NORTHWEST PASSAGE III

The Return Voyage of the "St. Roch"

When England's Henry VII, in 1497, hired the Italian navigator, Giovanni Caboto—better known as John Cabot—he instructed him to find a short route between Europe and China. The King gave him a vessel, the tiny three-masted "Matthew", loaded with gun-powder, brightly-colored scarves and daggers to trade with barbarians abroad. Master Cabot sailed from Bristol with a crew of 18 men, raised Canada a month later and in due course reported that an "impenetrable barrier of earth, mountain and forest" barred the way to the East.

Thus the search for a channel through this massive obstacle, or a Northwest Passage across the top of the continent, began. Many a mariner and scientist searched—and left his bones behind. Their names dot the Arctic—Frobisher, Davis, Hudson, Baffin, Kane, Parry, Ross, and Franklin. Of the dozen who tried to find a Northwest Passage, none succeeded.

Then came Roald Engelbregt Gravning Amundsen, the heroic Norwegian explorer. In 1908, in a converted fishing craft with a crew of seven, he set out on the classic route through Lancaster Sound. In 1908 he reached Nome—the first man ever to traverse the long sought Northwest Passage.

The second man to be credited officially with the conquest of the fantastic hazards of the Northwest Passage is Sergeant Henry Larsen of the Royal Canadian Mounted Police. Sergeant Larsen is a master mariner, Arctic navigator and ice pilot. His first passage, a voyage of 28 months, was completed in 1942. Now, in the same sturdy little motorship, "St. Roch", Sergeant Larsen has done it again. He sailed from Halifax July 22, 1944, reached Vancouver, via the Northwest Passage, 86 days later—October 17th—a feat once considered impossible.

Larsen is a modest man, a capable master, a navi-Route of the "St. Roch" from Sydney, N.S. to Vancouver, B.C., via the Northwest Passage.
and half the people of the Dominion have seen or heard of the motion picture records of that epochal journey.

Before the "St. Roch" was outfitted at Halifax to attempt the second passing of the Northwest route, she was given a new power plant. Her original engine, a Union, was 300 h.p. and it was judged wise to give her more power. A 500 h.p. Union was installed.

Late she was caught in early ice packs or checked in the narrow straits through which she must pass, the "St. Roch" was outfitted for three years, to be on the safe side. In provisioning the ship, the engineer officers went to the Imperial Oil officials in Halifax. Only Imperial products were to be taken, and the oil company experts assumed the responsibility for selecting the proper lubricants to meet Arctic conditions. They recommended Imperial Essohulf H.D. 30 as lubricant, and Imperial Diesel fuel oil. "It worked out very satisfactorily" said Corporal G. W. Peters, the chief engineer, upon arrival at Vancouver. "The lubricant stood up well. The fuel oil was good. On all the voyages we only cleaned one valve, and that was two days before reaching Vancouver. It was not really necessary but we wanted the exercise."

The voyage of the "St. Roch" was 7,500 miles. Incidentally it is 1,000 miles farther from Halifax to Vancouver by the Northwest Passage than it is from Vancouver to Halifax by the Panama Canal.

On the voyage the ship used 200 gallons of Essohulf H.D. 30, and 10,000 gallons of fuel oil. She made the voyage in 1,100 running hours. Included in the 10,000-gallons consumption was that used by the cooking galley and the auxiliary engines.

Northward, in that last week in July, the little ship bore almost to the Greenland coast before she turned west into Pond Inlet and threaded her way north and a little west into Lancaster Sound. Snow and fog and ice, with scattered bergs, made progress slow and caution necessary.

The crew of the "St. Roch" speak with admiration of the iron constitution of the navigator. It was nothing to see Larsen spend 60 consecutive hours in the crow'snest high above the deck. Often out of sight in fog he coned his command steadily through the ever-shifting and treacherous leads of open water twisting among the ice-floes.

There were, of course, occasional breaks in this progress. They had to stop at various landings and there obtained some rest. They checked over the historic points, the Royal Canadian Mounted Police posts and they took on and put off occasional Eskimo passengers.

At Beechey Island they stopped to examine the cache left there in 1853 by the last expedition from England sent out to search for the lost Sir John Franklin. This expedition disappeared into the Arctic in 1845 and Sir John and his entire force of 125 men perished under unknown conditions. It was not until a few years ago that any definite traces of this expedition were found. Then it was established that all hands had died long before the cache was built in 1853. However, the stores of food and arms was left for the benefit of other Arctic voyagers. The cache was stocked well with rum, bully beef, clothing, guns, ammunition, footwear and medical supplies.

Larsen's men found the cache had been raided by polar bears. Its strong stone walls were broken down and the beef was littered with torn clothing, chewed leather sea-boots and empty casks. The animals, however, had been foiled by some cans of soup and meat. These cans were honestly made and lived up to their reputation. Larsen brought out a tin of "ox jaw" soup, dated 1850, and put up by a manufacturer situated "opposite East India House, London." The directions for opening were to take a hammer and a chisel and cut out one end, being careful not to let flakes of paint with which the can was covered, get into the soup. "Warm gently, and season to taste."

Larsen proposes to serve this rarity with some sea-biscuits of the 1850 vintage that also proved too tough for the polar bears, at a luncheon for his friends. The polar bears that raided the cache did not get away Scot free. Larsen reports finding skeletons of two of the monsters on the beach nearby. Perhaps they fell victim to rum or maybe they ate poison from the medical stores. One skull was so large and its teeth were so mighty that Larsen took it to bring back to civilization. But someone—probably an Eskimo passenger who knew the value of good bone—abraded the tusks and teeth, and rendered the skull worthless as a relic. It was thrown into the ocean.

The ship passed on, through Barrow Strait, Vis- cousuk Melville Sound, Prince of Wales Strait, across Amundsen Gulf and the Beaufort Sea to Herschel Island. Fogs and gales, ice, rain and snow made every mile a mile of careful work. But, arriving at Herschel Island, the men knew they were making records and knew they had again made the Northwest Passage. At Herschel they landed an Eskimo, his wife, their five children and his grandmother, together with 17 dogs. The Eskimo and his entourage had been picked up at Pond Inlet and engaged to take care of the 17 dogs that were to be used for winter patrols by R.C.M.P. of Herschel. From Pond Inlet to their destination this group of eight lived constantly in a very small tent pitched on the deck of the ship. They were not the only passengers, for other natives were met at other points and given gifts to various destinations along the route.

The date was September 2. It was still a long reach to Point Barrow, most northerly tip of North America.

With steel sheathing rusting at her bows, the motorship "St. Roch," tied up at Vancouver at the end of her hazardous voyage, gave new second to nome in ice. Twenty years ago, Karl Klinkenberg, famous independent Arctic trader, was outfitting his equally famous sailing schooner, "Old Maid No. 2," at Vancouver for a trip into the western Arctic. Larsen, a young officer keen to learn more ice navigation, applied for the job of mate. The title was a moniker for the mates of Klinkenberg's ship were really navigators and masters.

Larsen sailed away on a long voyage with the ship. About the time of his return to Vancouver, the Royal Canadian Mounted Police had ordered constr- uction of a proper Arctic-type vessel, one that they could send confidently into northern waters to supply posts and administer laws in far-flung points where regular patrols were otherwise impossible. This ship was the "St. Roch", built at the Burrard Drydock Company plant at North Vancouver in 1928. She is a wooden vessel of 852 tons burthen, 85 feet long, 60 tons burthen. Her hull frames are very heavy sawn timbers, set with a scant inch space between each. With her ironhark outer skin, her sheathing, her inner fittings and her frames, she presents to ice-pressure a thickness equivalent to 22 inches of wood.

In 1929 she went into commission. Larsen, who had meantime joined the R.C.M.P. with the definite hope of commanding this fine vessel, was named as naviga- gator. The "St. Roch" has been his ship ever since. She made many voyages out of Vancouver into the western Arctic before Larsen embarked on his first earnest effort to make the Northwest Passage.

Everyone in Canada knows how he made that run,
and last possible barrier to a completion of the passage. In summer time, off the north shore of Alaska lies the Arctic pack, a solid icefield extending to and across the North Pole and down the other side of the world to Spitsbergen. Thus it has lain for thousands of years. Each year, a prevailing wind with constant, gentle pressure, moves the icepack far enough to the north to permit vessels to sail around Point Barrow. For generations hardy whalers used to make that voyage and score of them were forced to winter in the western Arctic because the ice closed down on Barrow. For in late summer every year, regular as the sun, the wind changes and abyes the pack, crushing and grinding, down upon Barrow. There it locks itself to the shore with a thunderous rumble and remains fast until the gentle southern winds of the next summer.

It was getting into autumn and Larsen feared the pack would get down ahead of him. Fog, very dense, smothered sea and land. "It was fog all the way to Barrow," said Larsen. "We made it, sort of hand-over-hand. That is, we sailed the entire distance by hand-lead-line. We knew the water was seven fathoms all the way to Point Barrow."

Mentionously the leadman would heave the chunk of metal, haul in and shout, "By the mark seven," then in a tone of surprise the leadman yelled, "I can find no bottom, and there's 25 fathoms out!"

"In provisioning the ship, the engineer officers went to the Imperial Oil Officials in Halifax. Only Imperial products were to be taken and the oil company experts assumed the responsibility for selecting the proper lubricants... it worked out very satisfactorily," said Corporal G. W. Peters, Chief Engineer, on Arrival in Vancouver."

"I knew then," said Larsen, "that we were through; for once past Point Barrow the bottom drops away tremendously."

On October 2 they rounded the Point, South, through Bering Sea, they sailed to pause at King Island, a rocky dot, off the Alaskan coast, inhabited by 180 natives. The "St. Roch" bore in to shore flying the Blue Ensign. Not a soul, not a dog, not a canoe or boat was seen. Signals from the ship brought no reply. Larsen suddenly remembered that King Island belonged to the United States and he ordered that the Stars and Stripes should be broken out to the breeze. Immediate, out of the very ground, a multitude arose. The natives, together with their dogs, had hidden in their foxholes when a strange ship bearing a strange flag appeared. They told Larsen they were sure his Blue Ensign was the Japanese flag!

A fortnight later, in more fog, the "St. Roch" made Vancouver harbor. It was a dark and dismal night and the little vessel, with the steel sheeting rusted on her bow, crept quietly to a berth at the outer end of a lonely dock. Awaiting, however, to give formal and official welcome to the men who had again brought honour to Canada and the R.C.M.P. were Superintendent James Pripps, R.C.M.P., and Commander J. M. Smith, R.C.N., naval officer in charge of the port. Both officers were in full uniform and both congratulated master and men. There were no public acclamations. Just another police job completed.

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marketed for special uses such as electrical cables and service station gasoline hose.

It was fortunate for the allies that when the Japs seized pearl harbour, research had reached the point where we knew how to make synthetic rubber in commercial quantities. If it were not for synthetic rubber production the stock piling of rubber would have outstripped the Vanishing Point, and a disastrous break-down of the war effort probably inevitable.

Realizing the desperate seriousness of the rubber situation after pearl harbour, the governments of Canada and the United States moved swiftly to get synthetic rubber into production in large quantities. In Canada a company, Polymer Corporation Limited, was formed on March 27th of 1942 and contracts were let for the building of a plant at Sarnia.

Several factors contributed to the choice of Sarnia as the location of the new plant. Possibly the most important was the fact that most of the raw materials used in the manufacture of synthetic rubber are obtained from petroleum, and Sarnia is the point of intake for the most secure and reliable source of crude oil coming into Canada—the Imperial Oil pipe line from the United States mid-continent field. The only other Canadian petroleum source free from dangers of submarine sinkings was Turner Valley, but oil from this field does not contain as high a percentage of synthetic rubber ingredients as does the oil from the mid-continent field. Also, Turner Valley is far away from the other necessary raw materials and from the rubber factories.

Another consideration was the fact that synthetic rubber manufacture calls for immense quantities of comparatively low-temperature water. The water of the St. Clair River, on which the plant is situated, is ideal for cooling. In winter it is frozen, in summer it is warm enough to cool the water. At Sarnia this was unnecessary.

Great quantities of brine are needed to make synthetic rubber and this is obtained cheaply and readily from salt wells at Sarnia. Also, the site of the plant is handy to water, road and rail transport.

In broad outline the Polymer plan was that the Government would furnish the money to build the plant and private industry would supply the “know how” for its design and operation. At Polymer’s request, Imperial Oil formed the St. Clair Processing Corporation Limited, to operate many of the units. Dow Chemical of Canada Limited was asked to operate other units. Canadian Synthetic Rubbber Limited was formed by Canada’s four major rubber companies to operate the plant which consists into Buna S rubber, certain of the ingredients produced by St. Clair and Dow.

The building of the Polymer plant was an epic of construction. Normally a plant of its size would require three years in the building, but under the stress of war several units of the plant at Sarnia were in operation less than 14 months after the first end was turned. Workmen came from many parts of the country and in the early days progress was spectacular. One week passers-by saw piles of brush and tree stumps and the next, straw shovels and piles of new lumber. Soon there were tool sheds, temporary offices, box houses for the construction workers were being rushed to the job. Walls of the permanent buildings rose, towers and spherical tanks and the tall stacks of the power plant cut the skyline.

Meanwhile, in the St. Clair Processing Corporation a number of chemists, engineers and operators from Imperial Oil, augmented by workers selected through the technical training schools of the Emergency War Training Programme and by technicians from Canadian universities, was taking an intensive course of study and practical training in the control of the chemical processes and the operation of the new and complex units.

Concurrently work was started at Imperial Sarnia refinery on a new unit to increase the production of gases used in the manufacture of synthetic rubber. These gases are produced by high temperature cracking of petroleum products in the presence of a catalyst. In the cracking process heat and pressure break down large molecules of a substance into smaller molecules of different substances. Although the Sarnia refinery processes more cracked gases than any other in Canada the supply of gases from the existing cracking units would not meet the large demands of the rubber plant.

Accordingly, Polymer decided to build a new cracking unit and the four existing Imperial Oil units were revamped for more severe cracking conditions.

The new supermagnesium cracking unit, with its four smaller companion units was of material assistance in getting the rubber plant into operation.

The development of supermagnesium cracking in itself enabled the Polymer Corporation to effect substantial savings in construction costs. Supermagnesium cracking is a refinement of magnesium cracking developed by Imperial's Technical and Research Department before any rubber operations were considered. The supermagnesium process differs from other cracking processes in the use of a relatively small amount of catalyst. The catalyst is mixed as a powder with a light oil and injected into the stream of oil to be cracked.

In supermagnesium cracking higher temperatures and greater quantities of catalyst produce a higher percentage of gas. The feasibility of this operation is such that with certain modifications to the existing units and by the installation of the new unit it was possible to supply the proposed rubber project with the full amount of feed stock needed. Installation of a large and expensive catalytic cracking unit was thus avoided.

Two types of synthetic rubber are manufactured in Canada. Buna-S, which takes its name from its ingredients: butadiene and styrene, is used in tires and other products. Butyl rubber, made from isobutylene, is used mainly for inner tubes.

Butadiene, the main ingredient of Buna-S, is made by removing hydrogen from butyrolactone, one of the gases produced by supermagnesium cracking. Styrene, the other ingredient of Buna-S, is made by the copolymerization of butadiene with a by-product of the steel industry's coke oven, with ethylene—another gas made in supermagnesium cracking. Polymerization is the process of cracking. In polymerization the light molecules of a substance are caused to join together. In copolymerization light molecules of one substance join with light molecules of another substance to form a different and heavier substance. Butadiene, with a molecular weight of 92.09, and styrene, with a molecular weight of 104.14, are copolymerized to form Buna-S rubber with a molecular weight of more than 92,000.

Copolymerization is also used to convert isobutylene, an ingredient of supermagnesium cracking, into butyl rubber.

It is a fairly simple matter to make rubber—in the laboratory. You could make it in your own kitchen from this recipe: put a solution of soap and water in a bowl. Into this solution gene three cups of butadiene and one cup of styrene. Add a dash of potassium persulphate and agitate. Then add a solution of salt and water and stir. Add a weak acid and stir again.

That's all there is to it. In the bowl you will have a material that looks like tallow. By pressing the soft mass between your hands and removing them out you will have left a white, crumbly material—Buna-S rubber.

It's quite a different matter, however, to make rubber in large quantities. In the first place the ingredients aren't delivered in individual bottles. At Sarnia those ingredients which come from the supermagnesium cracking units are mixed with a number of other hydrocarbons. This mixture contains

View of Polymer plant, June, 1943, showing isobutylene, butadiene and styrene units under construction.

Operated by St. Clair Processing Corporation, the steam plant is the heart of the plant in Canada.

Last step in synthetic rubber production is washing the milk line before drying and bulking.

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methane and ethane and other light gases; ethylene, one of the ingredients of styrene; propylene, from which an aviation gasoline blending agent is made; and a mixture of gases which the chemist refers to as the "C-4 cut", containing isobutylene, butylene, isobutane and butane. The "C-4" nomenclature is derived from the fact that these gases all contain 4 atoms of carbon. Of this cut the isobutylene and butylene are used in synthetic rubber production - the butanes are used to enrich motor gasoline.

The gases are separated in the light ends recovery plant. Operated by St. Clair, this plant first removes any sulfur compounds present in the gas and liquid received from the cracking units. By distillation the C-4 cut is then separated. The light gases are used for fuel by the rubber plant, and the excess sent to Imperial and the Union Gas Company. The ethylene is pumped to the Dow plant where it is copolymerized with butadiene to produce styrene. The propylene is sent to both Dow and Imperial for conversion to cumene, an aviation gasoline blending agent.

Ordinary methods of distillation cannot separate all the components in the C-4 cut because of the closeness of their boiling ranges. Isobutylene, for instance, boils at 19°F, while butylene boils at only one degree higher - 20°F. To separate the isobutylene the C-4 cut is sent to the St. Clair-operated isobutylene extraction unit. The free isobutylene is then sent to the butyl rubber plant, also operated by St. Clair. At the butyl plant, butyl rubber is made by copolymerization of the isobutylene with small amounts of isoprene at a temperature of 146° below zero. Isoprene, which is made from a selected naphtha, is imported from the Standard Oil refinery at Baton Rouge, Louisiana. The small amount of isoprene used makes it cheaper for Polymer to import this product than to go to the great expense of building and operating a plant to produce it.

Butylene, from which butadiene is made, is separated from the C-4 cut in the butadiene concentration unit. From here the butylene is sent to the butadiene unit where it is converted to butadiene. The butadiene is delivered to the Canadian Synthetic Rubber plant where it is copolymerized with styrene from Dow into Buna-S rubber. Both the butadiene concentration unit and the butadiene unit are operated by St. Clair, as well as the steam and power plant, the pumping station, the stock room, a gas analysis laboratory, the central mechanical shop, and the fire department.

The steam and power plant is the largest steam plant in Canada, and one of the largest producers of process steam in the world. Most of the steam is used in the various synthetic rubber manufacturing processes, and the remainder generates the 5,000 horse-power of electrical energy needed to drive equipment throughout the plant. Each twenty-four foot long and 100 feet high, the five furnaces in the steam plant consume more than 1,800 tons of coal each day - enough to heat every house in Winnipeg and Edmonton.

The pumping station with its six steam-driven units pumps more than 85,000 gallons of water each minute. The plant consumes as much water each day as does the city of Toronto.

No one can say for certain what will be the future of synthetic rubber after the war. Although no one synthetic rubber has been found with all the qualities of natural rubber, so many synthetics are now coming from the laboratories in the United States and Canada that it is possible that the natural rubber may one day be replaced forever by synthetic rubber in Canada and the United States.

In the meantime, synthetic rubber, developed in the laboratories of industry and manufactured in plants designed and operated by industry, has kept allied wheels rolling toward Berlin and Tokyo.

One of the most complete gas analysis laboratories on the continent is operated by St. Clair at the Polymer plant. Left, an assistant makes an analysis. Right, in another laboratory a piece of Buna-S rubber is tested for tensile strength.

Personalities in the News

F. R. Bimel Elected a Vice-President
International Petroleum Company

F. R. Bimel has been elected a Vice-President of International Petroleum Company Limited.

A Director of International Petroleum since 1925, Mr. Bimel has been associated with the producing and pipeline end of the oil industry during his entire business career. His early training was in pipeline construction and operation. In 1915 he became producing assistant in the Caddo district field in northern Louisiana, three years later taking charge of the Gasoline Department. In 1922 he organized a system of recovery of "light ends" which played an important part in the oil industry's conservation programme.

J. A. New Appointed General Secretary

J. A. New, Solicitor to the Company, has been appointed General Secretary.

Born in Southampton, England, John New came to Canada at an early age. During the First World War he served overseas as an officer in the Third Canadian Division. Returning to Canada after the war, he resumed his law studies and graduated from Osgoode Hall, Toronto, in 1920.

Mr. New joined Imperial Oil in 1920 as Solicitor. He was appointed Assistant Secretary in 1925 and served in this capacity until his recent appointment.

T. C. McCobb Retires

Formerly Secretary and Treasurer of Imperial Oil Limited, T. C. McCobb retired from the Board of Directors of the Standard Oil Company (New Jersey) September 1, 1944. Mr. McCobb had completed 42 years of service in the oil business and was presented with a resolution of tribute by his fellow Board members.

During the last war Mr. McCobb joined Imperial Oil and set up a new system of accounting for the Company. In 1917 he became Assistant Secretary and Assistant Treasurer of the Company, later being promoted to Secretary and Treasurer.

He moved to New York in 1929 to become Assistant Comptroller of the Standard Oil Company (New Jersey) and was made a director in 1935.

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NORMAN OIL FIELD BEING STABILIZED

Sydney Norman, Mining Editor of the Globe & Mail (Toronto) was a recent visitor to Norman Wells and the Canol project. Some of his impressions are recorded in the accompanying article which is reprinted with the permission of the publisher.

IN CONSIDERING the human miracles that have been brought about by combination of unlimited power in the name of the Canol Project, these essential facts must be borne in mind: That Norman Wells oil field, furthest north on this continent, is in an isolated wilderness, less than 100 miles south of the Arctic Circle, on the bank of a mighty river frozen stiff for six months of the year; that it is located 880 miles from railhead at Waterways, Alta., and that all heavy goods must be delivered over an uncertain freighting route of rail, portage, river, lake, and river again, and subject to the possibility of destruction in the wild storms that frequently lash Great Slave Lake to demoniacal fury. Only then can one absorb a proper idea of the stupendous task that has now been nearly completed and will always stand as one of the greatest feats in the dramatic history of the oil industry.

This article will deal solely with conditions as they now exist after the big battle against Nature has been won. The history of the combination of financial strength and physical power and its accomplishments has already been told and is well known to the world at large.

OVERNIGHT TRANSITION

The transition of Norman Wells, almost overnight, from a field of low production and minor importance—supported by but a few mining and transportation concerns hundreds of miles apart—to a district of world importance as a source of indispensable war supplies imposed a tremendous task upon all concerned; one that has been successfully handled in a manner reflecting wholehearted credit, and quite unprecedented.

Provision of living quarters and sustenance of a large crew has not been the easiest job in this gigantic task, but it has been carried out in an eminently successful manner by Imperial Oil which owns the original producing wells and has complete charge of the Norman Wells community, mushroomed on the right bank of the Mackenzie, on a narrow muskeg flat, flanked by the foothills of the Franklin Mountains. Now that the major war pressure has been met and the field is working back to more stabilized war-time conditions, many improvements are under way, with every promise that before another summer season arrives living conditions at Norman Wells will offer complete recompense for the tough days through which it passed in the earlier days of the great project.

POPULATION 650

At the present time, the population of the camp is approximately 650, of whom 580 are employed by Imperial Oil, and approximately 150 by Norman Exploration Co., charged with development of the field, and in which Imperial and the Governments of United States and Canada are jointly interested.

Acrorn the Mackenzie, which flows northwesterly past the camp, and is four miles wide, is old Camp Canol; on the south bank, still used for loading supplies from the north side, and four and a half miles back from the river, on the gradual slope leading up to the Mackenzie foothills, is new Camp Canol, built by the contractors to house and feed many hundreds of men during the rush days of road construction. Activity there has subsided in recent months, but the camp is still very much alive as headquarters for the road maintenance crews of Elliott Construction Co., whose task covers 600 miles of what is now a splendid highway through a mountain wilderness totally unknown until yesterday; the United States Signal Corps, which maintains the telephone lines, and the personnel of Standard Oil Co. (Alaska), which is charged with maintenance of the pipeline.

EVERYBODY WORKS AT NORMAN

Everyone works at Norman Wells—married or single, woman or man—and everybody eats at the Mess Hall, which seats 400 at each seating. The rush as the doors are opened at each mealtime is one of the sights of the North, resembling a movie mob scene, only more so. Only an occasional outsider finds accommodation, and he must be vouched for by the higher-ups and be provided with a ticket taken up by the checker at the door.

The Canadian Pacific Air Lines' airport, offering the only means of transportation during the greater part of the year, is a mile-and-a-half southeast, or

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Wood is one of Canada's most valuable resources, and since the war its conservation has become more important than ever, for wood has become a strategic war material. It is filling essential war requirements ranging from aeroplanes to explosives. It is closing gaps caused by shortages of other raw materials, some of which it promises to displace permanently. One of the best known examples of new ways in which wood is being used to-day is in the famous Mosquito bomber, which is entirely of plywood construction. Invasion barges are being built of plywood covered with metal. Motor torpedo boats feature plywood construction. Laminated beams are being used to replace steel members in war construction.

The worst enemy of our forests is fire—which in years past has laid waste thousands of acres of forest lands, at cost of many millions of dollars. Guarding our forests against this enemy is the job of the fire patrols of the various provinces. One of the oldest of these in Canada is in Ontario, where the Provincial Government developed the Ontario Provincial Air Service in 1924.

Across the top of the Province of Ontario are thousands of square miles of timber. In 1924 the Province turned to aircraft to do the job of patrolling this vast area, and that year fourteen planes were put into operation. Total flying hours amounted to 2,997, with 975 fires detected in the early stages, and 2,634-000 acres of the province surveyed.

Today the O.P.A.S. operates 29 aircraft, and is the largest organization of its kind in the world. Its scheme of operations has been extended from that of detection to actual combat of fires.

Indicative of the speed with which fires are now reached before they have a chance to spread is a
typical year’s classification of forest fires by size. Of the 1,265 reported, 278 were quarter-acre or under; 506 from one-quarter to five acres; 90 from five to 10 acres; 235 from 10 to 100 acres; 89 from 100 to 500 acres; 23 from 500 to 1,000 acres; 32 from 1,000 to 10,000 acres and eight over the 10,000 acre mark.

The main “fire months” are May, June, July and August, for in the same year under review 1,116 of the blazes were located in those four months with only 149 spread over the rest of the year.

What causes forest fires? The Ontario Provincial Air Service investigates them all. And in cold figures, it proves that a careless smoker in the bush is one of the greatest menaces. The figures run like this, in an average year: lightning 278; campers 271; smokers 219; sethills 103; railways 81; logging operations 45; incendiarists 23; road construction 30; prospectors 3; mining operations 2; miscellaneous 60; causes unknown 160.

With fewer people travelling and camping, however, these figures are expected to show a sharp decline during the war years. In addition, more care is being taken by lumbering operators who are turning out material for war purposes.

Much of the weight of fire detection falls on more than 200 towers, each erected at a regional vantage point. There is communication either by radio or telephone from towers to bases; from ground-to-plane and from plane-to-ground. The Service operates from 18 established bases. One plane is stationed at Algonquin Park; two at Biscotasing; one at Caribou Lake, Fort Frances, Ignace, and two at Kenora. There are three at Oka Lake and one each at Orient Bay, Pays Platt, Pickle Lake. Two are located at Port Arthur, one at Red Lake and three at Sault Ste. Marie, the main base where winter overhaul is carried out. Three more are stationed at Sioux Lookout and one each at Sudbury, Temagami, with two at Twin Lakes.

The machines operate on floats in the summer months, since Ontario’s lakes provide accessible “landing fields” every few miles. Skis are fitted for winter use.

Under successive Ministers of the Crown, Messrs. F. A. MacDougall and George Ponsford, Deputy Minister of Lands and Forests and Chief, Air Service Division, Department of Lands and Forests, respectively, have brought the Ontario Provincial Air Service to its present high state of efficiency despite serious difficulties due to the war. Approximately 46 per cent. of the flying staff have joined the services, and in addition, the Ontario Provincial Air Service has loaned men and equipment to the Federal Government as occasion necessitated.

“After discussion with the various district foresters and senior officials of the Department,” Mr. Ponsford said, “it was decided to embark on a policy of expanding our transport fleet rather than our detection fleet. The addition of observation towers throughout most of the districts has materially reduced the necessity for detection patrols, and the tendency of the work had been more and more in the direction of transportation and less and less in the direction of detection. The department has to-day 16 transport and semi-transport aircraft, eleven detection machines and one intermediate type capable of carrying a pilot and two passengers. The increase in the number of transport aircraft has enabled the department to provide quick and effective action on embryo fires, so that very few have reached the out-of-control stage. This is reflected in a substantial saving in fire fighting costs and a tremendous saving in timber.”

In one year, Ontario Provincial Air Service flew 5,876 hours at approximately 100 miles an hour, or well over the half-million mile mark. It battled fires covering half-a-million acres, with one of these blazes, in the Gogama district, providing one of the worst hazards Northern Ontario had seen in many years. But it is not only in fire detection and suppression that the sturdy Stinsons, Buhns, Fairchildis, Moths and Hamiltons have become familiar all through Northern Ontario. A typical year’s operation since formation of the service includes fire work, game detection, photographs, sketching, ordinary and special transportation, “overfly” flights, ferrying, flying instruction, observers’ instructions, dusting, wireless and radio tests.

Since it first started operation, the Service has carried well over 70,000 passengers and about the same number of personnel. It has flown approximately 9,000,000 miles and carried more than 28,000,000 pounds of effective load. It has trained some of Canada’s greatest fliers, and many noted bush pilots from the Arctic to the Antarctic age graduates of the Ontario Provincial Air Service. Now, many of them are in the Royal Canadian Air Force, the Royal Air Force, the Ferry Command. You’ll find them in Egypt and Africa; in Canada and China, where the Empire needs resourceful and daring pilots or ground crew.

In the actual combat of a fire the men of the Ontario Provincial Air Service have shown they are without peer. The operation is something like this: first, a fire is spotted by either plane or tower. In the case of the latter, location is worked out by triangulation and the nearest plane base is notified. The pilot takes off for a quick look. Through skilled eyes, he judges how many men and what equipment may be required. He may radio his base or the tower so that everything is ready upon his return.

Pumps, shovels and men are waiting. He loads them into the planes and takes off again, landing at the nearest lake. Sometimes it may mean a five-mile portage through heavy bush; again the fire itself may be situated right near the lake. In any case, there is no waste time. The pumps may put out a fire within an hour or so where, were it not for the fast transportation, the fire might have gotten away and run for miles.

Game detection is also an important part of the work. Not long ago, a band of poachers had been taking beaver and other furs from one of the large provincial parks—an area of 2,700 square miles. Waried rangers had tried for weeks to catch up to the group. Finally, the Ontario Provincial Air Service planes did the dirty work for the job. Snowmobiles were spotted from the air which indicated the course the poachers were taking to leave the park limits. Late one night, they started out to apprehend “safely” the rangers were waiting for them. Some of the heaviest fines ever imposed in Ontario for poaching were the result.

Ontario has what are considered the finest boys’ and girls’ summer camps in the world. Forestry (Continued on next page)
THE INSPECTION "LAB"

Making thousands of tests each day, Imperial chemists assure the quality and uniformity of more than 570 Imperial Oil Products.

The research chemist plays a vital role in industry, the inspection chemist plays a role precious but very important by ensuring that the benefits of improved quality and greater utility of products are consistently available to the consumer.

At Imperial Oil refineries across Canada, chemists in modern petroleum inspection laboratories sample and test every batch of every product manufactured to make sure it meets exacting specifications. Tests are made not only of the finished product, but at every step of manufacture, starting with the delivery of the crude oil from the well.

The latest inspection methods are employed. As a member of the American Society for Testing Materials, the Society of Automotive Engineers, and the American Petroleum Institute, the Company receives the benefit of any new testing methods developed by these groups. In addition, Imperial laboratories have developed new testing procedures which have in turn been passed along to the Societies.

SPECIFICATIONS

"Quality control" at Imperial Oil starts with the setting up of specifications. In this, various factors have to be taken into consideration. The use to which the product is to be put is one. Another requirement is the ability of the refinery to produce the required material. This takes into account the type and quantity of equipment, the kind of process available, the general flexibility of the refinery and the crude supply available.

The experience of petroleum chemists in the manufacture and production of petroleum products enables them to set up specific physical and chemical tests by which the quality of a product can be measured. Once they are agreed on what is required and what tests are necessary to carry out an inspection of the material, specifications are recommended which establish permissible ranges in which the quality must be maintained. This ensures not only quality but uniformity, a very important feature.

Specifications have been set up for 570 Imperial products. When a petroleum need arises that cannot be met in this huge range, Imperial chemists will "go to work" on specifications to produce a special product for a special job.

In one such instance, the Canadian Army asked the Company to develop a special lubricant for the front wheeluniversal joint of four-wheel drive trucks. From their knowledge of the properties and the availability of all Imperial products and a number of other associated materials, from their experience in the lubricating field, and from their basic training the chemists were able to form a very good idea of what
was required. Laboratory investigation showed how the lubricant could be made, and the refinery personnel was consulted to make sure it could be duplicated in the plant.

After the experimental product was subjected by the laboratory technicians to a number of practical tests a sample was submitted to the army for actual service in the field. On the army's advice that the performance and the cost of the material was satisfactory, specifications were drawn up by the inspection department.

Specifications for the new product were submitted to the Committee on Standards for final approval. This committee, which is made up of members of the manufacturing and marketing departments, studies the product specifications recommended by the chief chemist. If accepted, a copy of the specifications with instructions on test procedure is sent to the refinery laboratories. These test instructions, followed rigidly by the laboratories, provide quality control of the product.

**TESTING**

The first step in the actual testing of Imperial products is inspection of the crude oil. Samples of the crude oil to the stills are tested at regular intervals and if the tests reveal any variations the operator is advised and the operation of the processing units is adjusted accordingly. Then as the crude is processed the tests are taken to make sure proper results are being obtained in the various steps of manufacture.

In the manufacture of Marvelube motor oils, for instance, tests are made from the time the lubricating oil distillates are separated from the reduced crude at the vacuum distillation unit until the finished product is ready to leave the refinery. At the vacuum unit tests are carried out to see that the proper fractions are being obtained.

From the vacuum unit the distillates proceed separately to the phenol plant which extracts hydrocarbons with poor lubricating properties. The partially refined product leaving this unit is tested to make certain these hydrocarbons have been removed. Also, after the phenol has been extracted from the oil, the oil is examined to see that no trace of phenol remains. Phenol is very expensive, and the tests guard against its loss.

The distillates from the phenol unit go to the dewaxing plant where the waxy constituents of the oil are removed. This operation is controlled by testing the resultant product to see that proper removal of the wax has been accomplished.

The last step in the production of Marvelube takes place at the clay contacting plant where the phenol-

(Continued on page 21)
IN THE vanguard of the United Nations on the road to victory is the diesel engine. Diesel has joined the fighting forces in a war in which men, machines and supplies must be moved great distances swiftly and sturdily. Because of their rugged construction, dependability and the simplicity of maintenance and service, diesels are ideal for use on all fronts.

Diesel engines propel the submarine while it is surfaced, allowing the batteries used when submerged to charge. Diesel-powered destroyers and escorts vessels do coastal patrol and convoy duty, landing barges and invasion craft—diesel-powered—land men and supplies on enemy-infested beaches. Diesel-powered tanks carry the war into enemy territory, while crawler-type diesel-powered tractors pull trucks through muddy roads, drag supplies ashore, and with bulldozer attachment clear and fill in roads and landing strips bombarded and mined by the enemy. Midget diesel locomotives built to European track gauge move supplies from beachheads to the front. The diesel also powers portable generators for auxiliary and emergency lighting.

The development of Diesel fuels to their present state and their supply to the enormous quantities needed have helped to turn the tide of war in favour of the United Nations.

A 2,000 H.P. diesel engine being lowered into a submarine. Power plants like this drive the sub on the surface while its batteries are charging. Also gives it a longer cruising range.

A pancake diesel engine being installed in a tank. Tanks equipped with these diesels are more powerful, have more speed, and are easier to service, allowing more battle time.

Diesel-powered tractors dropping barges ashore with supplies from navy transports. Where shallow water prevents complete docking supplies are usually brought ashore in this manner.

A pumping station on the Canal pipeline which carries crude oil from Norman Wells on the Mackenzie River to the refinery at Whitehorse. Diesel engines are used to operate the pumps.
The first drilling rig in Canada was the spring pole arrangement operated by James Shaw in 1852.

Railroad tank cars were employed before the turn of the century to transport "lamp oil" from the refineries.

NORTH AMERICA'S FIRST OIL WELL

THE celebration in the United States of the 50th anniversary of the Drake Well at Titusville in Pennsylvania brought again the controversy as to whether was the first well in North America that brought commercial petroleum into existence.

Although Drake was the first to discover oil by drilling, it was a Canadian who brought in the first oil well. In 1855 J. H. Williams excavated a well at Oil Springs in Western Ontario, and found that the deeper he penetrated the earth the greater was the yield. This was really the first oil well in North America, although it did not pierce the limestone.

In 1850 the settlers in the vicinity of Enniskillen, in Lambton County—the extreme western part of Ontario—recorded the presence of oil in the swamps of that region. It was called "gum oil" and was present in such quantities as to be a nuisance because it killed vegetation and made the land useless for cultivation.

Williams' experiments in extracting naptha from the "gum" beds led to his digging the first oil well there. Familiar with the existing uses of petroleum in the Old World, he set about extracting what he believed to be the same sort of naptha as that produced by the wells at Bakou. His first equipment was a retort in which the "gum" was boiled. This primitive distillation produced a comparatively light, iridescent, liquid. In the hope that he might obtain greater quantities of raw material by digging beneath the surface of the gum beds he excavated a well.

The experiment attracted many persons to the field, and ten or twelve shallow wells were excavated at Black Creek, in the vicinity of Oil Springs. It was not until February of 1852, however, that actual drilling for oil was attempted in Canada.

This was undertaken by James Shaw, a poor photographer who had lived in Lambton County for many years. With an old-fashioned spring pole worked by foot-power, Shaw at Oil Springs punched the cap of the upper vein of oil rock to a depth of 165 feet. The result was a well that gushed thousands of barrels a day and flowed for a comparatively long period.

The excitement in the oil regions of Pennsylvania was keen when Shaw made his strike and this spread to Oil Springs and to Petrolia. Early gatherers encouraged the belief that the region was richer than Oil Creek in Pennsylvania. Many of the wells produced as high as 2,000 barrels a day. Three yielded 6,000 and the Black and Mathieusen had a record of 7,000 barrels a day for more than two months. Speculators poured in by hundreds and land values soared. Another prolific oil deposit was struck at Bothwell, in Kent County, and the story goes that the first well was sold for a wheelbarrow filled with gold coin. Invaders and promoters came from the United States and many crossed from England to make their fortunes in the new Oil Eldorado. Operators were working independently without any idea of concentrating their energy, and there was a great deal of confusion and loss in the marketing of the product.

By 1868, however, the Oil Springs boom was over. The flowing wells were fading, and as pumping became necessary the interest of the oil-gamblers turned to newer, fuller fields. In 1865, twenty-five wells stopped flowing in one week.

Meanwhile, the feverish activity of the drillers had shifted to Petrolia, a tiny hamlet eight miles north, set in an undrained mudhole which extended for miles. It had been named in 1861 by the first Postmaster, Patrick Barlow, because of the petroleum which oozed out of the banks of Bear Creek and often covered its waters. George L. Thayer and other Bostonians sank curved wells, much like Williams' first well at Oil Springs, to a depth of forty feet and found oil which they refined sufficiently to make crude lubricants.

By 1865 new markets had been found for oil, and the price was $10.00 a barrel. With a number of remarkable strikes in this year a boom developed at Petrolia as quickly as had the Oil Springs boom.

Petrolia leaped ahead just as Oil Springs had done. The population rose to 5,900. The main street was planked and Petrolia had splendid road communication with Sarnia and Wyoming. The streets were lighted, and general stores opened. However, the flow from the wells declined, pumping became necessary, and to-day although Petrolia still produces oil, the production is only a few hundred barrels a day.

The Petroleum Industry has come a long way since Williams dug his shallow well in 1858, and Drake drilled in the following year to a depth of 69 feet. As wells have gone deeper in the search for oil the problem is to find fields to which the spring pole of James Shaw has been succeeded by the cable tool drilling rig, and in turn by the rotary drill. Modern deep drilling has become a complex science, and to-day the driller is penetrating to depths of more than 15,000 feet and producing oil from nearly three miles below the earth's surface.

Today, oil is transported by a network of pipe lines, by fleets of tankers and by tens of thousands of tank cars. Compare this to the 300 home-drawn wagons drawing barrels of oil at a fee of $1.80 a barrel over a plank road to the small refineries which sprang into being following Shaw's strike at Oil Springs. The plank road was a great improvement because wagons could not negotiate the muddy tracks that were the first avenues of communication and the oil had to be drawn on stonecarts, one or two barrels at a time.

In 1888 petroleum meant oil for lamps and nothing else. The other products which were distilled in the search for the "lamp oil" were regarded as nuisances and were dumped in the nearby creeks. To-day, seven Imperial Oil Refineries across Canada produce more than 700 different products from crude oil.

It is delightful if Williams and Drake could foresee that their wells would start a train of events which would eventually become the twenty trillion dollar oil industry of to-day, with over a million employees and four million investors—more people than can claim ownership is any other industry in the world.

Sixty-year-old sketch shows how oil was transported from wells to underground storage tanks.

This sketch of the early Petrolia oil field was published in "Petroleum Canada" in 1922.
treated and dewaxed oil is mixed with special types of clay at moderate temperatures which remove the last traces of undesirable compounds from the lubricating oil. The control of this operation consists of testing for colour and odour.

Carefully tested at each step of manufacture, it would seem that the finished Marvelubes leaving the clay centering plant would need no further investigation. But the inspection laboratory takes nothing for granted. Run to tankage, the finished oils undergo an exhaustive series of tests to see that they meet every specification set for them. These tests include viscosity and viscosity index, pour point, oxidation, flash point, colour, carbon residue, neutralization number, precipitation number and gravity.

To the motorist the viscosity index of an oil is probably its most important characteristic. Viscosity has to do with the rate of flow of an oil at a definite temperature. The ideal motor oil would flow equally well in sub-zero weather as on the hottest day in summer. Unfortunately, there is no such thing as the perfect oil. Some motor oils which perform satisfactorily at engine operating temperatures become thick (viscous) in cold weather. Others which flow freely at low temperatures thin out excessively as the engine warms up. Obviously these oils would be unsatisfactory as engine lubricants and each would be rated by the chemist as having a poor viscosity. While there is no such thing as the perfect motor oil, there are oils such as Marvelube which possess a good viscosity and which flow freely at low temperatures and resist thinning out as the engine heats up, thus providing adequate lubrication over the operating range of the engine.

To determine the viscosity index of an oil, the chemist measures its rate of flow (viscosity) at two temperatures and determines the VI results from standard viscosity index tables. Of course, an oil with even a very high viscosity index would not flow at low temperatures if it contained large amounts of wax, for as the temperature dropped the wax would cause the oil to solidify. The removal of wax is an important step in the refining of a good motor oil and the pour point test is an indication of how well this has been accomplished. The pour point of an oil is the lowest temperature at which it will flow. To find it the chemist gradually cools the oil in a test jar in which a thermometer is inserted, and tests the oil for flow at every five degree drop in temperature.

An important characteristic of a good motor oil is its ability to resist oxidation. Like iron, poorly refined oil will rust (sludge) if exposed to air. At ordinary temperatures this sludging is negligible, but in an engine where the oil is in fine particles and is exposed to air at high temperatures, oils with poor oxidation characteristics sludge rapidly. The chemist tests an oil for oxidation by heating it to a high temperature, and then bubbling oxygen through it. The length of time it takes for the oil to form a sludge under these conditions reveals its tendency to oxidize. An oil with good oxidation characteristics will resist sludging for a long period of time.

Another important characteristic of a good motor oil is its volatility, or tendency to vaporize. An oil of low volatility will not vaporize as readily in the hot cylinders of a motor as will a highly volatile oil, and thus will not be consumed as rapidly. The flash point test is an indication of this volatility, and is carried out by gradually heating the oil in an "open cup" and periodically passing a small flame over the surface until the evolved vapours flash. The temperature of the oil when this happens is its flash point.

The colour of an oil is important in that a light-coloured oil will be free of material likely to form excessive carbon in an engine. The colour test is made by comparing the colour of the oil sample with the colour of a standard reference disc.

The carbon residue test is carried out by burning the oil and weighing the amount of carbonaceous material remaining. An oil with a low carbon residue is of course desirable for internal combustion engines.

When the chemist says an oil is neutral he means it does not contain any acidic or alkaline material. It is practically impossible to remove all of these materials from an oil, but a properly refined oil will contain only very faint traces of either one or the other. In the neutralization number test the inspection chemist determines the kind and amount of acidic or alkaline material present in the oil. If the test indicates that more than the allowable maximum is present, the oil must be subjected to further finishing operations.

To make doubly sure that undesirable material has been removed from the oil the inspection chemist carries out a precipitation test. In this test the oil is mixed with a solvent naptha and placed in a test tube in a centrifuge, which operates very much like a cream separator. If by chance the oil contains any solid contamination centrifugal force causes this material to settle quickly to the bottom. If this occurs, the oil is of course subjected to further refining.

Gravity testing is carried out primarily to enable the shipping department to calculate shipping weights, but it is also a very quick check as to whether an oil has been contaminated with another petroleum substance.

The ultimate test of Marvelube motor oil, or of any Imperial product, takes place not in the laboratory but in use by the consumer. The setting up of specifications and the thousands of tests performed each day by the Imperial inspection laboratories are designed to make them pass that test successfully.
Petroleum needs of the forces in this war are 80 times greater than in the last war. It is four or five times as difficult and costly to find new oil reserves today as it was in the pre-war period. And supplies have to be shipped vast distances, in ocean tankers compelled to travel slowly in convoy and by circuitous routes.

Look at this map. It shows how the oil resources of this hemisphere must be poured out across dangerous seas, to battle areas 4,000, 5,000, 6,000, 7,000 miles away. It shows how oil fields in Venezuela, Colombia, Ecuador, and Peru are being pressed into service to satisfy demand. As much as 67 per cent of the total tonnage of overseas shipping for war consists of petroleum products — more than twice the tonnage of all the men, food, planes, guns, tanks, ammunition and all other material combined.

Canada’s gasoline needs add but an extra burden. We, in this country, produce only 15 per cent of our own petroleum supplies. The rest must be shipped here from abroad. It must be taken from the common pool of the United Nations. More than 60 per cent of it must be delivered by ocean-going tankers. Ships and men—needed to serve the fighting areas — must be risked to provide our home front gasoline.

Your ration of gasoline is an “issue” of ammunition—entrusted to you to help keep vital civilian transportation rolling.

OIL IS AMMUNITION—use it wisely