The production of petrochemicals right where the raw feedstocks are processed reduces transportation costs. Then too, the refinery would have control over both the volume and price of the essential feedstocks. With refineries, the most economical operation is to have the petrochemical plant as close to the market as possible.[7] Sarnia is not far from the large markets of Ontario and the United States.

Another factor that could have influenced Imperial Oil's entrance into the field of petrochemical manufacture was that other major Canadian oil companies--British-American (Gulf), Canadian Petrofina, Irving Oil, Texaco, and Shell--were becoming involved in petrochemical programs. The net result of Imperial's expansion was the creation of one of North America's most versatile, integrated petroleum refineries and petroleum complexes.

Table 8 shows the refining capacity and the degree of expansion of oil companies into the petrochemical field in 1961.

Polymer's chemical intermediates have been effective in promoting valley growth. When Dow Chemical decided to remain in Canada after the war, Polymer sold Dow Chemical essential feedstocks so that they could manufacture styron. Since the establishment of Dow Chemical in Canada there has been close cooperation between these two companies. In addition to the styrene made available by Polymer in 1947, ethylene was also made available to Dow Chemical for the manufacture of ethylene glycol.

TABLE 8

CANADIAN OIL COMPANIES ENGAGED IN CHEMICAL MANUFACTURE (1961)[a]

**Imperial Oil Limited**

Refineries:

| | |
|---|---|
| Dartmouth | (54,000 bpd) |
| Montreal East | (80,000 bpd) |
| Sarnia | (122,000 bpd) |
| E. St. Paul | (20,000 bpd) |
| Regina | (24,000 bpd) |
| Calgary | (16,000 bpd) |
| Edmonton | (30,000 bpd) |
| Ioco | (34,000 bpd) |
| Norman Wells | (1,600 bpd) |

Chemical Plants:

Sarnia: olefins, diolefins
detergent alkylate
naptha solvents
fuel oil additives

Redwater: sulfur

**Shell Oil**

Refineries:

| | |
|---|---|
| Montreal East | (63,000 bpd) |
| Oakville | (31,000 bpd) |
| St. Boniface | (17,000 bpd) |
| Grande Prairie | (2,500 bpd) |
| Burnaby | (22,000 bpd) |

Chemical Plants:

Montreal East: solvents
epoxy resins
detergent alkylate

Simcoe: pesticides

Walterton: sulfur

Jumping Pound: sulfur

**Texaco Canada Limited**

Refineries:

| | |
|---|---|
| Dartmouth | (14,000 bpd) |
| Montreal East | (62,000 bpd) |
| Port Credit | (37,000 bpd) |
| Edmonton | (13,000 bpd) |

Chemical Plants:

Port Credit: benzine
toluene
hexane

Montreal East: napthas

**British American Oil (Gulf)**

Refineries:

| | |
|---|---|
| Montreal East | (50,000 bpd) |
| Clarkson | (61,500 bpd) |
| Moose Jaw | (15,000 bpd) |
| Calgary | (10,000 bpd) |
| Edmonton | (13,500 bpd) |
| Port Moody | (20,000 bpd) |

Chemical Plants:

Montreal East: cumene, benzene
cyclohexane

Pincher Creek: sulfur

Rimbey: sulfur

Shawinigan plants:
(25% interest by B.A.)

Shawinigan: calcium carbide
acetylene
acetic acid
vinyl chloride
vinyl polymers,
plasticizers
sulfuric acid
chlorine, caustic

Ste. Therese: vinyl coated
fabrics

Montreal East: phenol, acetone
bisphenol A

Varennes: formaldehyde
pentaerythritol
olefins, acetaldehyde

**Irving Oil Company Limited**

Refinery:

E. St. John (50,000 bpd)

Chemical Plant:

E. St. John: sulfur

**Canadian Oil Company Limited**

Refineries:

| | |
|---|---|
| Sarnia | (50,000 bpd) |
| Bowden | (4,430 bpd) |

Chemical Plants:

Sarnia: benzene, toluene
xylene

[a]A. H. Bird, "Oil Company Chemicals," Canadian Chemical Processing, 46 (April, 1962), 57.

The type of cooperation existing between Imperial Oil and Polymer was best demonstrated when Polymer found itself in the awkward position of not being able to generate enough butadiene from available feedstreams. Imperial Oil intervened with its new steam-cracking facilities and helped Polymer meet its demand by increasing its production of C4 hydrocarbons. Another example of industry interaction involving Polymer and Imperial Oil occurred when as a result of increased need for acrylonitrile monomer by Polymer, Imperial Oil decided to manufacture acrylonitrile to meet Polymer's demands.[8]

Since its establishment in the Chemical Valley 25 years ago, Polymer has become the single largest independent producer of synthetic rubber in the world.[9] The major problem of this company--a problem shared by most of Canada's major industrial manufacturers--is the smallness of the domestic market. Therefore, this Canadian company, not a subsidiary of an American concern as are many of the other companies in the valley, has been forced to expand beyond the borders of Canada. Tariffs were a major factor in a decision to build overseas. Polymer attempted to overcome the problem by locating within or behind tariff walls.

Polymer had access to the British market from its Sarnia plant but because of the establishment of the European Common Market did not have access to a tariff free market in Europe. Polymer constructed a specialty rubber plant in France and a butyl rubber plant in Belgium within the European Common Market and continued to sell its products duty free to this important European bloc of nations.

In order to continue operations in the Sarnia facilities, Polymer must sell rubber to some overseas markets. However, countries such as Australia, Brazil and Argentina have recently placed high protective tariffs on their infant synthetic rubber industries. If more nations follow this trend the result could be disastrous for the Sarnia based operation.

Polymer has diversified its Sarnia facilities. In 1963, a polybutadiene unit was added to their operations, and in 1964 an acrylonitrile unit. The basis for this expansion of facilities was the availability of the wide variety of raw materials now being produced in the valley.

Of all the companies in this complex none is more diversified or more integrated with other companies than Dow Chemical. From the early manufacture of styrene in 1947, Dow Chemical's expansion has been explosive. In 1952 Dow Chemical began producing styrene and later that year established a chlorine and caustic soda plant. By 1953 Dow Chemical had constructed a latex plant for paint and the coating of paper and fabrics. In 1955 they built an ethanolamine unit and the following year expanded their ammonia facilities with feedstock from Imperial Oil, Canadian Oil, and a new refinery in the area, Sun Oil.

In 1957, ten years after the construction of their first independent plant, Dow Chemical built a second ethylene unit. This was followed by a steam plant, a methyl and methylene chloride plant and a polyethylene plant, all in 1959. The following year Dow Chemical began the manufacture of polystrene beads and polystrene foam used in plastics. Entry into the manufacture of vinyl chloride took place in 1961, of

propylene, in 1963. In 1964, Dow Chemical added methyl chloroform to its list of diverse products and in 1965 expanded the ammonia unit, chlorine unit, styrene unit, polyethylene unit and vinyl chloride unit.[10]

In 1952 Canadian Oil (Shell) arrived in the valley from Petrolia. The decision of this refinery to choose Sarnia was based on several factors, the prime one being the fact that the valley was already the home of Polymer and Dow Chemical, thus giving Canadian Oil potential buyers for their hydrocarbon feedstocks. Another factor was the arrival of the Interprovincial Pipeline to the Lakehead (Superior, Wisconsin) permitting the use of crude oil delivered to their facilities by way of lake tankers.[11]

Feedstocks obtained from western crude oil go to the Dow Company which extracts ethane and ethylene. Propylene is returned to the refinery by Dow Chemical. A C4 stream is sent by Canadian Oil to Polymer which separates the isobutylene for butyl rubber and normal butanes for production of GR-S type rubber. After this "cut," the stream is returned to the refinery, thus illustrating another example of integration.

In 1957 Canadian Oil constructed the first benzene-from-crude-oil unit. In 1963 Canada's first fixed-bed catalytic hydrocracking unit was introduced, the first on the continent designed primarily to convert heavy oils to high quality middle distillates (stove, diesel, and heating oils).

The construction of this catalytic hydrocracking unit was the result of a market analysis.[12] The eastern part of Canada requires

about equal volumes of gasoline and middle distillate fuels. According to a survey conducted prior to the enactment of the National Oil Policy, there were large quantities of middle distillates being distributed west of the Ottawa River by refineries located east of this river. A change in Canadian Oil's refinery facilities could help reduce the need for these middle distillates from eastern sources. A reduction in products made from foreign crude oil and sold west of the Ottawa River was a goal of the National Oil Policy. Canadian Oil saw excellent market opportunities for their Sarnia-based facility, especially with the ease of access to the extended Interprovincial Pipeline.

The third refinery to move into the valley was Sun Oil. Prior to its arrival in 1953, Sun Oil had been shipping feedstocks by pipeline to the Polymer corporation from its refinery in Toledo, Ohio. One reason for the establishment of a refinery in this area was the location of nearby chemical companies to whom by-products could be sold.

Officially the Sarnia refinery of Sun Oil was put on stream in October of 1953, with a 15,000 barrel per day capacity. By 1970 the refinery had grown to a capacity of 35,000 barrels per day and was now operating on Canadian crude oil only from the Interprovincial Pipeline.[13]

The transportation of the refined products from the Sun Oil refinery to the Toronto area is done by a pipeline system, a pipeline that is owned jointly by Sun Oil and Canadian Oil.[14] This pipeline reflects marketing integration and illustrates the unique cooperation among the competing companies of the valley.

Expansion and diversification of the valley continued with the arrival of Cabot Carbon, a company which makes carbon black--one of the

major ingredients in tire manufacturing.[15] Executives of the Crown Corporation, Polymer, were instrumental in inducing Cabot of Boston to locate in the valley. Other American manufacturers of carbon black were also contacted, but Cabot Carbon was the only one which expressed an interest in the Sarnia area.

Two factors were important in Cabot Carbon's decision to establish in Sarnia. First, Imperial Oil could supply the company with heavy aromatic oil used in the manufacture of carbon black. In addition, they were interested in Polymer's plan to develop a "master batch" system for the supply of carbon black to make synthetic rubber.

Along with these factors, Sarnia offered a favorable location with regard to the major tire manufacturers of Canada which were located in the Toronto area. The establishment of Canada's first carbon black manufacturer was important to Canada in that it saved American dollars previously spent on imported carbon black.[16]

An interesting fact regarding the Cabot plant in Sarnia is that they had no tariff protection in Canada. The government had suggested that they build a subsidiary in Canada knowing their American competitors could produce carbon black for less, based simply on the scale of operation.

The valley had been growing very rapidly since 1951. New industries were arriving and the older ones were expanding their facilities. By the end of 1953, the total investment in the production of petrochemicals and associated products at Sarnia had risen to about $109 million, a figure representing nearly half of all the investment in Canada in the field of petrochemicals.[17]

In 1956 the Ethyl corporation located in the Chemical Valley. The company was influenced in its choice of a Sarnia site by the availability of ethylene from Imperial Oil and anyhydrous chloride from Dow Chemical. Since the market range of the Ethyl Corporation is from the Pacific coast to the Atlantic coast, Sarnia was central to the major destination points for their product.[18]

Ethyl Corporation's diversification permitted the company to manufacture several families of industrial chemicals. Among the ethyl products are anti-oxidants, detergents, and aluminium alkyl catalysts--used in the production of plastics and synthetic rubber. It should be noted that with the establishment of Ethyl Corporation in Sarnia, ethyl anti-knock compounds were manufactured in Canada for the first time.

Two new companies ushered in the 1960's in the Chemical Valley. The first was DuPont. They produced a wide range of polyethylene resins used in the manufacture of plastic pipes and containers of all kinds. These products are sold on the domestic and export markets. The Sarnia plant was designed especially for the small Canadian market, having the capability of producing both high and low density resins.

There were several reasons why DuPont located its plant in Sarnia. Of great importance was that their major raw material, merchant ethylene, was available only in the Sarnia area, from the Imperial Oil Company. Consideration was also given to the fact that Sarnia was the site of labor trained for this type of work. In addition, as is true of the majority of chemical companies, nearness to a large body of cooling water is important.[19] DuPont added to the growing chemical interaction in the valley.

The second company to establish itself in the Chemical Valley in 1960 was the St. Clair Chemical Company. This company located there originally because the Imperial Oil Company purchased the majority of its product, anhydrous aluminium trichloride ($AlCl_3$).[20] In addition to Imperial Oil, however, there were other potential purchasers of aluminium trichloride in the valley. Another basis for the Sarnia site was the fact that a basic raw material--chlorine--was available from a nearby source, Dow Chemical.

Dow Chemical, Imperial Oil and Polymer are all valley purchasers of the aluminium trichloride which is used as a catalyst in the manufacture of various products. However, production is geared to meet more than the local demands because $AlCl_3$ is shipped all over the world to such countries as Great Britain, United States, Germany, U.S.S.R., and Argentina.[21]

Three years after St. Clair Chemical, the valley added another prolific chemical company, Allied Chemical of Canada. Again several factors influenced the selection of Sarnia as the site for the plant, but like many other concerns, the availability of nearby feedstocks was the major one.

The Allied Chemical Company manufactured Toluene Diisocyanates (TDI) which require such raw materials as toluene, sulphuric acid, nitric acid, hydrogen, coke, oxygen, and chlorine.[22] Most of these raw materials were available in the valley.

The construction of this new plant added to the list of "firsts" in Canada because TDI had not been manufactured in Canada prior to this time. TDI is used principally in the manufacturing of a wide variety of

plastic foams, one of them being urethane which is produced primarily for automobiles and furniture. A plant located in Sarnia would be close to automobile and furniture manufacturers, a fact which greatly enhanced the Sarnia site. Nearness to water for cooling purposes was important to this plant also.

Canadian Industries Limited, Canada's largest producers of agricultural chemicals moved into the valley in 1965. The plant site selected was Sombra Township just south of Sarnia, and was committed to a 1,000 ton per day ammonia production. In addition, facilities were available for making phosphoric acid, nitric acid, ammonium nitrate, phosphate and urea.

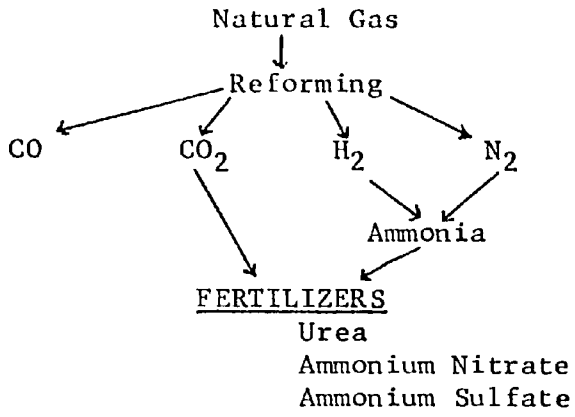
This location placed the company in a position having market access to both the Southern Ontario and the American mid-west fertilizer market. Since the market for fertilizers was expanding in these areas, the Sarnia site afforded easy access to customers.

The major factor influencing Canadian Industries was the availability of natural gas from western Canada, providing hydrocarbons upon which to build their ammonia plant, the largest anhydrous ammonia plant in Canada. Figure 13 indicates the process by which the various fertilizers are made.

In addition to the availability of numerous raw materials in Sarnia, sulfuric acid--used in the manufacture of phosphoric acid--could be delivered from Copper Cliff, near Sudbury, at a low cost. Canadian Industries Limited believed that the perpetuation of the growth of the Chemical Valley was inevitable and thus by integration of the industries of the valley with some of their processes, further diversification

FIGURE 13

PRODUCTS FROM NATURAL GAS




could be accomplished. A factor not related to any of the preceding points, but of considerable importance, was that the area of Sombra Township was eligible for special tax concessions under the Federal Incentive Act for Depressed Areas.[23]

Special consideration was given to the economies of scale with the proposed construction of such a large plant in Sombra Township. Since the fertilizer divison of Canadian Industries Limited, operating in other parts of Canada, had returned low earnings, the company had to either withdraw from this field or broaden its market area. This meant entry into the United States' midwestern markets.[24] In order to be competitive, costs had to be reduced and the size of the operation was very important in minimizing costs per unit output. Scale of operations was the basis for construction of such a large plant in the valley.

Chinook Chemicals added to the chemical diversification of the valley. As in other cases, the decision to locate in Sarnia was based

on the availability of raw materials from local suppliers: chlorine from Dow and ammonia from Canadian Industries Limited.

Chinook was one of two commercial producers of monoethylformanide, a solvent and a reaction medium, which is sold locally. In addition, Chinook has the world's second largest dimethylformanide plant; this solvent has a world wide market.

The newest chemical firm in the valley is Dome Petroleum. Dome's reasons for locating in the valley are similar to those of other companies: proximity to the Interprovincial Pipeline; proximity to the refineries in the Sarnia area; the suitability of the salt beds in the area for the underground storage of Liquid Propane Gases; and the proximity to markets.[25]

The plant is designed to fractionate 27,000 barrels per day of Liquid Petroleum Gases and will produce from this propane, n-butane, i-butane, and $C_5$ light crude oil. The obvious markets for their products are the local oil refineries and chemical plants, which made the selection of this site very practical. Already Dome is planning expansion to meet market needs, hoping to double their facilities within the coming year.

At the time of this writing, one of the most ambitious programs of expansion ever undertaken is being studied by several of the Canadian chemical companies in the Sarnia area. DuPont of Canada, Polymer Corporation, Dow Chemical of Canada, and Imperial Oil--the present operation of Canada's largest producing ethylene plant--are planning a multimillion dollar, world-scale ethylene plant in the Sarnia area.[26]

According to rpeliminary studies, the plant will have a capacity of one billion pounds per year, the equivalent of Canada's entire current demand. Ethylene is of extreme importance to the Chemical Valley as a material used in a wide variety of synthetic items.

This plant would rely on hydrocarbon feedstocks delivered to the Sarnia area by the Interprovincial Pipeline Company. Continued expansion of the companies in the valley depends on an assurance of a larger and uninterrupted supply of ethylene at world competitive prices.[27] Completion of this project by these four major companies in the Chemical Valley will strengthen the continued interrelationships of industry in Sarnia.

## Footnotes

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"The industry had told the Canadian Government, commencing in about 1954, that Canada's small market being the only exposed chemicals and plastics market on earth, it could not hope to prosper and this has indeed been proven."

L. D. Smithers, Chairman of the Board
Dow Chemical of Canada

## CHAPTER VII

## PROBLEMS OF PETROCHEMICAL INDUSTRY

The importance of the Canadian chemical industry to Canada's economy is truly great. Its contribution can be measured by the fact that in 1969 the value of manufactured goods produced by the chemical industry amounted to about 6 percent of all Canada's gross national product. This is only slightly less than the combined output of the automobile and pulp and paper industries.[1]

In terms of value added per worker, an important criterion of the impact of an industry on the economy, the statistics show the petrochemical industry to be one of the highest. Value added per worker for all industries according to the Dominion Bureau of Statistics was $8,900, while that for the petrochemical industry was $22,150. The petrochemical industry is a high capital intensity industry and this type of capital investment generates high value added per worker.

As the decade of the seventies approached, there was a growing awareness of problems that had to be solved by the chemical industry if it were to remain as viable as it had been in the sixties. Though there was talk of expansion, most Canadian chemical manufacturers decried the position taken by the Canadian government at the latest Kennedy Round negotiations of the General Agreement on Tariffs and Trade. Though the Canadian chemical industry has always been unprotected as a result of

low tariffs, the Canadian government did agree in the Kennedy Round to a further reduction in chemicals and plastics tariffs of approximately 25 percent. This was interpreted as the death knell for a progressive chemicals and plastics industry in Canada.[2]

The Chemical Valley of Sarnia is as vulnerable to the policies of Ottawa as chemical manufacturers in other parts of Canada. The valley, site of spectacular post war growth, was now confronted with difficulties that deserved federal interest, especially the tariff issue.

The question of tariffs and tariff rates is of extreme importance to the chemical producers in Sarnia. The problem is that they lack adequate tariff protection for their operations. In fact, prospects for the chemical industry look dismal if government policies do not change so as to give it greater protection in the domestic market.[3]

The importance of tariff protection for the chemical industry cannot be over-emphasized. Continued growth in the Sarnia chemical industry cannot be over-emphasized. Continued growth in the Sarnia chemical complex is contingent upon two very basic factors: scale and protective tariffs. Tariffs could aid in the construction of larger plants because domestic producers would then have inherent advantages: they would be located behind tariff walls.

The domestic market is growing in size, and demand for petrochemical products is increasing. New and diverse uses are developing for plastic resin. Plastic manufacturing is a major activity in the Chemical Valley and sales of the products are vital to the prosperity of DuPont and Dow.

While output of the world plastics industry will grow by 12 percent or 100 billion pounds during the decade of the seventies, Canada expects her domestic demand to grow at an even greater rate. Projections indicate the need for about a 13 percent increase per annum, to about 800 million pounds of plastics in 1970. This demand for plastics is expected to grow to 3 billion pounds per annum by 1980. If the rate of growth were to continue, the Canadian domestic market for plastic products by the mid-1990's would equal the present size of the United States market, about 8 billion pounds.[4] The advantages for a domestic producer to be protected by a tariff wall are obvious.

An examination of the position taken by the federal government regarding tariff protection for the chemical industries shows that there is a difference of opinion as to whether or not the Canadian chemical industry needs protection. While nearly all nations of the world have adopted policies that tend to encourage the development of a strong petrochemical industry, Canada is the exception.[5] Government policy is best revealed by statements made by Mr. Pepin, Minister of Trade, Industry and Commerce, to the Canadian Importers Association at a meeting in Montreal on January 20, 1971.

The Minister stated that Canadian tariff rates were then at the lowest level in Canadian history. He added that free trade is good for trade and for freedom. In summarizing a sequence of remarks made regarding the Canadian market, Mr. Pepin said that Canada is one of the most open markets in the world and it is the government's firm intention to maintain its commitment to trade liberalization into the future. As he put it, "Protectionalism is not our bag."[6]

The executives of the various plants in the Chemical Valley find the federal government's position regarding tariffs for the chemical industry to be unrealistic. The reason for their position is basically this: the major petrochemical producers in the world--United States, United Kingdom, Japan, Italy, and West Germany--all have seen fit to protect their industries. It is no accident that 85 percent of the free world's output of plastics comes from these five nations. These countries all have either large domestic markets which serve as a base from which to derive the economics of a large scale production, or they have adequate tariffs with which to protect this base.[7]

Considering the problem of scale alone, Canada is at a very definite disadvantage. Scale affects unit manufacturing costs in three ways: the scale of manufacture reflects the effect of plant size on unit costs; the scale of business considers the effect of market size in relation to the plant under construction; the scale of the company refers to the size and the financial resources of that company.[8]

In the petrochemical industry, unit manufacturing costs normally decrease as the size of the plant increases. Thus large scale operations promote lower prices which in turn stimulate further demand. Table 9 refers to 1969; it compares the size of the U.S. and Canadian markets. American chemical producers can construct large scale plants to meet domestic demand and as a result of scale offer unit prices.

In some cases the size of a single American plant is such that it has the capacity to meet the demands of the entire Canadian market. Table 10 illustrates this.

TABLE 9

RELATIVE SIZE OF CANADIAN AND UNITED STATES MARKETS IN 1969[a]

| Chemical | Unit | Canada | U.S. | Ratio Canada to U.S. |
|---|---|---|---|---|
| Urea | 000's tons | 350 | 2600 | 1:8 |
| Ammonium nitrate | 000's tons | 750 | 6600 | 1:9 |
| Butadiene | Million lbs. | 330 | 3100 | 1:9 |
| Sulphuric acid | 000's tons | 3100 | 27000 | 1:9 |
| Ammonia | 000's tons | 1200 | 13500 | 1:11 |
| Chlorine | 000's tons | 800 | 9000 | 1:11 |
| Formaldehyde | Million lbs. | 140 | 1700 | 1:12 |
| Gasoline | Million barrels | 153 | 2000 | 1:13 |
| Benzene | Million U.S. gal. | 75 | 1060 | 1:14 |
| Ethylene Oxide | Million lbs. | 190 | 2600 | 1:14 |
| Polyethylene | Million lbs. | 280 | 5000 | 1:18 |
| Phenol | Million lbs. | 75 | 1400 | 1:19 |
| Ethylene | Million lbs. | 750 | 15000 | 1:20 |
| Styrene | Million lbs. | 200 | 3900 | 1:20 |
| Vinyl Chloride | Million lbs. | 150 | 3100 | 1:21 |
| Perchloroethylene | Million lbs. | 25 | 620 | 1:25 |
| Polypropylene | Million lbs. | 32 | 900 | 1:28 |
| Methanol | Million U.S. gal | 20 | 600 | 1:30 |
| Acrylonitrile | Million lbs. | 27 | 1000 | 1:37 |

[a]W. H. C. Simmonds, "U.S.-Canada Scale Problem," Chemistry in Canada, 21 (October, 1969), 39.

TABLE 10

RELATIVE SIZE OF THE TOTAL CANADIAN PRODUCTION COMPARED TO THE LARGEST UNITED STATES PLANT[a] (in tons)

| Chemical | Total Canadian Production | Capacity of Largest U.S. Plant | Ratio |
|---|---|---|---|
| Ethylene | 750 | 1200 | 0.62:1 |
| Ethylene Oxide | 190 | 350 | 0.54:1 |
| Vinyl Chloride | 150 | 700 | 0.21:1 |
| Styrene | 200 | 750 | 0.27:1 |
| Acrylonitrile | 27 | 200 | 0.13:1 |
| Phenol | 75 | 300 | 0.25:1 |

[a]W. H. C. Simmonds, "U.S.-Canada Scale Problem," Chemistry in Canada, 21 (October, 1969), 40.

Here then is a problem of scale that faces the Canadian manufacturers in the Chemical Valley. With production facilities smaller than those in the United States, it is difficult to see how they can remain competitive in North America on the basis of markets or scale.

Another problem arises for the Chemical Valley when the large scale American plants expand. Normally plant sizes increase in steps somewhere between 100 and 250 percent of capacity while petrochemical markets increase by about 7 to 15 percent per year.[9] It is during times of excess capacity or immediately after expansion takes place that export markets are the recipients of surplus production. This excess capacity leads to price erosion and a reduced profit rate by the smaller, unprotected producer if he wishes to remain competitive.

Low density polyethylene, an important product manufactured in the Valley, is a case in point. In the 1960's the average price for a pound of L.D. polyethylene in the Chemical Valley was around 25 cents; today the world price is around 15 cents per pound. The effective tariff rate charged by the U.S. government was 31 percent when the price of L.D. polyethylene was 25 cents per pound based on a rate of 20 percent plus 2-3/4 cents per pound. However, when the price dropped to 15 cents per pound, this tariff rate amounted to a 40-cent effective tariff.[10] In any event, assuming a U.S. price of 15 cents a pound with the present tariff rates, a Chemical Valley manufacturer of L.D. polyethylene would have to be able to produce his product at around 10 cents per pound if he wished to compete on the U.S. market. At present, scale does not permit this.

While scale and tariff are both important to the Chemical Valley, costs of raw materials are also of great concern and could tend to offset scale disadvantage. One manufacturer in the Chemical Valley, Ethyl Corporation, believes that scale disadvantage can be overcome if key raw materials such as ethane, propane, butane, ethylene, chlorine, and benzene could be brought down to world prices.

A recent study made by the Canadian government of ten chemical companies operating in both Canada and the United States tended to support the point made by the Ethyl Corporation. In this study it was noted that at equal scale and with existing tariffs, Canadian disadvantage was most pronounced in two areas: raw materials and income tax.

Although scale can not normally overcome high raw material costs, cheap raw material costs can overcome scale disadvantages.[11] Scale must

be recognized as a major factor in unit costs, but raw materials costs play an equally important role. If Canadian raw material prices were lower than those of the United States, then scale problems regarding unit cost could be overcome. It is for this reason that certain petrochemical firms have requested tariff concessions on the importing of petroleum fractions, notably naptha. Union Carbide of Montreal contends that the 1-cent duty per gallon on light distillates has the effects of increasing ethylene costs by 0.49 cents per pound or 16 percent.[12]

However, Imperial Oil of Sarnia opposes this price reduction and the expanded use of feedstocks. It contends that all market opportunities must be exploited if domestic oil refiners are to obtain scale of operations. This illustrates an area of conflict between the integrated oil companies and the non-integrated petrochemical companies.

An interesting point to consider, however, is that products of the Montreal refineries are kept out of the U.S. market by the U.S. mandatory oil program which permits free import of ethylene and propylene from Canadian crude stocks, but not from foreign feedstocks.[13] This could have a neutralizing effect with regard to penetrating the U.S. markets by the Montreal complex, but Montreal producers with cheap feedstocks would have a domestic advantage since the National Oil Policy allows trans-shipment of chemicals across the Ottawa River.

The reduction that has been recommended with regard for duties on certain fractions of petroleum for use as feedstocks in the manufacture of petrochemicals amounts to from 1 cent per gallon to 1/3 cent per gallon.[14] Since these companies deal in thousands of gallons every day, the sums involved are substantial. The approval of such a

reduction would be a severe setback for the Sarnia complex. They would not have access to this foreign feedstock since they are located west of the Ottawa River. Thus the Montreal complex would have the advantage of cheaper raw materials. This is a major problem confronting the Chemical Valley in foreign marketing and could very well be extended to the domestic market.

An important fact regarding ethylene production is that one United States world scale ethylene plant has the capacity to serve the entire Canadian market (Table 10). If the Canadian costs of naptha, used in ethylene manufacture, could be brought down to world prices--18 to 20 dollars per metric ton rather than the United States price of 30-32 dollars per metric ton--unit costs would be less for the Canadian manufacturer. Unit costs in Canada run, as a result of scale and raw material costs, about 20 to 25 percent above United States costs.[15] This creates problems for the Canadian manufacturer on both the domestic and foreign market.

The Chemical Valley manufacturers must pay $3.25 a barrel for crude oil while the world price is about $2.00 a barrel. A way to reduce raw material costs could be by making it easier for petrochemical firms in Sarnia to have access to this cheaper feedstock.[16] At the present time, Sarnia is not able to utilize this foreign crude oil since Sarnia is west of the Ottawa River and the National Oil Policy does not permit delivery of foreign crude oil west of this river.

Taxes constitute another problem for the Chemical Valley. Tax rates have tended to have an adverse effect on profits, which in turn influence the amount of investment in the area. According to a study

made by the DuPont Company, after-tax profits as a percentage of gross investment declined by 42 percent in Canada during the decade of the sixties--from 3.7 percent in 1961, to just over 2.0 percent in 1968.[17] A comparison of the return on investment between the United States chemical investors and the Canadian investor is illustrated in Table 11. It can be clearly seen that the Canadian investor receives a smaller return for each dollar invested.

TABLE 11

CHEMICAL INDUSTRY PROFITS AS A PERCENT OF INVESTMENT[a]

| | United States | Canada |
|---|---|---|
| 1961 | 6.3 | 3.7 |
| 1962 | 6.4 | 4.1 |
| 1963 | 5.8 | 4.2 |
| 1964 | .62 | 4.6 |
| 1965 | 6.0 | 4.0 |
| 1966 | 5.7 | 3.7 |
| 1967 | 4.6 | 2.1 |
| 1968 | 4.5 | 2.4 |

[a]E. H. Bleckwell, "Introductory remarks to the Canadian Chemical Producers' Association, Education Committee Seminar," Paper presented to the Canadian Chemical Producers Association, Montreal, Quebec, October 31, 1969, p. 13.

The analysis between the Canadian and United States corporation taxes is significant in that most of the investment in the Chemical Valley is American. The Chemical Valley must continue to attract large amounts of capital for future expansion. The desirability of investment in Canada diminishes as the investment returns decline.

Actually, prior to 1959, the Canadian corporation tax rates were lower than the U.S. rates. After that, combined Canadian federal and provincial tax rates on corporate profits were between 47 percent and 49 percent compared to the U.S. federal rate of 52 percent. In recent years this relationship has been reversed with Canadian rates increasing to between 50 percent and 53 percent while U.S. rates have been reduced to 48 percent.[18]

At the same time the rate of Canadian withholding tax on dividends paid by Canadian subsidiaries to U.S. parent companies has been increased. This means that a U.S. subsidiary will incur a tax burden of around 60 percent on repatriated profits earned in Canada as compared to the prospect of a 46 percent U.S. rate of tax on profits earned in the United States.[19]

A change in tax rates so that they would be equal to the American tax rate would tend to be beneficial in terms of permitting the Chemical Valley manufacturers a chance to compete on equal terms with their competition south of the border. A classic example of what a tax free climate means to the development of the chemical industry is Puerto Rico. This small island with no major resources now has the world's largest aromatics plant--a billion pound ethylene unit--and the world's largest oil refinery. Aside from the fact that it had access to cheap foreign crude oil feedstock at world prices, tax exemptions for many years and access to the U.S. markets were responsible for this impressive growth.[20] No one in the Chemical Valley suggests a tax free period, but it would be advantageous to have reduced taxes so as to be competitive with other chemical areas having lower taxes.

Labor costs constitute another problem for the Chemical Valley. Wage costs in chemical industries are higher in Canada than in most other chemical industries with the exception of the United States (Table 12).

While U.S. rates exceed that of Canada, it should be pointed out that productivity per worker in the United States is considerably higher. Productivity is related to scale and is a measure of the productivity of capital. Thus labor costs per unit of output are about one-third higher in Canada than in the United States despite the wage differential.

TABLE 12

WAGE RATES IN CHEMICALS--1967[a]
(U.S. dollars per hour)

| United States | Canada | Germany | United Kingdom | France | Japan |
|---|---|---|---|---|---|
| 3.10 | 2.41 | 1.31 | 1.18 | 0.92 | 0.85 |

[a]E. H. Bleckwell, "Introductory remarks to the Canadian Chemical Producers' Association, Education Committee Seminar," Paper presented to the Canadian Chemical Producers Association, Montreal, Quebec, October 31, 1969, p. 12.

This unit cost, coupled with scale, makes it difficult for the Chemical Valley to compete in the United States, West Germany, United Kingdom, France or Japan. But the reverse is true for these nations with lower unit costs reflecting scale, raw materials, and labor; they have little difficulty marketing their products in the exposed Canadian markets. On the other hand, the Canadians are forced to pay a much higher tariff in their endeavour to market goods abroad.

Capital costs are high in the Chemical Valley. The Canadian Tariff Board, in recent studies of fractions of petroleum for use as feedstock in the manufacture of organic chemicals, compared costs of construction of similar facilities in Europe and Canada and found that Canadian costs averaged from 10 to 15 percent higher.[21] This adds to the many disadvantages that the Chemical Valley has in attempting to expand its petrochemical markets beyond the domestic ones.

In summary, the Chemical Valley is facing a very severe challenge. Prospects for future growth are contingent upon selling not only to the domestic market, but to the international markets as well. Scale, raw materials, taxes and costs associated with capital, labor and a low domestic tariff appear as major obstacles to success in the seventies. Continued growth of this complex may very well hinge on the policies of the federal government which were responsible for the initial growth of the dynamic complex in Sarnia.

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[9]Ibid., 17

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[11]R. H. Shannon, "The Competitive Position of Industrial Chemicals in Canada and Suggestions to Create Future Growth," Paper given to the Canadian Society for Chemical Engineering, Sarnia, Ontario, October, 1970, p. 41.

[12]"Why Sarnia Is Holding Its Breath," Oilweek (March, 1969), pp. 20-32.

[13]P. A. York, Executive Director, Trade and Industry Division of the Ontario Department of Trade and Development, Personal Communication, March 12, 1971.

[14]N. G. Darrock, Director of Canadian Tariff, Personal Communication, February 16, 1971.

[15]W. C. Dack, "Trouble Piles Up for Petrochemical Firms," Financial Post, Toronto, Ontario, August 21, 1971, p. 2.

[16]Ibid.

[17]A. D. Amery, "The Future for Secondary Industry in Canada with Particular Reference to the Chemical Industry," Paper given at University of Waterloo, Ontario, November 11, 1970, p. 5.

[18]E. H. Bleckwell, The Structure of Our Tax System--Its Effect on Economic Growth and on Employment Opportunities in Canada, Published by the Ontario Economic Council, November, 1969, p. 7.

[19]Ibid., p. 8.

[20]Shannon, "The Competitive Position of Industrial Chemicals," p. 2.

[21]Amery, "The Future of Secondary Industry in Canada," p. 12.

"Many economic and technical questions must be answered affirmatively before a company can proceed with facilities for manufacture of a chemical or petrochemical. There must be a market and preferably it should be a growing market--even after allowance has been made for the inroads of competitive products."

W. Dunnington, Development Manager
DuPont Company of Canada

## CHAPTER VIII

## COMPETITION OF OTHER DOMESTIC PETROCHEMICAL CENTERS

For the past thirty years the Chemical Valley of Sarnia has been known as the premier chemical complex of Canada. The area's title was justified, for nowhere in Canada was there a chemical center that could rival the production of the Sarnia area. The factors contributing to this phenomenal growth have been indicated. The valley's prospects for future growth remain excellent and the area should continue to develop. With such a dynamic company as Imperial Oil still expanding its facilities, and other companies in the valley doing the same, there is little doubt but that growth will continue.

However, this expansion may not be as spectacular as it has been in the past. Other areas of Canada are now challenging Sarnia as the most important chemical complex in Canada. This study would be incomplete if it did not acknowledge the development of these. Their growth will be of such a nature that they will produce many of the products that are manufactured in the Chemical Valley of Sarnia and as a result become domestic competitors. Their success will have a direct bearing on the continued expansion of the Sarnia area, since the companies in these areas will be attempting to capture the same domestic markets that are available to the Chemical Valley. It is important to capture a portion of the domestic market in Canada if a company expects to remain in

the chemical industry. The existence of these competitors will cause Sarnia to think twice before engaging in any haphazard expansion in the future.

There are at least three sites of chemical development that could challenge Sarnia: Montreal, Quebec; Edmonton, Alberta; and the Maritime facilities at Point Tupper, Nova Scotia. Each of these centers has a definite advantage that is not common to the Sarnia area.

Montreal East is the site of six of Canada's major oil refineries. One-third of Canada's petroleum refining capacity is located here and continued expansion of each of these six refineries is indicated.[1] Table 13 illustrates the rapid growth of the refinery community. The processing capacity of these six refineries is 180,000,000 barrels of petroleum, 25 million tons per year. If only 4 percent (normally 5 percent of the crude is used in petrochemical manufacture) of the total throughput were converted to petrochemicals, more than two million pounds of organic chemicals would be produced. That is four times the present capacity of the refineries in Montreal today.

TABLE 13

CRUDE CAPACITY OF MONTREAL REFINERIES
(thousands of barrels per day)[a]

| Refinery | 1961 | 1963 | 1965 | 1967 | 1969 |
|---|---|---|---|---|---|
| BP Canada | 25 | 33 | 35 | 37 | 65 |
| A-A Oil | 45 | 45 | 45 | 67 | 67 |
| Canadian Petrofina | 27 | 29 | 33 | 52 | 52 |
| Imperial Oil | 77 | 77 | 85 | 95 | 95 |
| Shell | 62 | 62 | 62 | 62 | 110 |
| Texaco | 59 | 59 | 59 | 59 | 59 |
| Totals | 295 | 305 | 319 | 372 | 448 |

[a]"Montreal Set for Big Scale Petrochemicals," Canadian Chemical Processing, 25 (March, 1968), 46.

In addition to the expanded oil refinery facilities, there is every indication that continued expansion in the field of petrochemicals is also imminent. There are several reasons why Montreal could soon become Canada's leading petrochemical center: Montreal has access to low cost crude oil that arrives in Montreal in huge quantities; Montreal is Canada's leading seaport and has direct water links with foreign markets and a water route to the interior of Canada; Montreal has a large labor force; Montreal has access to relatively cheap hydro-electric power.

Just as Imperial Oil became the cornerstone for the development of the Chemical Valley of Sarnia, Shell Oil of Montreal East, the largest refinery in Montreal, appears to be the company in the forefront of petrochemical development. In addition to expanding its crude capacity to 110,000 barrels per day, Shell has added a hydrocracker and a hydrogen plant. With present facilities producing isoproponal, methy-ethyl ketone, alkylate solvent and epoxy resins, this means a more diversified production of petrochemicals.

If the large and diversified facilities of Union Carbide and Shawinigan Chemicals with their petrochemical potential are added to the six refineries in the area, Montreal has then the nucleus of a very competitive complex for the Sarnia area industries.

Recently the area's potential petrochemical productivity was enhanced when Gulf Oil acquired a major interest in Shawinigan Chemicals of Varennes, a Montreal suburb. Shawinigan built the world's largest single stage ethylene to acetaldehyde unit. This construction was a direct result of Shawinigan's association with Gulf Oil.[2]

The feedstock used in this unit is Kuwait naptha made from the crude oil shipped to Gulf Oil from that Middle East nation. Gulf "cuts" the naptha fraction (final boiling point of 350°F) from the crude oil and then pipes it over to Shawinigan Chemicals. The key product processed from the naptha is ethylene which has a wide variety of uses in the petrochemical industry.

In the chemical operations of the Montreal chemical complex, naptha is basic to the production of ethylene. Table 14 indicates the major manufacturers of ethylene in Canada. As also indicated by this

TABLE 14

ETHYLENE IN CANADA
(Capacity in millions lb/year)[a]

| Producers | 1966 | 1968 | Feedstocks |
|---|---|---|---|
| Imperial Oil (Sarnia) | 150-170 | 300-350 | Naptha, gas, oil and Coke gas |
| Shawinigan Chemicals (Varennes) | 120 | 600 | Naptha |
| Union Carbide (Montreal East) | 175 | 175 | Light ends: naptha |
| Dow Chemical (Sarnia) | 75-80 | 80 | Light ends: some liquids |
| Polymer Corporation (Sarnia) | 40-50 | 40-50 | Light ends |
| C.I.L. (Edmonton) | 50-60 | 80-100 | Ethane |

[a]"Montreal: A Swing to Naptha Feedstock," Canadian Chemical Processing, 50 (November, 1966), 57.

table, naptha is the prime feedstock for ethylene manufacturing in the Montreal area. This could explain why Montreal wants duty free naptha. With the duty removed, Montreal's petrochemical facilities could well become Canada's premier chemical complex. A favorable federal decision would enhance the attractiveness of the site.

Other factors contributing to the potential of the Montreal site are connected with the political climate of Quebec. The province has offered assistance to new industries by giving direct grants to companies moving into Quebec.[3] This fact contrasts with the position of the Ontario government. According to Mr. P. A. York, Executive Director of the Trade and Industry Division of Ontario, the Ontario government has never aided the petrochemical industries in the Chemical Valley by direct grants of any kind. The province of Quebec hopes to entice new industries, particularly petrochemicals, with this type of financial incentive.

A growing auto complex in the Montreal area will also aid the petrochemical industry there. When General Motor's first car rolled off the assembly line at St. Therese, a Montreal suburb, a boost was provided for the Montreal chemical industry. There was an increased demand for tires and a wide range of uses for plastics. Goodyear of Valleyfield, Firestone in Holiette and Dominion Rubber in St. Jean--all located near Montreal--are important tire manufacturers in Quebec. Increased tire production means carbon black consumption and since carbon black is a low cost commodity not economic to ship long distances, this could mean that it would be made locally.[4] Phillips Petroleum's affiliate Pacific Petroleum is considering building a facility for this purpose in the area.

At the present time, Shell, Gulf, Imperial Oil, Canadian Petrofina, Union Carbide, and Shawinigan Chemicals have the leading chemical/petro-chemical facilities in the Montreal area. British Petroleum and Texaco may soon enter the field of petrochemical production. Unquestionably, this complex will become Sarnia's major domestic competitor.

Edmonton, Alberta is the site of a major western chemical complex. This area has all the raw materials needed for such an industry. Alberta has over 80 percent of Canada's oil and natural gas, also salt, limestone, silica sand and adequate processing water near the major commercial centers. Because of its vast oil reserves, Alberta has often been compared to Texas and in Texas the petrochemical industry followed the oil industry.

However, Texas and Alberta are different in numerous ways. Alberta does not have easy access to an ocean and its associated inexpensive transportation costs. At present there are no large domestic markets in the area although forecasts regarding the growth of the western market are very encouraging for Edmonton. There are no large concentrations of industry to provide a market for chemical intermediates.

Despite these problems the Alberta petrochemical industry looks forward to expansion. Growth of the western markets, particularly British Columbia, appears favorable. The refineries in the Edmonton area, Gulf, Imperial Oil, and Texaco have plans to expand their refining capacity. This will increase the amount of feedstocks available to a growing petrochemical complex.

The list of chemical companies in Edmonton's "chemical row" is impressive: Canadian Industries Limited--polyethylene; Naugatuck Chemicals--agricultural chemicals; Alberta Polytube Limited--plastic pipes; Polychemical Industries--plastic products; Northwest Polyrama Limited--plastic products; Canadian Marietta Limited and Monsanto Chemicals--phenolic and urea formaldehyde resins; Dymer Plastics--plastic foam insulation; Marpak Industries--plastic bottles; Isothane Industries Limited--synthetic caulking and elastomer compounds; and Canadian Chemical Company--an extensive array of petrochemicals.[5] Add to the list the companies located in Fort Saskatchewan, only ten miles from Edmonton, and the chemical complex becomes all the more impressive. Major concerns in Fork Saskatchewan are Sheritt-Gordon Mines, Dow Chemical and Inland Chemicals Limited. Altogether these concerns comprise a large and diversified petrochemical industry.

For the major chemical producers in the "row," access to cheap natural gas and refinery light ends was the prime reason for locating in the Edmonton area. The complex at the present time markets most of its production abroad. Canadian Chemicals Company, the largest manufacturer of chemicals in Alberta, exports over 70 percent of its products overseas--most of it to Latin America. Low tariffs on textile goods coming into Canada have tended to curtail production of synthetic fibres by Canadian Chemical which is opposed to the Canadian government's position of low tariffs on almost everything.

One of the bright spots in market development for this western complex has been the unprecedented domestic and foreign demand for chemical fertilizer. Access to cheap natural gas has meant that these

industries have ideal conditions of cheap local raw materials and a growing domestic demand for fertilizer. The American mid-west market offers unique opportunities for the Edmonton complex. Chemical fertilizers can enter the United States with no duty problems and Edmonton, with its extensive reserves of natural gas available for processing into nitrogen and ammonia, seems ready to take advantage of this market opportunity.

In the final analysis, it appears that just as the Edmonton site will have no difficulty penetrating the eastern markets of Canada--due to the freight rate differential on raw materials as compared to manufactured products--so too will Sarnia have problems when and if the Chemical Valley manufacturers attempt to market products in western Canada. If Edmonton cannot claim to be Canada's premier chemical complex, it can surely call itself western Canada's most important chemical complex.

The third area that could have an impact on Sarnia is the growing chemical complex at Point Tupper, Nova Scotia. The basis of a petrochemical complex has been established by the building of a fifty million dollar oil refinery there by Gulf Oil. To assist Gulf, Devco--a Crown Corporation financed by both the federal and Nova Scotian provincial governments--gave a four and one-half million dollar grant to help defray the costs of a deep water dock adjacent to the Gulf refinery at Point Tupper. The Atlantic Development Board agreed to pay half the cost of rail and road facilities in the immediate area. In addition, the Area Development Agency of the Canadian Federal Department of Industry agreed to a five million dollar grant to Gulf for establishing industry in a depressed area.[6]

Point Tupper is considered one of the best deep water ports on the east coast of North America. Giant oil supertankers can move up the Strait of Canso's 120 foot deep channel right to the dock facilities of Gulf. These tankers are capable of carrying 2.2 million barrels of crude oil and Point Tupper has the facilities to handle this huge amount. At present, Point Tupper has eight crude oil storage tanks, each with a 450,000 barrel capacity.[7] These storage tanks are reported to be the largest ever built in Canada; other smaller tanks are under construction. Gulf expects satellite petrochemical plants to locate here since they would have ready access to naptha or light end feedstocks.

In addition to the accessibility of hydrocarbon feedstocks, surveys have indicated that there is an abundance of salt in the immediate area. Dow Chemical and C.I.L.--through its subsidiary Dew Mining --have acquired rights to land near the Gulf refinery. This could mean that they intend to take advantage of the availability of salt and nearby hydrocarbon feedstocks to build what Gulf hopes would be the beginning of a major petrochemical center.

To add to the attractiveness of the Point Tupper site, the Mobil Oil Company and Texas Eastern Oil recently found significant flows of gas on Sable Island, off the coast of Nova Scotia.[8] If Point Tupper had access to this natural gas--Mobil indicates the flow could be up to 10.6 million cubic feet per day--this area could compete with the Gulf Coast area of the United States as a low cost supplier of petrochemicals in export markets.[9] Although they would possibly concede the domestic market to Sarnia and Montreal, however, with a tax break from Ottawa and

Halifax this complex will challenge both Sarnia and Montreal for the overseas market.

Supplementing the other advantages offered by Point Tupper, the complex is well supplied with power to operate its chemical processes. Canadian General Electric recently completed construction of a heavy water power plant there. The Nova Scotia Power Commission has also constructed a power plant in the area and this thermal plant will receive its raw operating material from Gulf. This is the first example of integration in the area.

The future of this new chemical complex seems assured. With the support of Ottawa and Halifax, investment in the area has topped $130 million. There is every reason to believe that new and more diverse production will soon occur here. Gypsum deposits have been located near the Strait, resulting in the construction of a gypsum wallboard company in Point Tupper. The chemical industry might very well convert the calcium sulfate to sulfuric acid or possibly sulfur. Here then is another opportunity for chemical diversification.

Though Point Tupper at present represents no immediate challenge to the Sarnia chemical industry, companies in Sarnia should project themselves a few years in the future when they consider extended building for overseas marketing. Every indication is that within a few years Nova Scotia's peninsular extension into the Atlantic may finally give it an advantage over the interior complexes of the heartland of Canada.

Today, however, Sarnia is still the premier chemical complex of Canada. There are plans for new and dramatic expansions of the facilities of the Chemical Valley. Under the leadership of Imperial Oil,

Polymer Corporation and Dow Chemical, there is little reason to doubt that this center will remain Canada's premier chemical complex. Markets of Southern Ontario and pipelines to great reserves of oil and natural gas are here. Despite the evolution of regional petrochemical industries, Sarnia will retain its control of the vast markets of Ontario and will remain competitive in some of the chemical markets in the American mid-west. For these reasons Sarnia will remain "king of chemicals" in Canada.

## Footnotes

[1]"Montreal Set for Big Scale Petrochemicals," Canadian Chemical Processing, 25 (March, 1968), 46.

[2]"Turning Out the Basics at Varennes," Canadian Chemical Processing, 47 (July, 1963), 65.

[3]"Montreal: Firmly Based on Chemicals," Canadian Chemical Processing, 50 (October, 1966), 77.

[4]Ibid., 78.

[5]Istvanffy, D. I., A History of Alberta's Petrochemical Industry (Edmonton, Alberta: Department of Industry and Development), p. 33.

[6]"Chemicals Loom Large in Nova Scotia Projects," Canadian Chemical Processing, 52 (July, 1968), 37.

[7]"Nova Scotia--Recent Industrial Developments," Chemistry in Canada, 21 (November, 1969), 24.

[8]"Mobil, Texas Eastern Find Oil and Gas Off Coast of Nova Scotia," The Wall Street Journal, October 8, 1971, p. 2.

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