Imperial Oil

REVIEW

JUNE, 1946
Canada seeks her oil reserves

Increasing demand and decreasing production are inspiring the nation's greatest search for oil, an essential commodity.

Canada is an oil-hungry nation; she produces only about 15 per cent of her requirements of crude oil, and she has less than one-tenth of one per cent of the world's proven reserves. Canada's reserves are chiefly in two fields: Norman Wells in the Northwest Territories, and Turner Valley in Alberta. Norman Wells is so remotely situated that it is not economically sound to transport the crude southward to our larger concentrations of population unless greater reserves are created. Turner Valley is deficient; it reached its maximum crude production of 28,410 barrels per day in February, 1942, and has since dropped to around 20,000 barrels per day.

Emphasizing this rather barren domestic situation, Canada, with her modern and progressive industries and her high standard of living, is a great user of oil. On a per capita basis Canadians use more petroleum than any other people in the world except the citizens of the United States. For her supplies, therefore, Canada must turn to foreign fields and, inevitably, she must add the cost of transportation to the final cost of her petroleum products.

Men "pulling pipe" at Norman Wells, North West Territories, where Imperial developed Canada's second largest oil reserve.

Fortunately much of Canada's demand can be supplied by water from South America and from the United States. Some American crude can be brought in by pipe line, as is done at Sarnia in Ontario. Boat and pipe line are the two cheapest forms of oil transportation, and Imperial is able to take care of about 80 per cent of its needs by these means.

The remaining 20 per cent, however, is required for the inland Regina and Calgary refineries, where it must be delivered from local producing fields or else moved long distances by rail at high cost. There is, of course, the alternative of supplying the prairies with water-borne crude by rail from Churchill on Hudson's Bay, or from Vancouver, but costs would probably be higher than from the United States sources in the case of Vancouver and the difficulties of the Churchill route are well known.

Transportation costs on crude oil which is brought to the prairies are an important factor in the ultimate price of products.

Prior to 1936 crude oil production from Turner Valley was negligible and most of the crude used in the refineries in Alberta and Saskatchewan was imported from fields in the United States—the greater percentage of these imports being from the nearby "Cutbank" field in Montana. The price of gasoline was governed by the cost at the well of this imported crude, plus the cost of transportation. In 1936 the tank wagon price of gasoline—the price to the dealer—was 21.5c at Calgary and 22c at Regina.

By early 1937 Turner Valley was producing enough crude oil to displace, to some extent, imported crude in Alberta refineries, and by the end of 1937 was starting to displace imported crude in Saskatchewan as well. As a result, at the close of 1937 tank wagon prices had dropped to 17.5c at Calgary and 20.5c at Regina.

Alberta crude oil production rose steadily, and gasoline prices kept dropping accordingly. By 1941 Alberta crude had displaced imported crude entirely in both Alberta and Saskatchewan and, at the close of that year, tank wagon prices were 16c at Calgary and 18c at Regina.

1941 was the only year, however, that Alberta crude supplied the total requirements of both Alberta and Saskatchewan for, due to wartime demands, the prairies' need for petroleum products rose steadily—the demand in 1942 was almost three times as great as in 1936. Despite the fact that Alberta reached its peak of production in 1942 Saskatchewan imported more than one million barrels of oil in that year. The demand kept rising, but in 1943, Alberta production started to drop off and the result was that more and more oil was imported into Saskatchewan until, in 1945, imports totalled more than five million barrels.

To secure oil for their war effort, the companies had to go farther and farther into the United States, for the Montana fields were now able to supply but a fraction of the requirements. This meant much heavier transportation costs. In some cases as much as $1.95 per barrel was paid in transportation costs alone on oil imported into Regina.

Ordinarily this large-scale resumption of imports would have meant that the price of gasoline would rise in Saskatchewan, but Canada was at war, and price ceilings had been set. To hold the price, the Dominion government paid subsidies to the refineries in Saskatchewan to help cover the increased cost of importing crude oil. Without these subsidies the price ceiling could not have been maintained.

Now, the war emergency being ended, the government has reduced the subsidy on imported crude oil with the result that the cost has been increased by 4½c per barrel. A corresponding increase in the price of Alberta crude oil has been allowed to maintain the status quo.
In spite of greatly increased efforts by many companies to find more oil in Alberta, the production is dropping off, and as a result, the producing costs are rising. Production in 1945 was 7,642,000 barrels compared to 10,157,398 barrels in 1942—a drop of 2,514,498 barrels—and it is of urgent importance that more oil be found. The cost of exploration and drilling is very heavy. In the plains area there are few outcroppings of rock to guide the geologist and consequently costly geophysical methods must be used; in the foothills the formations that may contain oil are deeply buried, more than two miles down in some cases, and drilling is unusually difficult because of the nature of the rocks that must be penetrated.

A striking, if somewhat exaggerated, example of the effect of the discovery of an adequate local crude supply occurred when oil was found at Fort Norman. Production was obtained from three wells near the banks of the Mackenzie river following the original discovery in 1919. A small skimming plant was built to produce gasoline for the benefit of the few fishermen and trappers in the area. As a result the price of gasoline dropped from $2.50 to 50¢ and more recently to 30¢ per gallon. Of course the distances, figures, and types of transportation involved are not applicable to the whole of Canada, but the principal is the same.

It might be thought that we should make the best of an unfortunate situation and find consolation in the fact that at least oil is available to us on the prairies from United States sources. Oil fields, however, are diminishing assets; once the oil has been taken out of the ground it is not replaced. During the war the oil industry in the United States made a tremendous effort in supplying the needs of victory. In 1945 world production of petroleum amounted to two and three-quarter billion barrels, and of this amount the United States supplied 64 per cent. The United States, as a measure of self-protection, must exercise some caution with regard to her remaining reserves. By the same token it behoves Canada to pursue the search for oil with added vigor.

Of course there is the possibility that synthetic processes may come to our aid. There is the Fischer-Tropsch process which was used by the Germans to convert coal into petroleum products and which may be used to convert natural gas into gasoline and other products. This process is still largely in the experimental stage on this continent, and its utility will only be determined on a cost basis. If the cost of synthetic production is greater than the cost of production from crude transported to the prairies, it certainly will not be utilized. Imperial Oil is aware of the possibilities which lie in this process and future decisions must be governed by the economic factors involved. A round figure estimate of the cost of a Fischer-Tropsch unit of reasonable size in the United States has been placed at $25,000,000.

The vast reserves of oil in the Athabaska tar sands might also be made available. Again the cost factor is, meanwhile, indefinite and may be prohibitive, as any presently known methods of recovering oil from these sands appears to be more, and not less, costly than crude from other sources.

Despite this present rather gloomy picture the prairies, which are today at an economic disadvantage in regard to oil supply, give some indication that they may, ultimately, develop into one of the world's great oil producing areas. The petroleum industry, as a whole, is today engaged upon the greatest search for oil in Canada that our nation has ever seen and has concentrated on the western plains. Imperial Oil has pioneered this search and is still taking a leading part.

Much has been learned about oil exploration on the prairies since Imperial's first well was drilled in 1917 near Conklin, Alberta, on the Alberta Great Waterways Railway. Imperial Oil's first large exploration program was inaugurated in 1919, when some 12 geological parties were dispatched to various parts of the western provinces. Since that time exploratory drilling, geological surveys and geophysical surveys have been carried on with varying degrees of success. The Company was, of course, active in the original exploration and development of Turner Valley, and was entirely responsible for the development of Norsem Wells, Canada's second largest reserve. The Company has discovered or assisted in the discovery of various other oil and gas fields. This has involved the expenditure of truly vast amounts of time, money, and labor, but at the same time, from an exploratory viewpoint, we must regard Western Canada as a relatively untested area. This may come as a surprise to some, but man's knowledge of what lies beneath the surface of the earth is gained slowly. Oil is found in areas where...
sedimentary deposits were laid down in ancient seas. Such deposits lie in varying thicknesses from the Rockies far out across the prairies, and from the prairie-U.S. border to the Arctic. In the Rockies they run to a depth of 10 miles or more and, generally speaking, taper off to more shallow depths eastward.

In spite of aerial photography, the study of outcroppings of rock and of sub-surface contours, examination of surface seepages and other geological data in this vast area, it is still necessary to drill, for only by drilling do we get a final test, which may or may not confirm the geologist’s hopes. However, earthquake clocks are often called “earthquake detectors.”


dynamite explosions cause vibrations which are reflected on sub-surface structures. Shown here is the seismograph record.

from a careful examination of cuttings obtained by drilling, first at one location and then another, it is becoming possible to piece together a pattern of the sub-surface geology which may lead to the discovery of oil. It is a rather remarkable fact that, of approximately 1,000 holes drilled in western Canada to date, those fortunate enough to have been drilled deep enough to test all the possibilities of the sedimentary deposits we need not, therefore, be disappointed if there appear to be relatively few tangible results from western exploration up to the present time.

Geologically the west might be compared to some of the United States areas which have been partly responsible for supplying its crude during recent years. It is similar in structure and oil bearing possibilities to a great section of the United States lying immediately to the south—the states of Montana, Wyoming, North Dakota, South Dakota, Colorado, Iowa and Nebraska. In those states about ten times as many holes have been drilled as in Canada, and the ultimate yield is estimated at about one or one-half billion barrels.

The future of oil exploration in western Canada is bright. This, coupled with the national need for greater petroleum reserves, justifies the large expenditures Imperial has been making to develop Canada’s oil resources. This high cost of exploration is often overlooked. Geological or geophysical surveys, and occasionally both, represent a considerable outlay before a location is even made. Drilling equipment, to penetrate to the increasingly greater depths to which exploration must be carried, is expensive. The dry hole which Imperial drills is on the average, testing formations to a depth of 12,155 feet, cost in the neighborhood of $300,000. In Turner Valley, where producing depths are from 7,000 to 9,000 feet, it costs a minimum of $150,000 to drill a well and there are many producing wells in the Valley which will never repay their original costs to their owners.

From 1939 to the end of 1945 Imperial has spent in exploration in round figures, a total of $4,800,000 in Alberta, $3,800,000 in Saskatchewan and, exclusive of the Canal project, $2,500,000 in the Northwest Territories. In consideration of the risks involved the rewards have indeed been small. Oil development, if it is to be done on a continuing basis and if workers and all others concerned are to be treated fairly, requires the adequate financial reserves of a strong and healthy business. The Company plans to continue its efforts to develop Canada’s latent oil resources on a national scale; in fact, as an integral part of the Canadian oil industry. Imperial Oil considers this development work as an obligation which, with the nation’s welfare at stake, it cannot ignore.

No review of Canada’s search for oil, particularly during the war years, would be complete without reference to the Canal project. This was entirely a wartime development and any criticism of its utility can be met by the reminder that the North American continent, at the time of its inception, stood in dire peril from the Japanese entrenched in the Aleutians. Had they succeeded in bringing up greater reinforcements, Canal might have powered the defence line against invasion. His contribution to the operation of the Alcan highway, the fueling of bombers being flown to Russia and other military developments in the Pacific Northwest was a vital one.

The threat of Japanese interference with the tanker movements to Alaska, coupled with scarcity of Allied tanker transport, led United States military authorities to seek a source of petroleum closer to the zone of actual combat. The explorer Steffenson was called to Washington as a consultant in Arctic conditions, and he drew attention to the small oil field developed by Imperial at Norman Wells. Officials of the Company were asked to co-operate and they agreed that a vigorous drilling campaign could probably bring production of the field up to 3,000 barrels a day. About May 1, 1942, the Canal project was begun with this objective. Imperial being in charge of drilling and oil production. Drilling began on July 4, 1942, and in that year 16 wells were completed, two of which failed to find oil in commercial quantities. When, on March 8, 1945, the order was given to halt operations, 67 wells had been drilled. Of those 60 were commercially productive and seven were classed as dry holes.

Four of the dry holes might be considered as wildcats for they were drilled some distance from the productive area in an attempt to extend the field. During the last six months of operation the field produced at the rate of more than 4,000 barrels per day.

This is a preliminary to shooting a well in the oil field. A fine cement-sand mixture is being injected into the shot which will be lowered into the drill hole. When the shot is exploded, the deep rock formation will be loosened to clear a passage for the ready flow of the oil reserves.

DO YOU KNOW OILMEN’S TALK?

It’s a long time and a far cry from the days when a few enthusiasts first decided to dig for oil in North America, to the highly efficient drilling operations of modern oilfields. During the intervening years the oil business has developed a special language all its own. Some general terms have specialized meanings to oilmen. Others that began as slang expressions have been so used and seriously in dignified government reports and appear in scientific dictionaries. Here is a set of 20 questions designed to test the oilfield vocabulary of discoverers. To get it right in less than 20 seconds or more is an excellent score and to get all right proves you know your derricks. How many of these terms can you define?

1. Blind trips 11. Derrick
2. Rotary fish tail bit 12. Hard rock rotary bit
3. Tool jumper 13. Christmas tree
4. Cat driver 14. Rotary drilling mud
5. Canned mud 15. Slime shaker
6. Lead long man 16. Lag
7. Back up tong 17. Derrick man
8. Speed in 18. Work tour
10. Fat hole 20. Draw works

Answers on page 11.

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ANSWERS TO DRILLING QUIZ ON PAGE 6

1. In rotary drilling the entire operation of pulling a worn bit out, replacing it and running back to bottom of the well is called a "bundled trip." 2. The rotary felt ball tip is shaped like the ball of a fish and used in very soft formation drilling.

3. A "cat driver" is a supervisor of driller on all three shifts for one or more wells.

4. "Cat driver" is slang for the driver of a caterpillar tractor in an oilfield.

5. The opposite on a drilling rig is somewhat similar to a captain on a ship. Rope rolled on the outboard is used for enabling, lifting and various other purposes. The operator is known as the "cat driver." 6. The operator of tong or giant wrenches which tightens or loosens the drill stem is known as the "tong man." 7. The tong or wrench which holds or grips the opposite direction from the lead tong is called a "hick-up tong." 8. The term "spud" is used to start drilling an oil well.

9. The term "bug" designates a piece of steel about 4 inches square and 16 feet long which passes through a square or hexagonal hole in the rotary table of a drilling unit. The design permits it to drive the drill pipe and bit and down the bit as the drill head goes into the ground. 10. The "cat hole" is a sloping hole where the "bowl" is placed when removing the drill pipe to change bits.

11. A derrick is a square open tower, usually built of steel, which stands on the well and is being drilled. The tower tapers toward the top and varies in height from 140 to 180 feet. Imperial Oil is believed to have introduced the first steel derrick in Canada in 1919. Prior to that derricks were built of wood.

12. A hard rock rotary bit contains mounted polished gears about four inches in diameter. Each gear rotates on its own axis. The teeth of the gears are hard and sharp and cut the formation being drilled.

13. "Christmas tree" is a combination of pipes and valves placed on top of the casing head to regulate the flow of oil or gas from a well.

14. Rotary drilling mud is a carefully prepared mixture of water and clay which is pumped into the hole to cool the bit and remove the cuttings. It is circulated continuously.

15. A "shale shaker" is a constantly moving sieve over which the circulating mud passes leaving the cuttings. These cuttings are examined for fossils and identify the formation being penetrated.

16. "Rig" is the general term used to refer to the derrick and drilling machinery on an oil well.

17. The man who stands on a platform about 100 feet above the ground is known as a "derrick man." He handles the length of drill pipe in the derrick when the bit is coming out or going into the hole.

18. "Wrench" or "wre" means to work on shift. There are three eight-hour shifts per 24-hour day.

19. "Boulevard" is an all inclusive term used to describe all drilling personal with the exception of the driller. It is used more particularly in rotary drilling. 20. The "draw works" are the engine and device which operate the cable drum; these draw up the drill pipe from the hole.

SOUTH AMERICAN ACHIEVEMENT

IN FACE OF CRITICAL MATERIAL SHORTAGES INTERNATIONAL PETROLEUM CO. SET NEW PRODUCTION FIGURES WHEN WAR NEEDS WORE URGENT

FOUR miles from Talara, Peru, there stands a great air base. Built in 1942 by the U.S. Army, it is a monument to the vital part Talara refinery and the International Petroleum Co., Ltd., played in the war against the Japanese.

The base was built to provide aircraft protection for the east coast of South America and to guard tankers carrying gasoline and kerosene from Talara to the Pacific war theatres. During the war the tankers carried more than 400,000,000 gallons of refined products from the refinery to the Pacific theatre.

International Petroleum was awarded the U.S. Navy Certificate of Achievement in 1945. In the letter advising of this award, the navy said that it was being made in recognition of "the splendid efforts put forth by the men and women of that organization in support of the war production program." In addition to this award, International received those letters of appreciation from the U.S. Army and the U.S. Navy.

The impact of war made great changes in International's Peruvian activities. The Company's prewar operations were carried. Prior to the war its oil fields exported crude to other South American countries and to North America, while the refinery at Talara supplied fuel and lubricants to the motor vehicles, farms and industries of Peru and other South and Central American countries. The main industries in Peru are the mines, with the copper mines of Cerro de Pasco and the copper mines of the Canadian Corp. Two of the most important. In recent years mechanization of farming has made great strides in Peru, and farms have become an important market for the refinery's products. The extensive highway program started in 1930 by the Peruvian government has resulted in a tremendous increase in the use of motor vehicles. Sales of motor gasoline in 1946, the first war year, totaled 45 million gallons, an increase of 57.1% over sales in 1936 when the highway program was started.

During the war Talara refinery, soon here from the air, doubled normal production to keep lighting oil to the Pacific theatre.
International's producing and refining operations centre around the town of Talara, Peru. The refinery is situated on Talara Bay, and the oil fields surround it on three sides, stretching inland a distance of ten miles. Gathering lines carry the oil to a tank farm, and from there the crude flows by gravity through feeder lines to the refinery.

In its marketing operation the Company ships its refined products by tankers to main bulk points along the Peruvian and Chilean coasts. From these points the fuel and lubricants are taken by railway tank cars to future bulk stations and then by tank truck to the customer.

The outlook for war altered this picture. Under lend-lease arrangements tankers started carrying millions of gallons of motor gasoline and kerosene from Talara to Australia and New Zealand. The great mines were now working at full capacity to supply the mills of the United States and with this increased activity came a raising demand for petroleum products. The shipping shortage had made transportation of bunker fuel from Californian refineries to Chile a critical problem, and the Company undertook to supply quantities of fuel oil to the South American tankering ports.

To accommodate these demands International’s operations changed drastically. No more crude oil was exported. The entire crude oil production of the International field went to the refinery and even this was not enough. More crude had to be secured by purchase from Lobitos Oilfields Ltd. to the north.

The refinery, by changing its processing procedures, increased its output from 19,000 barrels a day—its normal production—to more than 38,000 barrels per day by 1943.

It is fortunate that oil refineries are flexible. If increasing production had meant the building of new units it would have been impossible to refine more oil. New units take time and war demands and the shipping shortage had combined to shut off all but a trickle of oil supplies from the United States to South America. However, by dismantling its cracker operation and by using the cracking rolls as topping units, the refinery was able to skim off the gasoline and kerosene fractions from the crude oil, leaving the rest as fuel oil to supply the increased demand.

On paper such a change in refinery operation sounds simple—but doubling refinery output isn’t done quite that easily. The change-over was accompanied by plenty of headaches. Changes in refinery processing were unaccompanied by a thousand and one operation problems, and Talara’s process control engineers bartered the midnight oil solving them. Adding to their troubles were production specification changes to fill changing allied war needs. Each specification change meant a change in processing, and International personnel are justly proud of the fact that there was no specification demand made which they were unable to meet.

The increased demand brought even greater head-aches to the oil field engineers. The same situation existed with regard to steel for drilling equipment as with the refinery—none was available. But where refinery production could be increased without steel for new units, drilling wells takes steel—lots of it. In drilling the average well in Peru thirty-four and one half tons of steel casing alone are used.

Necessity is said to be the mother of invention, and faced with the necessity of increasing crude production to feed the refinery the engineers got together to figure out how to drill wells without any new steel. They found their answer in the old wells drilled many years before the war.

These wells had been producing for many years. In recent years their flow had been declining, and under normal conditions in a few more years they would have been abandoned. Production would have dropped off to the point where it would have been uneconomical to continue pumping. Each well contained steel casing, and some which had been drilled by the old cable tool method were little “gold mines” of steel, for cable tool drilling uses much more steel casing than does the modern rotary method.

The engineers decided to abandon these old wells and to pull out the casing. This decision was not made without some misgivings, for rapping the old wells prematurely was not in line with normal efficient practice. But more oil had to be produced—new wells had to be drilled—and the old wells were sacrificed.

In all, more than 125,000 feet of steel casing was pulled from the old wells, and with their casing worry solved the engineers were able to embark freely on a large scale drilling program. The success of this pro-

These geological assistants are studying fossils found in rocks brought to the surface while drilling. The fossils indicate the types of formations being penetrated by the drill.

During the war new steel was available, and the machine shop and foundry helped keep the drills operating by re-building equipment and making new parts from scrap steel.

NAVY MARINE

During the war the enemy was not content with our offensive strength. They raised a submarine fleet to make war on the United States and its allies in the Pacific theater.

International Petroleum maintains a modern hospital at Talara. During construction of the Talara air base the Company provided medical aid for the U.S. Army personnel.
IMPERIAL ANNOUNCES SCHOLARSHIP PLAN

IN THE scholarship plan announced last month Imperial Oil has added to its list of employee benefits something which has long been hoped for by its directing officers. The new plan is twofold: through undergraduate scholarships it will enable gifted children and wards of Imperial Oil employees and annuitants to obtain higher education and, through post-graduate fellowships, it will promote the development of knowledge and new techniques in the chemical, engineering and geological fields.

It will undoubtedly also bring opportunity to many gifted young men and women who might not otherwise have been able to put their talents to the best use through lack of advanced education. As such it is an investment in the future of Canada and Newfoundland.

The plan provides for the establishment of 11 undergraduate scholarships, at $500 per annum each, to be awarded to children or wards of Imperial Oil employees for study of any regular subject leading to graduation at any recognized university in Canada. The scholarships may be held for four years.

In addition there are four Imperial Oil graduate research fellowships, open to graduates of Canadian universities. The fellowships are valued at $1,000 a year each and may be held for three years. They are awarded for research in petroleum engineering, petroleum geology, chemistry and/or chemical engineering, and mechanical engineering. Children or wards of employees or annuitants of Imperial Oil Ltd. and its Canadian subsidiaries, who are members of senior classes in secondary schools or their educational equivalent are eligible for the scholarships. Applicants may also be children or wards of employees who died while in the employ of the Company or its Canadian subsidiaries, and children and wards of deceased annuitants. The employee must have had not less than one year's service with the Company.

One scholarship will be granted yearly to qualified students in each of the provinces of Manitoba, Saskatchewan and British Columbia. Two scholarships will be awarded annually in each of the following areas: (1) the Maritimes provinces and Newfoundland; (2) Alberta, the Yukon Territory and the Northwest Territories; (3) the province of Quebec; and (4) the province of Ontario.

Selection of scholarship winners will be made by a selection committee appointed by the directors of the Company. Besides scholastic standing the committee will consider aptitude, character and other relevant circumstances in making the award.

Created to promote and encourage academic research in technical phases of the petroleum industry, and to encourage public interest in scientific advancement the four fellowships are offered for post-graduate work leading to a master's or doctor of philosophy degree.

Applicants will be nominated by the university and selection made by a fellowship selection committee composed of three members appointed by the National Conference of Canadian Universities and two members appointed by Imperial Oil.

Fellowship winners may indicate the university or universities they wish to attend and the choice is not confined to Canadian universities, but is subject to the approval of the fellowship selection committee. The subject of research in the field for which the fellowship is awarded will be arranged by the holder of the fellowship with the university involved.

The plan is a continuation of the policy which has already provided employees with pension, annuity, group insurance and hospitalization plans, and sickness and death benefits. Even as these have helped to bring a higher standard of living, the twofold plan will help to promote a higher level of education and scientific development in Canada and Newfoundland.
OUR FORESTS SPEED RECONVERSION

CANADA'S LUMBER INDUSTRY, ONE OF THE WORLD'S GREATEST, PROVIDES GAINFUL EMPLOYMENT AND A HOST OF USEFUL PRODUCTS

Deep in the forest, we may find today the men who are the foresters, engaged in Canada's second largest industry, whose forest products are the raw materials for items in short supply in almost every Canadian home.

That lumbering is important to Canadians may be indicated by the fact that in 1941 the net value of forest products was roughly $37,000,000. Almost a quarter of a million persons were employed in forest industries that year.

Forest products have many uses. Wood is needed to build homes. It is needed for fuel. It is needed to produce a host of useful articles such as furniture. Farm implements, household necessities. Many useful plastics are now being made from wood; fabrics, such as rayon, are also made from wood fibre. Paper manufacturing from wood pulp is one of Canada's most important industries. Explosives and aircraft bodies which helped win the war were made from wood.

Of all the land areas of our nine provinces 18 per cent is forested; of this 275,000,000 acres are productive. Few of these productive areas are more interesting than the primeval forests of British Columbia's Vancouver Island, so let us visit in person one of the lumber camps there.

We travel from the mainland by boat, then by automobile, gaso-line speeder and truck. Lumbering, we soon find, is a mechanized industry.

Our first sight of the logging camp is somewhat of a surprise, for it has little in common with the lonely rows of bunkhouses we had often heard about. This is a busy community, with many city conveniences. The trend here is away from casual employment.

There is good housing, recreation, schools, electric light, running water; a diesel engine provides current for radios, refrigerators and appliances.

The camp is what is known as a railroad logging camp. Standard gauge tracks radiate out through the timber limits, which are considered sufficient for 40 years' logging. Gner drive locomotives haul tremendous loads of logs over these tracks, and gasoline speeders scatter through the forest bearing groups of loggers to their tasks.

After a six o'clock breakfast, with lunch-pails in hand, we board one of these speeders for the seven-mile trip to the logging operation. With us there is another visitor— an Imperial Oil industrial engineer. Petroleum plays a large part in the logging industry. It provides light oils for power saws, heavy oils for steam locomotives, diesel oil for stationary power units, gasoline and gaso-line for trucks. The industrial engineer, who studies performance and problems in the forest, is the field arm of the research laboratories which have produced the products best suited to the needs of lumbermen for generations.

As the speeder whizzes along the route we see, conspicuously placed at frequent intervals, portable fire fighting equipment. It is in units which may be strapped on men's backs and packed into the forest, and it consists of light canvas hose, a small gasoline motor, and "tank" or ball. With this equipment water may be drawn to quench fires.

At our destination the men jump from the speeder and waste no time in getting to work. The first operation we see is in the felling of the giant tree. Gasoline power saws that look like outboard motors topple the trunks in short order. These saws drive circular chains which look much like the drive chain on a bicycle, except for the addition of large teeth to each link. Soon the age-old cry of "timber" is heard.

As soon as the tree is felled it is cut into 24 or 48-foot lengths. Man-powered buzzsaws do this work, and it is a job that calls for stamina and endurance.

These logs, familiarly known to lumbermen as falling and bucking, prepare the logs for their journey to the mill. Next comes the exciting job of actually moving them. This is usually done by a "travelling block", which travels as much as a half mile along an aerial cable. This apparatus takes some preparation.

First a giant fit, towering perhaps a hundred feet in the air, is "tipped" so that it stands straight and naked of its branches. This operation is spectacular.
and still holds an element of danger, and is now performed only on the trees used in moving the logs.

Men now fix a steel cable and pulley to the top of the tree. The other end of the cable is fixed to the lower part of a tree half a mile away where the logs are lying. The "travelling block" has several dangling ends of steel rope, and these are fastened about the logs by men who are known in the industry as hand chokers. Sometimes as many as four logs, each weighing many tons, are tied to a single travelling block. As soon as the hand chokers finish their work, a donkey engine at the other end of the cable pulls the travelling block along its aerial steel rope to the point where trucks wait to carry the logs to the sea.

Here again we glimpse the immensity of this logging operation. So that the trucks may get into the deep forest, in good weather and bad, roads are built. Some are built with more thought to their endurance than many a highway and there are asphalt-surfaced roads through the forest which will never serve any other purpose than to bring its products to mankind.

The huge spar tree which brought the logs out on the aerial cable now serves another purpose. Another donkey engine controls cables from which hang big tongs, similar to ice tongs. These are clipped on to the logs and they are lifted bodily on to the trucks. Occasionally it is more practical to run a railway track in, and when this is done the logs are loaded on flat cars. Sometimes, too, there is no giant fir in a convenient spot to use as a spar in lifting the logs; then a high steel tower is built.

All the equipment is built for rugged utility. The locomotives are gear-driven for greater power. The trucks are huge 18-wheel vehicles which carry 60 tons with ease. They have long trailers equipped with water-cooled hydraulic brakes. Handling them on hills calls for skill and experience, and the drivers are among the most resourceful men in the camp. When trucks are travelling empty, the donkey engine picks up the trailer and hoists it to the back of the truck, where it perchess 'pick-a-back' to save tire wear and make driving easier.

When railroad cars or trucks arrive at the salt chuck (Indian for salt water). The load is spilled into the sea. The boom hose, with its spliced pole sorts the logs to make separate booms of cedar, fir, spruce, hemlock, pine, and other woods.

The government scale checks the quantity and the logs are made into booms or Davis rafts. The ordinary boom is held together by logs chained together, in a huge oval in which the logs float freely. The Davis raft is cigar shaped and floats partially submerged. It may contain a million feet of lumber.

Such is the still picturesque, still lusty, still somewhat dangerous job of logging. We heard that this community was in a timber limit good for 40 years. What then? What if all the trees in a forest were cut? The answer is that forests, a destructible asset, are also renewable. No longer is the land mined and left with only a pile of sawdust to mark the passing of the woodman. Reforestation is being practised wherever there is large-scale logging in Canada, and the art of silviculture, which is the science of cultivating forest trees, is constantly growing.

In a railway logging camp flat cars are good to transport logs to the "salt chuck." Sharp or gear driven locomotives move the tremendous load down the steep, winding tracks.

Logging is a dangerous occupation and yet the accident record is low. Constant reminders such as this old man safety "Be careful again today" are posted throughout the camp.

Light, gasoline driven chain saws speedily fell the trees. Spars "burls" chains are sharpened and hung on a numbered rack. Each machine has a chain to fit the individual motor.

Community life in a logging camp includes a recreation hall where the latest movies are brought in. The camp once a week.
During recent months public interest has been whetted by newspaper and magazine articles about the synthesis of gasoline and oil from various raw materials, especially coal and natural gas. This is of particular interest now due to the wide circulation of rumors concerning dwindling reserves of crude petroleum in Canada and the United States.

The oil shortage scare turns up at regular intervals. In 1933 it was estimated that the petroleum reserves of the United States were less than one billion barrels. Again in 1939 the chief geologist of the U.S. Geological Survey gloomily pointed out that there was less than seven billion barrels of oil underground and that petroleum production would never meet the demand.

There have been many such forecasts, but to show how wrong they were we have only to point out that in the U.S. alone some 28 billion barrels of oil have been withdrawn from the earth and there are now proven reserves totalling another 29 billion barrels. Add to these reserves the potential production of vast areas as yet unexplored geologically and it will be apparent that there is little fear of an oil shortage for many years. It is true, however, that oil is a natural resource and a diminishing one which Mother Nature is in no hurry to replace.

There are enormous potential areas of production throughout the world, but unfortunately many of them are far removed from the areas in which petroleum products are consumed. At present these more remote areas cannot compete economically with fields nearer at hand because of the extra costs of production and transportation.

The Canadian west suffers in this respect although it is potentially a great producing area. The Turner Valley field has now passed its prime and its production is waning. Intensive exploration and drilling is being carried out over a wide area but so far the results have been very disappointing. If this should continue to be the case then the next best thing would be to cast around for some method of making fuel and lubricants from some other material which is near at hand in abundant quantities.

One such material which can be converted to gasoline and oil is natural gas and Imperial Oil has embarked upon an extensive program of exploratory drilling to locate natural gas in quantities great enough to warrant construction of a synthesis plant if synthetic production costs can be brought down to economically practical levels.

Crude petroleum is a mixture of molecules known as hydrocarbons, all of which are composed of carbon and hydrogen combined together in a multitude of arrangements. It would seem logical then that if we could replace hydrogen in the molecules of crude oil, we could make a material like crude oil and this has actually been done. Carbon occurs in many forms, in trees, diamonds, coal, sugar, natural gas, oil, grain and graphite—diamonds and graphite being pure carbon in widely different forms. Hydrogen, of course, forms the H2 in H2O which is the chemical symbol for water, as well as being chemically combined in natural gas.

To separate carbon and hydrogen in a suitable form from their source materials, and then to recombine them in the proper proportions to make a synthetic crude oil is a problem of the first magnitude. On which large sums of money have been spent in research and plant equipment. A synthesis plant makes crude oil from various raw materials and then the synthetic crude must be processed in a refinery much as natural crude oil is. Hence an extra operation, that of making the crude oil, has been added, and the greatest obstacle at present is to reduce the cost of synthesis to the point where the synthetic crude can compete economically with imported crude oil.

The synthesizing of various chemical products from coal has been an established industry for many years but it was only 30 years ago that the possibility of producing liquid hydrocarbons from coal was established by Fischer and Tropsch in Germany. When coal is heated in special retorts it is converted to coke and if steam is passed through the heated coke a chemical reaction takes place and water gas, a mixture of carbon oxide and hydrogen, is produced. Fischer and Tropsch found that by passing this gas over a catalyst (a catalyst is a substance which assists a chemical reaction without being changed itself) at certain temperatures and pressures, a liquid resembling crude oil was produced which could be separated into various portions similar to those obtained from naturally occurring crude oil.

Another process was actually adopted more widely in Germany and England for the production of motor fuels, but the Fischer-Tropsch process was used to a great extent in Germany for the synthesis of acids, alcohols, solvents, edible fats and lubricating oils. Up to the present neither England nor Germany has been able to produce a synthetic fuel at a price competitive with ordinary fuel, and heavy subsidies have been required to support the industry. A considerable amount of research is still necessary to...
To improve the process so it can compete with crude oil, Canada's west, with its apparently diminishing supplies of relatively cheap crude, may prove to have huge reserves of natural gas. That she may have is indicated by already established reserves. If an adequate supply of gas is assured and improved processing methods become available it is possible that a synthetic fuel industry may serve the West.

By the best known methods at present we can get about 4,000 gallons of gasoline from 1,000 cubic feet of natural gas. This is equivalent to about 11,000 cubic feet per barrel. It will be obvious that a plant to make, say, 5,000 barrels of gasoline a day would have to handle 55 million cubic feet of gas per day.

Two points are apparent here: first, there must be an enormous underground gas reservoir to supply such a plant for long enough to pay off the investment, and secondly a plant to handle and process such large quantities of gas must necessarily be large and complex, and may cost roughly 55 million dollars.

The Imperial Oil is engaged in discovering and evaluation of natural gas resources in Alberta against the day when it may be necessary to turn to gas synthesis as a source of fuels and lubricants for the west. It is necessary to proceed cautiously at present, since the discovery of further adequate crude oil fields in this part of the country would seriously jeopardize such a large plant investment. Rough estimates have been made of the reserves in the Viking-Kinsella area to be from 400 to 600 billion cubic feet.

Eleven wells have been drilled to date in Imperial Oil's exploration program in the Viking-Kinsella area of Alberta. These have proved up several hundred billion cubic feet of natural gas reserves, and there is every reason to believe that this may prove to be one of the largest gas reservoirs on the continent.

The gas which has been discovered is of excellent quality, containing about 90 per cent. methane. Methane, the smallest member of the hydrocarbon family, is the basic material from which the whole family, right up to wax, can be synthesized.

Natural gas emerging from the well head may contain sulphur and other impurities. It is especially necessary to remove sulphur compounds since they poison the catalyst used in later stages of the process. Therefore the natural gas is passed through a tower where the unwanted compounds are "scrubbed" out by means of chemicals.

The next step is to convert the gas into a form suitable for the synthesis reaction. This is done by passing a mixture of the gas and oxygen through a heated chamber in the synthesis gas preparation plant. This produces a mixture of carbon monoxide (CO) and hydrogen (H₂), which is the same water gas that can be made from coal as described in a previous paragraph. The oxygen used in this step is extracted from the air by a plant designed for that purpose.

The synthesis process follows next and here the carbon monoxide and hydrogen, mixed in the proper proportions, are passed through a vessel containing a catalyst which makes them join together in the right way. The temperature and pressure in this operation is carefully controlled to make the gas react more so as to produce the required material.

The products of this reaction are carbon dioxide, hydrocarbon gas and water. These are separated and the lightest ones may be returned to the beginning to go through the process again and make more synthetic crude. Water drawn off and the synthetic crude is separated into various fractions in conventional refining equipment. The heavier gas which are not of great value in their natural state, may also be put through a process whereby a very high octane fuel called polymeric gasoline is made.

The gasoline produced in the synthesis process is not of very good quality, but by further treating and adding cracked gasolene and polymer gasolene a good yield of high grade fuel is obtained. The cracked gasolene is made by subjecting some of the heavier synthetic crude oil to considerable heat and breaking down the molecule which forms it into the smaller molecules which form gasoline.

Good diesel engine fuel is obtained from the synthetic crude as well as wax which can be used for cabling, preserving, impregnating paper and so on. Unfortunately the synthetic material does not contain any lubricant oils in its normal state. However, by taking certain portions of the synthetic crude and making its molecules join together to build up big molecules we can have lubricating oils which are better in some respects than the natural ones.

This synthetic process has other unusual points too. By changing the type of catalyst used to guide the reaction, or by altering the conditions of temperature and pressure in the reactor it is possible to produce a variety of chemicals and other synthetic products. For instance soaps, alcohols, oxammoniac and edible oils can be made by chemical processing the synthetic materials.

The research programs now in progress will, no doubt, culminate in improved methods and processes which will bring out of the synthetic fuels and lubricants into line with the prices of products derived from natural crude oil. The petroleum industry is ever striving to give the consumer better products at lower prices. If conditions in the West dictate that a synthetic gasoline plant must be built to supply that area, the consumers may feel secure in the knowledge that they will not have to pay exorbitant prices for their fuels and lubricants. Indeed, that area may even profit by the establishment of new industries based upon the by-products derived from the synthesis of petroleum.

Some gas fields yield a "wet" gas which contains gases like propane, ethane and methyl methanol. These are separated and condensed to give high octane gasoline which is stored in tanks like these.
SEARCH UNENDING

A MOTION picture which takes Canadian audiences into the heart of the greatest oil search in Canada’s history is being made for Imperial Oil Ltd. and is now nearing completion. Titled “Search Unending,” the new film shows the work of the geologist and driller in their search for oil in Canada today.

In its twenty minutes “Search Unending” tells the story of the formation of petroleum, the work of the exploration crews as they search for places where oil may be found, and of the drilling of an oil well. Filmed in full color, it shows the breath-taking beauty of the rugged country in which the geologists and the drillers are operating.

The opening sequences show how oil was formed. The picture swings from illustrations of what the North American continent was like hundreds of millions of years ago when as much as half of the present land mass was covered by the sea, to pictures of marine life—the origin of oil. The picture shows how, as these marine creatures died and fell to the ocean floor, layer after layer of silt covered them; then giant upheavals tortured and twisted the earth, and the bodies gradually changed to gas and oil.

An unusual feature of the film is the microcinematography of marine life. While still photography of microscopic subjects is common, very little motion picture work—especially in color—has been done along this line, and the camera crews had little or no guide as to how it should be done. The marine microscopic sequences were taken in the laboratories of the University of British Columbia, and with the assistance of the laboratory technicians the crews finally produced some of the most unusual microscopic scenes ever filmed.

The next sequences of “Search Unending” take the audience out with exploration crews as they search the floors of the most remote areas for oil. By air, by truck, by train, canoe, automobile and on foot the survey parties explore for structures which their experience tells them may indicate oil deposits. The vital part played by aerial photography in supplementing ground exploration by mapping huge areas with the aerial camera, is shown. Seismograph and drilling crews are pictured as they follow the exploration parties to map the sub-surface strata of seamounts which the geologists have reported as showing favorable surface indications.

Next the picture shows how the geologists offer re-ordinate the findings of the field geologists. Micro-paleontologists study the rock fossils found by the core drill. Here the experience gained by the camera crew in the University of British Columbia paid dividends—for they were able to take microscopic pictures of the fossils and thus include in the film pictures of the remains of the tiny animals which lived hundreds of millions of years ago and from which oil was in part formed. The film shows how skilled technicians also study the seismograph’s record of sub-surface rock structures. With all findings assembled, the picture shows how a final report goes to those upon whom rests the decision as to whether the great expense of drilling a wildcat well is warranted.

The decision made, the drilling begins and the last portion of “Search Unending” shows this operation. Great bulldozers push roads through the wilderness to the drilling location. The drilling rig is erected, and the camera takes the audience to the drilling platform as the crew pushes the drill deep into the earth in the final test in the search for oil.

The search for oil in Canada today is a search which vitally affects every Canadian. It is costing millions of dollars but, if successful, will not only make Canada more self-sufficient but will make available even cheaper products from petroleum, and so give Canada an even higher standard of living.
REPORT TO THE SHAREHOLDERS

SOME little-known facts about Imperial Oil's operations are graphically presented on these pages in charts from the Company's annual report for 1945.

Perhaps one of the most interesting is that dealing with wholesale price index. As is well known the petroleum industry has constantly striven by scientific development to make more, more varied and better products from a given amount of crude oil. The success of this policy is reflected in a graph line that shows an almost constantly decreasing gasoline price over the years. The wholesale price index of gasoline, exclusive of taxes, has dropped to approximately three-fifths of what it was in 1926. On the other hand the general wholesale price index, which dropped sharply in the late 30's and early 30's, has risen almost steadily since and today is higher than the 1926 figure.

The average net profit per gallon for all products sold from 1931 to 1945 is also charted. A "pie" chart breaks down the Company's sales dollar for 1945. Out of each dollar received for product, 53 cents were paid out for crude oil; 12.4 cents for manufacturing and packaging; 11.2 cents for freight; 9.26 cents for marketing; 8.13 cents for taxes, and 5.05 cents profit. Stated in terms of total sales, 1,291,000,000 gallons of products were sold for $174,101,796.88. Costs totalled $168,749,509.75, leaving a total profit of $19,352,287.13.

COMPARISON OF GASOLINE WHOLESALE PRICE INDEX (WITHOUT FEDERAL AND PROVINCIAL GASOLINE TAXES) WITH GENERAL WHOLESALE PRICE INDEX

SALES RECEIPTS, COSTS AND PROFITS OF IMPERIAL OIL LIMITED
FOR THE YEAR 1945

In 1945 Imperial Oil made and sold 1,291,000,000 gallons of products (Aviation and Motor Gasolines, Kerosene, Fuel Oils, Lubricants, Greases, Waxes, Asphalts, etc.).

For these it received $174,101,796.88

The cost of the Crude Oil and other raw materials was $92,270,766.01

The cost of manufacturing and packaging was $21,589,606.46

The cost of freight was $19,037,598.17

The cost of distributing and selling was $16,128,134.04

(Salaries and wages included in the four items above totalled $19,461,484.00)

The taxes paid (sales tax, property taxes, income tax, etc.) but not including gasoline taxes which ranged from three to thirteen cents per gallon were $14,155,440.07

This made a total cost of $163,749,209.75

Leaving a profit of $10,352,287.13

A PROFIT OF 4.15 c. PER GALLON

NET EARNINGS OF IMPERIAL OIL LIMITED FROM CANADIAN MARKETING, MANUFACTURING, TRANSPORTATION AND PRODUCING OPERATIONS • 1931 TO 1945
(EXPRESSED AS CENTS PER IMPERIAL GALLON OF PRODUCTS SOLD)

IMPERIAL OIL REVIEW

JUNE • 1946
PLASTICS FROM PETROLEUM

A HOST OF PLASTICS MAY BE MADE FROM PETROLEUM, ONE OF OUR MOST USEFUL NATURAL RESOURCES.

In our ordinary everyday life we see and use various objects of beauty or utility and we note in a natural way that they are light, bright, strong and usually eminently suited to their applications. We might even identify them as being made of those new-fangled plastics that are advertised so much.

Those of us who are more curious might pull out a dictionary to find out what plastics are, and would be confronted by the following statement:

PLASTIC(S) (n.) — Literally, anything that is mouldable. Specifically, any of a large group of natural and synthetic organic materials, derived from cellulose, protein, hydrocarbons or resin, which are moulded (under heat and pressure), extruded, cast or fabricated into various shapes.

Having absorbed this information we sit back in our chair covered with a plastic fabric and turn the plastic knob on our plastic radio cabinet, watching the pointer through the plastic dial. We muse awhile about these wonderful new plastics and then do the crossword puzzle.

Plastics certainly are wonderful, but they are by no means new. Cellulose nitrate, which we know as celluloid, was first made 80 years ago and has been in commercial use for 75 years. Even today the cellulose nitrate plastics play an important part in the face of stiff competition of modern plastic materials.

About 30 years ago a Dr. Baekeland concocted a mixture of phenol (carbolic acid) and formaldehyde (a fumigant) and found he had discovered a material which had boundless possibilities. He found that this material could be formed into shape in a mould and then upon heating it a chemical change took place which made the material set hard in whatever shape it had been moulded. This material was named bakelite and we now use it in countless forms.

Chemists were intrigued by this fascinating material and embarked upon a program of research which has not yet ended. As a result of their vision and persistence, plastics now appear in every conceivable application and the new types or uses seem to be announced almost every day.

The list of plastic materials seems almost endless. There are dozens of main types, many of which are subdivided by slight changes in chemical structure into further kinds for special applications. A list of some of the main family groups includes such formidable names as phenolics, urea, melamines, celluloses, alkyds, acrylics, vinyls, poly styrenes, polystyrenes and nylons. Add to these the names of the different relatives of each group and then multiply by the trade names given each product by the various manufacturers and we would fill a book!

The petroleum industry’s entrance into the field of chemical products has been slow but certain and now petroleum promises to play an increasingly important part as a producer of plastics. Advances in petroleum technology in recent years have shown that certain chemical products can be separated or produced from petroleum more cheaply or more abundantly than by any other means.

This has been brought about indirectly by the industry’s search for improved methods for producing more and better gasoline from the same amount of crude oil. The introduction of such processes improved the quality and quantity of gasoline but at the same time introduced another problem because large quantities of gases were produced by the force action of high temperatures on the crude oil.

Many uses, however, were found for these gases.

As well as supplying us with fuels and lubricants, the oil industry is now producing to make synthetic rubber and plastics. Sarnia refinery is a source of oil chemicals.

Petroleum is composed of hydrogen and carbon, and the various products are called hydrocarbons. Some of these hydrocarbons stayed out in the heat too long and lost part of their hydrogen. These hydrocarbons interested chemists greatly for they had, so to speak, two free hands each—having let go of their hydrogen atoms. Given the right conditions these hands will grab onto any other free hands on other molecules which happen to be around until there are so many of them joined together that they become tangible substances in the form of liquids or solids.

This miraculous building of molecular dairy chains is known as polymerization. Polymerization is used in the petroleum industry to make high octane gasoline. Polymerization is also the basis of manufacture of all plastics and so when the demand for raw materials increased it was natural that the petroleum industry should step in with its supplies of useful gases.

It is in the field of plastics that the wizardry of chemists makes itself most apparent. Taking a hydrocarbon such as ethylene, which boils to a gas at 105°F. below zero, the chemist can create such conditions of temperature and pressure that the free hands of each molecule of the ethylene gas join up with free hands on other molecules until they build up enormous chains, all interlinked, and instead of a gas we have a solid material, polymerized ethylene, generally known as polyethylene or polythene. It may take as many as 30,000 ethylene molecules to make one molecule of polythene. A polythene toothbrush handle might be half a million polythene molecules thick.

This plastic is used mainly for electrical insulation but other uses include medical equipment, moulded objects, collapsible tubes, impregnating cloth and lamp shades.

The lightest member of the petroleum hydrocarbon family is methane, which is obtained from refinery gas and natural gas. By a series of steps, this gas is converted to formaldehyde and by reacting this with phenol the chemist produces the phenol-formaldehyde plastics such as the commonly-known and

Enormous quantities of synthetic rubber were made from oil during the war. Here Canadian-made rubber came from the washing and drying machine for additional processing.
widely-used bitumen. The use of these plastics are endless, ranging from bottle caps, pot handles, electrical equipment, radio cabinets, telephone switchboards, to inexpensive bonding material for the plywood glues of light boatmen.

Ethylene glycol is used as a basic material in the plastic industry. Make it come with benzene, which may be derived from petroleum, and we have started the first step of turning it into molecules in large quantity to make polyester, a glass-like substance with such good optical qualities that it is used for lenses, wires, and electrical isolation, containers for cosmetics and chemicals, and refrigeration fittings. Ethylene, made by Imperial Oil at Sarnia, and oxygen to styrene at the Polymer Corporation, will soon be used to make polystyrene plastic at a plant which is being built adjacent to the Polymer plant for the Dow Chemical Company.

Styrene, which bears the imposing chemical name of vinylidene chloride resin, is the exciting child of the rubber industry—parent, petroleum and salt. Ethylene from petroleum and chlorine from salt have united chemically to make a liquid. The molecules forming this liquid have some free ends and they can be induced to join together in various numbers to make a plastic material ranging from soft and flexible to hard and tough. It is used widely in the form of chemically resistant piping which can be threaded like ordinary steel pipe, or welded by merely warming the ends and pressing them together. Other uses include invasion by swelling, proof upholders, belts and hose connectors.

There are several other kinds of vinyl resins, besides styrene, which may be derived from ethylene in combination with other chemicals. They are used to make such articles as transparent oxygen tents, safety glass, molded objects, unbreakable records, synthetic shoes, and rubber cement.

Cellulose is the basic material in all types of vegetal industry. We form cotton or wood although some use the waste from sugar cane are also sources. Nitric acid acts with cellulose to make the eating wood. With other chemicals, which may be derived from petroleum, such as ethylene oxide and acetate, we make ethyl cellulose and cellulose acetate plastic. It is almost impossible to go through the day without touching or using some article made from these materials.

Possibly the general public is best acquainted with the use of plastic in their homes. These materials may be also be derived from petroleum which have been severely abused in chemical processes, and finding that in many cases is strength, the molecules have joined up to form a solid free against practically all solvents such as chemicals, strong acids, and bases. These materials, known as acrylic resins, may be more transparent than glass and are most commonly associated with aircraft windows and ornaments or as ornamental objects for the home.

However, one catalogue lists many different uses including dentures, artificial eyes, denturing instruments, and anesthesia parts.

Propane, a hydrocarbon used in making the acrylic mentioned above can also be converted by a series of steps into plastic materials known as the alkyl resins. Paints, lacquers, printing inks and coated fabrics are derived from these resins.

Butylenes is the next larger member of the petroleum group and each molecule has two free ends to grab anything passing by. However, for the production of Butylene 2-synthetic rubber, it was found that two ends were not enough as Butylene molecules were made to run through a very hot furnace. In fact, it was at hot that two more hands were forced to get at their hydrogens. This made quite a difference to the molecule—in fact they behaved like different people and so we called butylenes undecane.

This material was found to be especially useful to join up with styrene, which we have mentioned before, to form a rubber-like substance, Buna S, which played a very important part in the war when the Allied forces most of their sources of natural rubber supply. Synthetic rubber, which can be manufactured to meet different specifications for different purposes, has proven better than natural rubber for many products. During the war Imperial Oil supplied the hydrocarbon for the manufacture of synthetic rubber at Sarnia, where it is still being made.

Butylenes is the twin of butylenes, but, like twins in a family, it is different at all times. This has not done the right people to have a successful career. For instance butylenes, also made at Imperial’s Sarnia refinery, is separated from the twin, butylene, at the light end plant of the Polymer Corporation. There it is introduced to Specramen, a carefully chosen chemical, and the two join forces to produce Butyl rubber which is used for inner tubes, life rafts, and laboratory tubing as it is more resistant to the havoc of gas or air than plastic.

Plastic in the home has produced the fascinating kitchen. This kind is made of Polyethylene and it can be handled creating an economical and attractive effect. This material may also be used to join bands with more molecules of itself to polyurethane to a rubbery material such as Villastic. This material is used along with wax for moisture resistant coatings on paper mill and food containers. It is also used to insulate high voltage electric wires, for self-tracking aircraft fuel tanks, and as an adhesive.

These synthetic rubbers may soon be far removed from the more beautiful and colorful substances which we think of in connection with plastics. However, they are actually plastic materials having the desirable qualities most nearly approaching natural rubber, and are known generally as elastomers.

To the latter nylon has only one or two meanings—either stockings or drying mud and bitches. Look at your teeth britain amusements and the common usages that the former will be of nylon, all uniform in slit and not soggy when wet. Paint brushes are made of nylon fibres by a tricky process which produces the desired laquerating brushes. Less well known is the fact that this material is used to produce molded shapes and fabric coatings. Certain of the petroleum products in the form of chemical compounds may be used in the intermediate stages of the manufacture of nylon. So far we have not met with a few of the plastics family.

Other plastics include the areas, esters, ethacryl, nitrile, and acrylonitrile, and so on, with their own special properties and applications, and many of which may involve some petroleum chemical in their manufacture.

Once the raw plastic has been made these are many different ways in which it may be converted into the finished article. Depending upon their properties the plastics are divided into two main groups, the thermoplastics and the thermostetting materials. Thermoplastics are soft and plastic when hot and may be moulded, shaped or extruded through a die, and when cooled they hold their shape, whereas, however, can be hardened only after being formed by heating. Thermostetting materials are stabilised by heat and may be moulded or shaped as desired, but, continued

heat causes a chemical change to take place and they are permanently hardened. A plastic ash tray is a good example of thermostetting material—it would never do to have a thermostetting one which might sag out of shape from the heat of a cigarette or two.

Plastics come in the fabrics in the form of sheets, rods, tubes and moulding powders, either colored or plain. Sheets, rods and tubes may be cut, machined, bored and heat, and so formed into parts, curved windows and doors, marble plates, instrument dials and so on. The moulding powders are manufactured into an enormous range of products by these different processes known as compounding, injection and transfer moulding, wherein the powder is heated until it becomes plastic and then used under pressure to every corner of the mould cavity, they faithfully reproducing every detail which has been incorporated into the mould.

In extension moulding the powder is heated and forced, like next paste from a tube, through a metal die of suitable shape to make rods, tubes, extrusion and tiny tubes for your breakfast.

Thermoplastic plastics are also used to impregnate cloth, paper and this cloth. Several layers of one of these impregnated materials are then placed in a heated group the material is connected together into a hard tough sheet. Some examples of this technique are seen in ornaments trays, table tops, fibre glass, automobile fenders and wings, and boat hulls.

Plastics have become such an essential part of our lives that we are inclined to take for granted the magic which chemists have wrought. From nothing into objects of value, the ability to fashion beautiful to those of exquisite beauty, we are surrounded by plastics.

The polymer industry, through scientific research, has done much to add to the comfort and welfare of mankind. It is proved, as a source of many of the new materials for the plastics industry today, to make this new contribution to a better life for all.

Besides the eleven plastic groups are joined by hot pressure binding. Polished by the hand, the page ends are pushed together and sealed themselves to a tight joint on sealing.
THE UGANDA VISITS TALARA

By SUB. LIEUT. J. S. PATTENSON, R.C.N. (R)

MAKING the important oil town of Talara the
first port of call in South America for the Royal
Canadian Navy cruiser, H.M.C.S. "UGANDA,"
which is currently engaged in a training and goodwill
cruise to the southern continent, had two important
features as far as the officers and men were
concerned. First, it afforded them a chance to put their
feet on South American soil for the first time knowing
they had many Canadian friends ashore who would
show them the ropes. Secondly, it gave those who
were familiarizing themselves with Spanish a chance to
practice without getting into serious difficulties.
Talara, the westernmost town in South America,
owed its importance to the International Petroleum
Co. Ltd. It was, therefore, except for the scenery,
many ways like a bit of Canada the sailors stepped
into when they went ashore.
The town of Talara, it was learned by Uganda's
men, is just five degrees below the equator. It has a
population of some 45,000 people including the
natives, most of whom work either in the oil fields
or the huge plant of the petroleum company.
Uganda, under command of Captain E. R. Main-
guy, O.B.E., R.C.N., of Dunfan, B.C., had no sooner
dropped anchor in the Bay of Talara, than a welcoming
party, representing the oil company and civic
officials, came on board. Heading this group were
Arnett Norvott, general manager of International
Petroleum in Talara, Capt. H. C. Davison, who has
seen long service with the Imperial Oil fleet and is
at present superintendent of International's marine
department at Talara, and A. D. Landry, industrial
relations supervisor.
During the evening three days of the visit an elabora-
ted program of entertainment was enjoyed by officers
and men ashore.
Many of Uganda's crew were highly interested in
the oil fields and plant, and tours of both were ar-
ranged. The sailors learned that the area had first
been turned over by the Peruvian government to a
brotherhood of Peruvian monks several hundreds of
years ago, with the understanding that they were to
pay the necessary taxes in the form of grain. But
because of the arid condition of the soil and the fact
that it rains in Talara only about every seven years,
the monks soon abandoned the place.
Next it was turned over to a Spanish baron who
had similar luck in his attempt to make the land pro-
ducive. It was known to the Peruvian natives in the
last century that oil existed in the area, but nothing
is on record which would conclude that they utilized
this precious liquid. During the first World War
International started the development of the large
fields of Talara area, and at the present time there
are some 2,500 producing wells.
There are three fields from which the Company
draws oil. The oldest field is in Talara. Five miles
distant is the town of Negritos, which also has a
production of some 2,000 wells. Situated there is the
second field and another huge plant. To the northwest
of Talara at the considerably smaller town of Lobitos
is located the third field.
There are four young sailors serving at present in
Peru who plan someday to go into the oil busi-
ness. They are along these lines in their off-
watch time at sea. They are Able Seaman P. G.
Russell of Turner Valley, Alta., Leading Seaman I.
Emberton, of Sedgewick, Alta., Stoker Petty Officer
C. L. Fraser of Victoria, B.C. and Stoker E. Woodall
of Mimico, Ont. A special trip was arranged by
Harold McDonald of Negritos for these lads during
which some valuable instruction was given them.
Other parties from the ship were conducted through
the oil fields and plants by various members of the
Company.
While the Canadians who work for the oil company
in both Talara and neighbouring Negritos are many
thousands of miles from home, they still live as
Canadians. For instance, they get good Canadian
food through the Company's supply arrangements,
and many of the officers and men ate delicious home-
cooked meals of roast beef and roast chicken at the
homes of Company employees.
There are two golf courses, one in Talara, and
another in Negritos, both of which were thrown wide
open to the visiting navy men. Both evenings the
ship was in port dances were held at these clubs. The
golf courses, incidentally, are entirely without green
grass owing to the desert-like conditions around
Talara. But they are well kept and the sand "greens"
are particularly tricky.
Baseball, basketball and football games were
organized between the Talaranas and the sailors.
The visitors came out on the short end of each of these
events, but certainly didn't suffer from lack of fun.
To add to the occasion the ship's band came along
at the ball park to play between games.
Many of the men in Uganda found that some of the
people working for the oil company had actually come
from their own homes towns in Canada, and in some
cases had been here before. For instance, the Rev.
Orville P. Hoskie, Chaplain, R.C.N., who comes from
Sarnia, discovered some of his old school chums had
settled there. The Padre was even called upon to
baptize their children. He performed nine such cere-
monies on board after church Sunday morning.
Mr. and Mrs. William B. Cole are from Sarnia and
Padre Hoskie knew them both in school. He christened
their son. The son and daughter of Mr. and Mrs.
When H.M.C.S. Uganda called at Talara, Peru, members of the
ship's company saw International Petroleum oil fields and
plant. Here Calvin Ferguson, Sarnia, explains plant piping.
OPERATION Muskox, which took Canadian army men and their snowmobiles over a 2,100-mile route through the wind-whipped snow covering the ice and muskeg of the Canadian Arctic, has been the most severe test given such a mechanized force over such terrain. Northern winter travel is expected to benefit greatly from the experience gained in many fields by the expedition’s experts.

The Muskox trail commenced at the Hudson’s Bay port of Churchill on February 14, swung north to Eclipse Point and northwest to Baker Lake, near Thelon game sanctuary, home of the musk-ox. Perry River, Cambridge Bay, Coppermine, Fort Radium, the site of the uranium mine, Norman Wells, Fort Simpson, Fort Nelson, Dawson Creek, all were stops on the Muskox maps. Then Edmonton, at the end of the long trek, and into advancing spring, with warmth and lights and city noises and the empty white spaces of the Arctic and sub-Arctic far behind.

Fuel and lubricants used on the exercise presented no new problem, for Imperial Oil research had already met many of the difficulties presented by sub-arro

As R.C.A.F. Huskies supply planes delivered fuel to a northbound snowmobile as the Muskox Trail crossed the Arctic Circle

ARCTIC PROVING GROUND
WHILE MOST CANADIANS PREPARE FOR SUMMER’S HEAT SCIENTISTS ARE STUDYING LESSONS OF THE Icy MUSKOX TREK.

The semicircular trail of Exercise Muskox, plotted on a large-scale map by men of the expedition before leaving Churchill.
Portable gasoline-burning heaters warm up the engine of a Troop Carrier Command Dakota which supplied the expedition.

At 49 degrees below zero, Mr. Lake found that oil treated with a disinfecting agent, but ordinary oil was “broken”.

The expedition also received all possible assistance from Imperial stations at Churchill and Norman Wells.

The Royal Canadian Air Force Dakota and Norwex aircraft, which kept the operation going, supplied the supplies dropped by parachute, flew through bitter cold and snow blown as high as 2,000 feet by ice-blasted winds. The pictures on these pages illustrate vividly the conditions met in a little-known part of Canada.

A meal in the Arctic involves melting snow with a gasoline stove and then chaffing the other items on the Will-o’-wisp. Here men on the exercise stand their stove behind an igloo.

The Royal Canadian Navy was in on Operation Muskrat too. Here personnel collected fuel oil & stored it in heating the Churchill naval wireless telegraphy station in Arctic weather.

On the barren, wind-swept tundra northwest of Churchill three Canadian army snowmobiles halt in 38 below cold. Parachutes and tags had to be attached to each drum of fuel for the snowmobiles before supply planes delivered it.

No friendly Imperial service stations and free air in the sub-Arctic, so this Canadian army snowmobile crew does its own refueling from supplies carried by their trailer. After dropping supplies to the men on the frozen snow on R.C.A.F. Dakota circles to make sure the precious drums and parachutes are all collected, before returning to its base.
PERSONALITIES IN THE NEWS

T. F. McNamara Receives 40-Year Service Button

T. F. McNamara, who received his 40-year service button just prior to his recent retirement, was born in Franklin, Penn. His first job was with the New York Central Railway where he worked from 1886 to 1906. He began his career in the oil business in 1906 when he joined the Atlantic Refining Co. In 1916 he came to Imperial Oil in the manufacturing department at Sarnia, and in 1917 was appointed head yeild and cost clerk. In 1929 he was appointed assistant chief accountant, and in 1939 chief accountant of all refineries, the position he held when he retired.

Horace N. Carr Receives 40-Year Service Button

Horace Carr's entire business career has been spent with the Company. Born and educated in Beeton, Ont., he came to Toronto and at the age of 15 joined the stock department of Ontario marketing division. In his forty years with the Company he has been with Ontario division in various positions. In 1915 Mr. Carr enlisted with the 48th Highlanders and served overseas, being wounded twice in the battle of Vimy Ridge. He returned to Canada and Imperial Oil in 1918.

A. T. Roblin Appointed Assistant Manager, General Traffic Department.

Born in London, Ont., Arthur T. Roblin moved to North Bay at an early age and received his secondary education there. Before joining the Company in 1932, he served 17 years with the C.N.R. and saw service overseas with the Canadian Army. Mr. Roblin's first position with the Company was that of salesman in Saskatoon. From 1932 to 1941 he worked in different capacities in the Saskatchewan marketing division, and at the time of his transfer to Newfoundland as manager in 1941 he was district manager at Saskatoon. In 1943 he left Newfoundland to take the post of special representative, general sales department, Ottawa, and held this position until his recent appointment.

Andrew Hargin Receives 40-Year Service Button

Born four miles south of the Ontario oil centre of Petrolia, Andrew Hargin became interested in the oil business at the age of 17 when he worked as a "roughneck" on drilling rigs in the Petrolia field. His career with Imperial Oil began in 1906 as engineer of the boiler house of the line receiving station at Petrolia. In 1913 he was transferred to the pumping station at Buryan, Ont., where he is still employed.

D. H. Piper Appointed Special Representative, Ottawa.

D. H. Piper, who began his career with Imperial Oil as office boy in 1918, was born in Cobourg, Ont. and educated in Toronto. He joined the Company in the Ontario marketing division, and became an order clerk in 1914. He enlisted in the army in 1917, and in 1918 returned to Ontario division as a salesman. In the following years he held various positions with the Ontario division, becoming sales manager in 1939. In 1941 he was transferred to the Manitoba division as sales manager, and in 1944 returned to Toronto as manager, national accounts, general sales department, the position he held till his move to Ottawa as special representative, General sales department.

IMPERIAL OIL REVIEW
These spherical tanks at the plant of the Royalite Oil Co. at Calgary are used to store highly volatile petroleum products, the products, extracted from Turner Valley natural gas, must be kept under pressure to prevent evaporation. For the same container strength, a sphere permits greater inside pressure than any other shape.