The Next Seventy-five

Although man has known of petroleum for 6,000 years or more, it is only 98 years since James Miller Williams, an enterprising Hamilton, Ont., businessman, brought in the world's first commercially successful oil well at Oil Springs, Ont., and realized that this black, sulphurous liquid had industrial possibilities. And it is less than 60 years since Man realized that gasoline is one of the greatest sources of energy he has known.

It is against this background that Imperial this year celebrates its 75th anniversary, as the oldest oil company in Canada. Though the company's corporate history dates from September 8, 1880, the story of some of its 16 founders goes back almost to the very beginnings of the oil industry in North America.

William Spencer, who founded the Ontario village of Wyoming, was refining oil in Woodstock, Ont., as early as 1862. "Jake" Englehart, in 1866, was already on his way to becoming one of the giants of the early industry at the tender age of 19.

Today, Imperial is the largest oil company in the Dominion. Its 13,400 employees and nearly 10,000 dealers operate in and contribute to the wealth of Canada's 10 provinces. Much of Imperial's success is due to men like Spencer and Englehart, for they left a legacy of determination in the face of adversity and challenge, and a spirit of improvisation and technical pioneering. This spirit, in later generations, introduced such things as fluid catalytic cracking to Canada, produced new methods of oil processing, and in consequence better oil products for Canadians.

While it is always satisfying to look back on years of progress and achievement—particularly in Canada where 75 years is a venerable corporate age—an industry or a company remains virile and continues to progress by looking forward. Just as in the past Imperial people—drillers, refineries, marketers, engineers and chemists have met and conquered the challenges and difficulties that faced them, so too, we expect, will those of today and tomorrow.

Many of them are already working to beat these challenges. For instance, in Imperial's Sarnia research labs, petroleum specialists are even now designing the gasolines that Canadian motorists will be using in 1980.

The Amazing Jake Englehart... page 2

Jacob Lewis Englehart just couldn't turn down a challenge. At 58, after building an oil empire and helping to found Imperial Oil, he took over the founding T. & N.O. railway, ran it into virtual ruin and made it pay—by Ian Scandlars.

No Need To Shout!... page 8

An unusual telephone in Imperial refineries helps the men on the cat cracker in closer contact with the control room.

The First 75 Years... page 9

A salute to the achievements of the men and women of Imperial who, over 75 years, have built the largest oil company in Canada.

They Called It London-In-The-Bush... page 21

The birthplace of Imperial was for more than a decade the country's major refining center and today is one of Canada's richest and prettiest cities—by Fergus Cronin

Management Changes... page 25

Appointments in the marketing department and the western Canada regional office of the producing department

How They Revived Golden Spike... page 26

A year after it was discovered it looked as if Golden Spike would leave more than half its oil in the ground. Here's how engineers in the field and in the company's producing research lab increased the yield of this reluctant oil field—by Robert Collins

Theo Dinsson, who designed and illustrated the 13 centre pages and the two covers, is a former London, Ont., artist, now working in Toronto. A graduate of the Ontario College of Art, he is 25 years old. Noted for his design work, Dinsson is equally at home in the fields of editorial and advertising illustration. This is his second Review assignment and his largest editorial unit to date. He achieved the woodcut effect by scraping the black-ink lines with a sharp razor blade. Next to his fiancée and his drawing board, his most fond of sports cars—particularly his black MG.

Photo Credits: Peter Cserdon (P. 1); Staff (P. 5, 26-29); M.M. Engio (P. 5); Photographic Surveys (P. 7); Univ. of Western Ontario Library (P. 21, 23); London Free Press (P. 24 top); Ronald Nelson (P. 24); Bruce Reid (P. 26).
At 19, he owned an oil company and built the largest oil refinery in Canada. At 33, he sparked the formation of Imperial Oil and became its vice-president. He then ran the T. & N.O. railroad into virgin bush and made it pay.

In 1905, when Sir James Whitney became premier of Ontario, he discovered that the Temiskaming and Northern Ontario Railway, a provincial government venture which had been launched three years earlier, was in a sorry mess. He needed the busiest man he could find to unravel its tangled affairs, complete its construction, and put it on a paying basis. He appealed to Jacob Lewis Englehart, of the little southwestern Ontario town of Petrolia, a founder and vice-president of Imperial Oil Limited.

"Jake," he is reported to have said, "will you come to the rescue and run the T. and N.O. for me?"

"I'll be happy to," Englehart is reported to have replied, "What is it?"

The thinning number of men who remember the amazing Jake Englehart still tell this apocryphal story because it throws a light on three facets of his complex character: he was always willing to help a friend, he reached decisions instantly, and he was not afraid to tackle anything. These traits might have ruined an ordinary individual. But Englehart seldom failed at what he tried.

When he established his own oil company, as a rawboned youth of 19, older men laughed at him and predicted his bankruptcy. They stopped laughing when within a few years he had built, and successfully operated, the biggest refinery in Canada.

At the age of 33, he was the organizing genius behind the move that brought 16 leading oil men, businessmen and political figures together to form Imperial Oil. And at 58 as chairman of the Temiskaming and Northern Ontario Railway—now called the Ontario Northland—he took on the unfamiliar task of stretching steel into the wilderness and opening up the rich northern Ontario mining territory.

He also, at one time or another, made a single uproarious appearance in police court; initiated workmen's compensation long before governments thought of doing it; and built a mansion with a private golf course for his wife. When she died, in 1908, he turned the mansion into a hospital in her memory and endowed it with Imperial Oil stock which has maintained it ever since. Finally, in his old age, living in a suite in a hotel, he corresponded with an army of nieces and nephews and wrote...
a will which named 139 beneficiaries and disposed of an estate of more than $3,500,000.

Books have been written about far less engaging figures, but Englehart shinned publicly and kept himself in the background so that curiously little is known about him today. The facts of his life have been pieced together from fragments—from a few paragraphs in an old volume of biographical sketches of prominent Canadians, from items in old newspaper files, and from the recollections of old Petroleums like Dave Storthers, who had a tailor shop in the town for 70 years, and Len Howlett, a retired contractor.

**His Own Office in New York**

The biographical volume says he was born in Cleveland, Ohio, on November 2, 1847, a son of S. John Joel and Hannah E. Englehart, and that in 1866 he formed L. J. Englehart and Company, "refining, producing, and exporting Canadian petroleum," with a refinery at London, Ont., and an office at New York. The volume does not say what his father did or how Jacob Lewis Englehart, at 15, had acquired enough cash to come to Canada and set himself up in business. But the American Civil War, which in 1866 was just newly over, had given many Northerners opportunities to make money. Englehart may have been one of them. Or he may have been backed by his father. In either case he required a relatively modest amount of capital. Refineries, in 1866, were cheap, tiny contraptions which looked like overgrown ink bottles. The largest of them had a capacity of only a few hundred barrels a week.

They were risky investments because many of them blew up. But those which didn't explode yielded high profits, for throughout North America people who had always burned a mixture of whale oil and lard in their lamps were clamoring for the wonderful new lighting fluid, kerosene, developed by Dr. Abraham Gesner of Nova Scotia. Southwestern Ontario was then one of the chief sources of the petroleum from which kerosene was distilled. That's how the industry was when Englehart came to Canada.

While his first refinery was being erected in London, Englehart traveled through the oil fields persuading small producers, mostly farmers with oil wells in their pastures, to let him handle their oil and sell it through his New York office. Before his refinery started operating in the fall of 1866 he had an assured supply of crude petroleum to feed it.

He had this in spite of competitors who followed him around spreading word that he was "out behind the ears," too young to be trusted, and, what was worse, a city slicker from the States. Ironically, a practical joke and his one appearance in police court enhanced his popularity with the producers in the back concessions and defeated the efforts of his competitors.

Englehart, at the time of this affair, was a guest at the Tecumseh House in London and one evening as he was going out for a stroll he noticed two wooden spigots from beer kegs on the hotel proprietor's desk.

On the street a couple of minutes later he encountered the head of the game protective association, and, on an impulse, informed him gravely that he suspected the proprietor of the Tecumseh of breaking the game laws, as he had seen two woodcocks in his office. Without checking up, the president of the game association rushed off and laid a charge against the hotel-keeper. Englehart was summoned as a witness.

Called to the stand he confirmed his statement that he had seen two woodcocks on the proprietor's desk.

"I have them here," he said, producing the spigots from his coat pocket.

Everybody roared with mirth—except the president of the game association. And in the back concessions, where a good joke was appreciated and hunting restrictions were disliked, the incident cemented Englehart's prestige and his reputation of being a "real man even if he looks like a schoolboy."

Englehart was to rock London on two other occasions—but not with laughter. On April 9, 1869, his refinery exploded with what newspapers termed "a report that rocked the town." But, if the blast shook windows, it injured nobody and the damage was estimated at only $2,000. Less than seven weeks later it was ripped by another explosion. This caused $6,000 damage.

One paper reported the explosions was the Wyoming News Letter, published at Wyoming, in the heart of the Ontario oil fields. It was in this same year, 1869, that the New Letter ran an editorial advocating a new oil company "with a capital of $500,000" to enable Canada to carry on "an export trade of larger proportions." Englehart never forgot this editorial and 11 years later when Imperial Oil was born it had precisely what the News Letter recommended—a capital of $500,000.

But other things were to happen first. Englehart rebuilt and expanded his London refinery and in 1870 got an order for Germany for a $30,000 shipment of kerosene. When the shipment reached its destination it was rejected on the grounds that it was not up to specifications. The cost of bringing the kerosene back to London, refining it again, and returning it to Germany, would have been ruinous. Englehart met the emergency by sending refining equipment to Germany and re-processing the kerosene there—a procedure which reduced his losses.

Meanwhile he had been acquiring oil wells at Petrolia, where dollars were spent on oil wherever they sank a hole and where oil even flowed down the deep runs of the main street. And—perhaps convinced by the German experience—he decided that in addition to his London refinery he needed a second refinery close to the oil wells. So, in the muddy, boiling, excited little town of Petrolia, he bought a refinery and enlarged it until it was reputed to be the biggest and most efficient in the world. He also laid a system of pipes through which oil could be pumped right into his plant.

Dave Storthers, who tailored in Petrolia for 70 years, recalls Jake Englehart as he was then. He recalls, being a tailor, that Englehart was about five feet, thick-set, and that he was always immaculately dressed.

He preferred dark suits and wore thick-soled shoes with a high shine, a high starched collar, eyeglasses with a broad black ribbon, a moustache, a Vandyke beard, and, invariably, a flower in his buttonhole.

**He Was All Business**

"He was a nice man," says Storthers, "but all business—all business, no fooling. Used to back here one time, him and Ed Kirby, the first mayor, bawled together in a frame house."

He was dealing with Ed Kirby in 1880 when his dream came true—the dream of an oil company with financial resources large enough to improve petroleum products, create new outlets for them, place the Ontario oil fields on a solid foundation and meet the competition from American fields. After months of negotiations in which he played a leading role, Imperial Oil...
Company Limited—now Imperial Oil Limited—was formed. Englehart became vice-president and assumed an active role in managing the new corporation.

The new company absorbed refineries belonging to some of the 16 original shareholders, and used the equipment to enlarge Englehart's London and Petrolia plants. These became the first Imperial refineries.

**IN TWO WEEKS MAN RE-HIRED**

Englehart was at the plants six days a week from morning till night. Refining was still a hazardous trade. Englehart instituted a system by which funds were set aside to compensate men injured at work, but he also reduced hazards and preached safety roles.

Once he saw a man running through a dangerous part of the refinery. He fired him, but re-hired him two weeks later and from his own pocket paid him the wages he had lost.

The new business grew even faster than he'd expected. Within three years of its inception, Imperial products were selling throughout the pioneer settlements of the prairies and reaching across the Rockies. Englehart traveled here, there and everywhere, handling the company's affairs. But some of his trips were short and purely personal for he'd fallen in love with Charlotte Eleanor Thompson, daughter of Thomas Thompson, a prosperous farmer at Adelaide, near London. They were married in December, 1891.

Englehart, whose wealth was increasing daily, built a red brick mansion for her—a massive bit of Victorian architecture on a hill. He terraced and landscaped the hill from its crest down to a meadow through which a creek flows—a creek with oil slick on the surface.

Once, when they were away on a holiday, they discovered they liked golf. Englehart built a nine-hole course on the meadow at the foot of his hill and introduced the game to Petrolia. For years he fought a constant battle against the creek, which had a habit of overflowing its banks and flooding the golf course.

Les Howlett, a retired contractor who knew Englehart well, tells of being engaged to construct a retaining wall along the bank of the creek. "He spent thousands of dollars trying to stop the water from flooding his golf links," he chuckles. "He was a good man to work for. He kept his eye on everything and saw it got his money's worth—but he was fair. One real hot day he thought my crew was loafing. He said so. 'Well,' I said to him, 'don't you think it's a pretty hot day to be going too hard in the sun?' 'Yes,' he said, 'perhaps it is. Here, have some tobacco for your pipe.' That's the way he was here—and I guess they liked him up north too."

Up north he prosed a railroad into almost virgin bush country! Englehart spent a lot of time there after he accepted the chairmanship of the T. and N.O. from Sir James Whitney. It was a new adventure for a man who was a pioneer at heart. The salary that went with the job, which was supposed to be very much a part-time job, was $5,000 a year. Englehart made the job very nearly a full-time job and gave his salary away to north country settlers who needed help.

Until 1908, when she died at Toronto, his wife often accom-

panied him on inspection tours in his private railway car. After her death Englehart gave Petrolia his red brick mansion, which became the Charlotte Eleanor Englehart Hospital. He set aside to support it, Imperial Oil stock that was then worth $38,000 and is now worth many times that, so the hospital has cost Petrolia's taxpayers nothing. Englehart also gave Petrolia his golf course, and a set of chimes for the Anglican church he and his wife attended. Then, to forget his grief, he went back north to the T. and N.O. It was still under construction and in 1911 it reached Petrolia just as the worst forest fires northern Ontario had ever experienced broke out.

Englehart worked night and day organizing relief for fire refugees. His trains carried hundreds of fire refugees to safety. He spent his own money freely to buy food for people who had been left penniless and at the height of the disaster he tacked up a sign on the station at Englehart, a town that was named after him. It read simply: "No one need pass here hungry. J. L. Englehart."

**FOREST FIRES HARD ON RAILWAY**

The forest fires and the rains they left in their wake complicated the difficult task of making the railway pay—but Englehart made it pay anyway. He watched every cent of expenditure and a section hand said of him, "If there's a match missing on this line, Englehart knows it." Gradually, as the line probed further into the bush, one mine after another came into production to provide freight, and new settlers moved in to create passenger traffic.

It delighted Englehart to watch this happen, but, by the end of the first world war, it was too old and ill even to run his favorite railroad. He took rooms in the old Queen's Hotel in Toronto which stood on the present site of the Royal York Hotel. Having no children of his own—he had sometimes told friends sadly that his children were an oil company and a railway—he wrote warm little letters to his nieces and nephews, and to their children. He also wrote his last will and testament.

"To Lorne Frank Englehart of New York my five-stone diamond ring; to my nieces Blanche R. D. Dittonhofer and Estelle Dittonhofer of New York my French concave glass cabinet and contents; to my wife's nieces Eleanor Lyle and Nora Lyle, photographs of my late wife, her mother and myself; to my nephew Howard Lindeman my cobalt blue France vase and two steel engravings, The Wedding Ring and The Soap Bubble . . ." Thus the will went, on and on, naming 119 beneficiaries. For many of them there were large sums of money but there was also, for each, some sentimental memento—a silver match box, a walking stick with a root handle, a mahogany desk. It was typical of the man that he remembered which of his possessions each of his beneficiaries had admired.

When he died at 73 on April 6, 1921, at Toronto, his legacy also included a railroad that had opened up the north and an oil company that had grown into a national enterprise with refineries in Sarnia, Montreal, Regina, Vancouver and Halifax, and its products sold in every Canadian province.

Jacob Lewis Englehart was buried at Petrolia beside his wife. As his funeral procession wound through the little town—which he had helped build into Canada's first oil capital—all window shades were drawn in respect. And rough, tough oil drillers wept.
No need to shout!

Take two tin cans, join them with a length of string and you have a small boy's primitive telephone.

Imperial engineers, working with a principle that differs little basically from that of the small boy's toy, have solved a major problem of communications on the large processing units in the company's refineries.

Men working high up on the catalytic crackers, which are often 10 or 12 stories high, and on the huge vacuum distillation units, have to be in frequent touch with engineers in the control room on the ground.

Ordinary telephones are susceptible to the noise and vibration of the large processing units. To lick the problem, Imperial engineers are using a telephone—based on a wartime development—that needs neither electricity nor batteries—it is powered by the human voice. The "sound-powered telephone" is vibration-proof, corrosion-proof and does not distort the voice as an ordinary telephone does on occasion.

Like the small boy's toy, the sound-powered telephone consists of two receivers and a connecting cord. The difference is that inside the sound-telephone receivers is a special magnet, made from nickel, aluminum and cobalt.

It works like this. The voice rattles a diaphragm in the receiver as in an ordinary phone. This stimulates the Alnico magnet, which sends a slight current through the cord to the other end. Here the current is translated back into voice by the diaphragm of the second receiver.

As the magnets, which are the heart of the operation, remain constant in power, the instruments have an unlimited life.

One of the biggest advantages of the sound-powered phone is its mobility. The man on the cat cracker or vacuum tower carries his receiver—just like an ordinary telephone receiver—in his pocket and plugs it in wherever there is an outlet. Engineers are installing 60 outlets on the two processing units at Sarnia refinery. These outlets will be linked directly to the control room. Similar systems are already in action at Leduc refinery, near Vancouver, and at Imperial's Regina and Montreal plants. It is also to be installed at Edmonton refinery.

Should the control room engineer wish to talk to someone on the cat cracker, he calls for him on a special amplifying system. The man makes his way to the nearest outlet and plugs in his sound-powered receiver, gets his instructions and reports back if necessary. Should an operator on one of the units need to contact the control room, he first calls on the amplifying system and then plugs in his phone.

Though at Sarnia they will be used only over the short distances between the processing units and control room, the telephones are effective up to 30 miles.

All of which goes to show what an engineer can do with an idea like two tin cans and a length of string.
London, Ontario, in 1880 was a bustling little town. It was already the commercial centre of the rich farming lands of southwestern Ontario, and for some years had had a nest of foul-smelling little oil refineries in its east end. So on September 8, 1880, when another oil company hung out its shingle in London East, the sign didn't create much of a stir. It read: Imperial Oil Company Ltd.

The new company was the latest venture of 16 local business and oil men, many of whom had operated refineries in Woodstock, London and Petrolia and taken part in the development of the oil fields at Oil Springs and Petrolia. Some of them had been partners in oil ventures before; all of them knew that the Canadian oil industry was at the crossroads, and that this might be their last oil venture.

The era of overnight fortunes, which came with the birth of the North American oil industry in the flat muddy fields bordering Black Creek in Ontario's Lambton county, had ended. Canada's sulphurous crude was losing both foreign and domestic markets to the better quality, more abundant crude from Pennsylvania.

The price of kerosene, the industry's major product, had skidded from $1 a gallon to 12 cents. Drillers were leaving for more prosperous fields in the U.S. and Europe. Companies which had been in business since the early 1860's were closing.

Only a company with refining capacity big enough to supply a large market, and financial resources strong enough to fight for that market could survive. Imperial's 16 original shareholders organized such a company. It had $500,000 capital and received a charter "to find, produce, refine and distribute petroleum and its products throughout Canada."

The men who backed the new company were young. Forty-year-old F. A. Fitzgerald, its first president, remained at the company helm for 20 years; J. L. "Jake" Englehart, first vice-president, was 33 but had been in the oil business for 14 years; the treasurer, W. M. Spencer, was 28. None of them lacked experience in the fiercely competitive oil business and they took the company's broad charter quite literally.

One of the first moves was to hire Herman Franch, an eccentric little German chemist, who had operated refineries in London with Spencer and J. R. Mintzokick, another of the shareholders. Franch devised a more efficient distillation process which reduced the amount of sulphur in the refined oils and made the Canadian
product more competitive with the pure, sulphur-free kerosene from the U.S. With a better product in hand, a London oil dealer, H. E. Sharpe, was sent to scout for sales in the settlements of western Canada but before his reports could get back, lightning struck Imperial’s London refinery and it burned.

Rather than rebuild in London, the company’s crude refining operations were concentrated at its second refinery in Petrolia, in the heart of the Larriston oil fields, and the former Enfield refinery there—at the time it was built, it was the biggest in North America—was expanded. A smaller plant was maintained in London. With kerosene and axle grease coming off the production line again, a young salesman, S. B. Blackhall, was sent to assist Sharpe in the west. For five years these two ran Imperial’s western operations. Their territory stretched from the Lakehead to the Pacific. Their headquarters were a dingy second-floor room in Winnipeg, a muddy frontier town of 6,000 people.

Carloads of oak barrels filled with oil products went out to the end of the rail line and then were relayed by oxen to Haldon’s Bay posts across the prairies. Barrels were so scarce that refunds of $1.25 each were offered, but homesteaders preferred to keep them to catch rain or to saw in half for washboards and primitive armoires.

James Grassick, Imperial’s first agent in Regina, recalls that a salesman’s average trip meant six weeks of driving horse and buggy over hundreds of miles of bad roads and horse trails. Bed at night was often a buffalo robe on a granary floor, or at best, a makeshift cot in some lonely farmhouse.

By 1893 the new company was firmly established in the domestic market. Its refining plant at Petrolia was again expanded and now sprawled over 65 acres. It had 11 branch sales offices in eastern Canada selling products ranging from illuminating oils and lubricating greases to cokes, paraffins and candles. Among its best customers were the lighthouses of the federal government and the rapidly expanding railroads.

In fact, the company’s very success brought about a major crisis in 1897. If it were to take advantage of the markets it had pioneered in the west, it would again have to expand. The demand for its products far exceeded its capacity to supply. After months of unsuccessfully attempting to raise money in Canada and the United Kingdom to finance the expansion, Imperial approached Standard Oil Co. of New Jersey. Standard Oil was already operating in Canada through Eastern Oil Co. in

The Waterman's began their Atlantic refinery in 1906.

When London refinery burned in 1906, Petrolia became the company's refining centre.
Halifax and other marketing agencies. The link with Standard gave Imperial ready-made marketing outlets throughout eastern Canada, and the new capital allowed the company to take over and enlarge a refinery at Sarnia on the St. Clair river; a site offering access to cheap water routes. The Petrolia plant was closed, and many of its processing units moved to Sarnia.

The new Sarnia refinery—which grew to be the largest in the Commonwealth and still is the biggest in Canada—became the company’s head office and remains so today, although the executive offices were moved to Toronto in 1916.

Among the new employees recruited to staff the new refinery were men eventually destined to guide Imperial through one of its most important phases of growth. The manager of the refinery, C. O. Stillman, was a future president. So was W. J. Hann, the company’s legal advisor. Another new arrival was a smooth-faced youngster, Tom Montgomery, who became Imperial’s chief engineer and directed construction of refineries from coast to coast.

Cumbernauld, gasoline-powered tractors were just beginning to nudge out their lumbering rival, the steam-engine tractor, when Montgomery went west to start construction of 3,000 bulk storage tanks across the prairies. Prefabricated at Sarnia, the grey metal tanks were built to fit two to a railway flatcar for shipment west. With squat “box-car” rail stations and towering grain elevators, they became one of the first landmarks of many new settlements.

As a stimulant for the oil industry’s growth, the tractor ran second only to the automobile. There were only 565 cars in Canada in 1905, but just a dozen years later 57 McLaughlin Bucks were a day’s sales for one garageman in a small Saskatchewan town. The auto had become part of Canada’s daily life, and its demands brought another institution—the service stations. Canada’s first service station was a primitive thing—an ordinary kitchen hot-water tank mounted on a concrete pillar outside Imperial’s warehouse at Vancouver’s Smythe and Cambie streets. Thumb and forefinger were used to control the flow of gasoline through a length of garden hose.

Back at the turn of the century, Imperial officials had been confident that Sarnia refinery would meet all future demands, but they had reckoned without the internal combustion engine. Gasoline, formerly petroleum’s problem product confined to the hardware or laundry as a cleaning fluid and often burned as waste, became the industry’s best seller. Now, Imperial had not only to launch a major refinery building program, but also had to look beyond the dwindling Canadian fields in Lambton county for a supply of crude oil.

With the men at war, women often had to man the gas pumps.
To meet the immediate demands for more crude, a pipe line was laid from Cuyug, Ohio, linking Sarnia with the U.S. Mid-Continent oil fields. The same year, 1914, Imperial formed a subsidiary, International Petroleum Co. Ltd., to develop oil properties in South America. To western Canada, then wildly excited by the discovery of oil in the Turner Valley, near Calgary, Imperial sent a geological party. But before it accomplished much, Canada was at war. Reducing oil products for the first mechanized war became more important than wildcatting. As a step in boosting gasoline production, Imperial installed the country's first cracking equipment in its Sarnia plant.

Dynamite blasts and the ring of axes disturbed the quiet of the bush at Burrard Inlet, north of Vancouver, as workmen hacked out a site for Imperial's second refinery and British Columbia's first. The plant was finished in 1914, but German raiders in the Pacific captured the first cargo of crude, and delayed the refinery's opening until 1915. The next spring Montgomery did an even faster job of erecting the first prairie refinery at Regina. Construction began in February. The weather was bitterly cold and water pipes had to be buried 7½ feet below the surface. Spring muds followed the ice and frost, but the refinery was complete by July. That year too, Imperial's Montreal refinery was built, in 1918, across the harbor from Halifax, Imperial's fifth refinery went on stream. In four years the company had more than doubled its refining capacity.

While engineers, plumbers and pipelayers were building refineries ashore to increase the supply of oil products, tankers of the Imperial fleet—which began in 1908 with three lake barges—were running the German U-boat blockade bringing crude oil north to Canada from South America. Three were lost. An International Petroleum tanker, the Lac Blanche, stood its ground and with its single 12-pounder fought it out with a German submarine. When finally forced to abandon ship, the crew was rescued by an American sub-chaser.

The war had interrupted Imperial's intended search for oil in western Canada. The first test well—a dry hole—had been drilled at Coquitlam, Alta., in 1917, but it was not until two years later that the first planned geological survey of the west was started. It was directed by a candy-chewing English geologist, Dr. T. O. Bosworth. Bosworth, described by a colleague as a "strange mixture of absent-minded professor and Wall Street lone wolf", covered the great sedimentary area from the U.S. border to the Arctic circle and laid the groundwork for future geological surveys.

On his recommendation, an Imperial drilling party fought its way 1,100 miles down the Mackenzie river to Fort Norman, just below the Arctic circle, where 130 years before explorer Alexander Mackenzie had watched Indians coating their canoes with a "biseman" substance they found seeping to the surface. North of Fort Norman, geologist Ted Link made an arc with his arm and told the crew to drill "anywhere around here." By an amazing stroke of fortune, they found oil. Later tests revealed that had the crew drilled a few hundred yards away in the one-shot wildcat venture they would have missed the field.

A diminutive British army veteran, Ronald McKinnon, trekked 1,250 miles through 40 below weather to bring out news of the Norman Wells operation. This six-week marathon underlined Imperial's belief that aircraft held the key to the north.

The company had already made the first flight north of the Hay river in 1919. Within three years it was operating its own planes up and down the Mackenzie and became the first company to use aircraft in the north. Since then planes and helicopters have carried Imperial geologists and exploration crews onto almost inaccessible mountain tops and deep into the North-west Territories bush.

With no markets near enough to warrant bringing the Norman Wells field into production, Imperial turned again to the prairies in its search for oil. It entered the Turner Valley field in 1921 through a subsidiary, the Royalite Co., and built a refinery at Calgary.

While bearded geologists and heavy-booted drillers were combing the west and northwest, there was a lot of white-collared pioneering going on in the company's laboratories and offices in the east.

In 1924, Dr. R. K. Stratford, a young man with degrees from universities in three countries, applied for a job. He was hired. In the beginning he shared a corner of another man's desk and was a one-man research group, but by 1930 he was head of a modern research and testing laboratory. From that lab and its successors have come processes which gained worldwide recognition and one; the phenol treatment for high-grade fabri-
eases; solvent dewaxing of lubricating oils; clay treatment to improve storage stability of gasoline; suspension cracking which produced high octane gasoline and hydrogenation gases for synthetic rubber and plastics.

Another type of research was going on in the company's offices—practical research in human and industrial relations. From this "lab", at the end of World War I came the eight-hour day for Imperial employees, and in the same year a unique system of employee-management joint council which, in its first five years, made nearly 1,200 adjustments on wages, working conditions, hours of work and industrial representation. This was followed by the Co-operative Investment Fund which enabled employees with one year's service to become shareholders in the company. A retirement plan and later a scheme for hospital and surgical benefits were established.

On November 1, 1932, Imperial again set an industrial precedent when it introduced the five-day, forty-hour week to Canada.

It was during the Thirties too, that Foster Hewitt, one of the best-known radio voices in Canada leaned towards a network microphone in Toronto's Maple Leaf Gardens, and said: "Hello Canada", when Imperial took over that national institution—Hockey Night in Canada. Now in their 18th year, the Saturday night National Hockey League programs from Toronto and Montreal are listened to by more than three million Canadians and seen on television by thousands more.

During the last war special re-broadcasts of the games were beamed to Canadian troops overseas. That was one of Imperial's easiest war assignments, but the conflict also tossed it some tough ones. It co-operated with the federal government in the establishment of Polyrene, a crown corporation producing vital synthetic rubber at Sarnia. It joined with both the Canadian and U.S. governments in the famed Canal project which supplied oil products to the Arctic defense forces. Imperial drilled more than 60 wells in the Norman Wells field while others laid a pipe line to Whitehorse and built a refinery to process the Norman crude.

One of the war's best guarded secrets was "Operations Shuttle" on the east coast, which kept oil supplies flowing to Great Britain during the two years before the U.S. declared war. The oil was gathered in a huge storage plant built and operated by Imperial at its Halifax refinery for the British Petroleum Board. Despite the great numbers of tankers which centered their operations on the refinery, only a handful of persons knew of the system. Unable to deliver oil direct to Britain, neutral American tankers dumped their cargoes at the storage plant, where the crude was picked up by British and Canadian tankers.

The horse-drawn wagon yielded to the more efficient tank truck.
and fared to England. Four Imperial tankers, and three under charter to the company, were sunk by enemy submarines.

Throughout the war Imperial kept up almost single-handedly the search for oil on the prairies. The tempo was stepped up when peace came. The break in the 30-year search—in which Imperial drilled 133 dry holes—came one cold February day in 1947. For weeks, Imperial toolpush Vern Hunter had been running along a wildcat well in untried territory 15 miles southwest of Edmonton. Then on February 13th, while newspapermen, radio men, legislators and sightseers watched, oil and gas gushed up from Devonian lignite 800 feet below the ground. The now-famous Leduc field, herald of a new era for Canadian oil, had come in.

For Imperial, Leduc meant doubling and redoubling its efforts and expenditures, to develop, produce and refine the new Canadian supplies of oil. To raise capital, the company sold its subsidiaries, International Petroleum and Royalite. As new wells proved Leduc to be a major field, Imperial bought the wartime Whitehorse refinery and dismantled it. An army of huge diesel trucks hauled 7,000 tons of steel pipes, boilers, tanks and towers more than 900 miles over the Alaska highway to Dawson Creek, where it was reloaded on railway flatcars for its new home, Edmonton. Here it was enlarged, modernized and reassembled into an almost new refinery. Woodend, Redwater and Golden Spike fields followed as Imperial drilling crews spread out over the plains around Edmonton, and it became obvious there was oil enough to supply all the prairies. To supply other areas, Imperial initiated construction of the Interprovincial pipe line in which it now holds a minority interest. Originally planned to extend only to Regina, the line was laid 1,129 miles across the prairies to Superior, on the Great Lakes in a record-breaking 150 days. Later it was extended to Sarnia.

With an oil supply for the west assured, Imperial built its ninth refinery at Winnipeg, and continued an expansion of its other plants. At Montreal, in 1948, Imperial had built Canada's first fluid catalytic cracking unit to make high octane motor gasoline. Even more advanced versions have since been installed at Sarnia, Regina, Edmonton and Vancouver. Another is under construction at Halifax.

Today Imperial, as the largest integrated oil company in the Dominion, keeps 13,300 employees busy in all parts of the country. Geologists probe the backland of the north, the low-lands of the St. Lawrence, the farmlands of southern Ontario, and the broad acres of the prairies—still looking for, and producing, more oil for Canada. In the research labs at Sarnia, chemists are seeking better ways of using the oil that is found. In the nine refineries from Halifax to Vancouver, lofty towers break crude oil into 648 products while engineers devise better ways of using the chemists' discoveries. And the marketers, who already have spread a supply network through all 10 provinces, are continuously searching for more efficient methods of getting the finished products to Canadians.

On that September day in 1958, when 16 oil prospectors pooled their resources to rescue the failing industry, they did so with great hopes but grave doubts. Their hopes have more than been fulfilled and the future promises more achievements to come.
Many of the group were prominent in London's civic as well as business life, and in the political leadership of the province. Frederick Arndt Fitzgerald, who became president, had interests in groceries, furniture and liquor as well as oil. A block of buildings on London's main street, Dundas Street, once occupied by his stores, is still called Fitzgerald Block. He was one of the builders of the London Water Works in 1876.

T. H. Smillan, a ticket agent for the first railway to Port Stanley, started a company to produce chemicals for the oil business, then became a refiner. For many years he was president of the London Water Board. There were also three Waterman brothers. Isaac Waterman was on the first council of London, then became its reeve, and later was president of the London Board of Trade as well as hospital trustee. He organized and operated the first municipal steam heating company in Canada. In 1866, with his elder brother, Herman, he formed the Atlantic Oil Company. Waterman won for himself the distinction of Chamberlain of the Legion of Honor at one of the Paris Expositions. The pair shared their business life until 1903 when they died within a few days of each other. Finally, there were Joseph Seymour Fallows, William English, and William Dawson Cooper, all Londoners.

**TELEPHONE JUST INVENTED**

In spite of the slump in the oil business, the year 1880 was a prosperous year in Canada, the best the 13-year-old Confederation had for seven or eight years. It was a progressive era. The telephone had only recently been invented in Brantford, Ont., and the London Advertiser of Sept. 18, 1880, carried this item: "Mr. Thomas A. Edison states that he has succeeded in making the electric light entirely practicable for all illuminating purposes." The standard of living was rising steadily. The London Free Press commented: "Of what use are church bells in a country where every family has a clock and every grown man carries a watch?"

Much of London's prosperity came from the oil refiners and car shops, where expanded employment doubled the population between 1866 and 1872. When the first CPR train chuffed into London in 1887, it brought the advantages of competitive freight rates and access to the rapidly developing markets of western Canada and the plains.

But with all its expanding industries and population it must have been a law-abiding community because in 1877 there were 32 applicants for the office of chief of police. London then was already a sporting town. In 1877, when the population was only 17,000, "Jake" Englehart contributed the money to organize the Tecumseh Baseball Club. Largely because of the pitching of Fred Goldsmith, a husky, 21-year-old six-footer from New Haven, credited by some to have invented the curve ball, the Tecumsehs swept the 11-team International League and won the championship.

In 1880, gravel roads had just started to cobble the district. The city was proud of its planted streets, of its cigar industry, its brass, metal and ironworks, and proud of its oil refineries.

The formation of Imperial had an almost instant buffeting effect on the faltering oil industry. The new company bought out many small refineries in London and Petrolia and provided an assured market for Ontario crude, which until then had been going begging. Its success was indicated by the London Advertiser's "Weekly Oil Report," on Sept. 24, 1890: "The market for crude has been booming during the past week, the figures having jumped from $1.66 (per barrel) at our last issue to $1.95 today .... the sudden appreciation is traceable to the action of the Imperial Oil Co. ... Probably the activity in drilling (at the Petrolia fields) at the present time has never been equalled in the history of the trade."

To increase demand for its kerosene, Imperial imported and distributed a new type of German lamp with centre draft which brought with it a brighter light.

Some of the partners were also able to opportunities created by western settlement. The Free Press of Aug. 24, 1880 reported: "Mr. Charles N. Spencer has just returned from his trip to Manitoba and speaks glowingly of its prospects." On another occasion W. M. Spencer (his son, Maj.-Gen. A. C. Spencer of London, recalls) decided to take advantage of a reported shortage of illuminating oil in Vancouver. Two carloads were sent off, while Spencer took a train for San Francisco and from there a boat to Vancouver—until 1885 this was the only oil transported to the Canadian coast. Sight unseen, he sold his two carloads at a good price and returned home with the proceeds in a money belt.

In the years that followed, the general conditions of the oil industry improved. Advances were made in the distillation of creosote oil and methods were discovered for eliminating the sulphurous smell of Canadian oil. The growth of eastern Canada and the opening up and settling of western Canada increased consumption. The growing use of machinery created a demand for lubricating oil. Then, in the last decade of the century, the invention of the internal combustion engine created a market for gasoline—one of the products of distillation which until then had been considered waste—and the modern phase of the oil industry was born.

By that time London had ceased to be an oil refining centre. In the early Eighties fiercer U.S. competition convinced surviving oil companies they would have to reduce costs. Some did this by moving to Petrolia, closer to the source of supply, while others planted a pipe line from Petrolia to London and asked the London city council to contribute $20,000 towards it. But London had had more than it wanted of fires and explosions, which were commonplace among the early refineries, and in 1883 city council turned down the request, even though oil had contributed handsomely to the city's prosperity. Most of the refineries therefore moved to Petrolia, including that of Imperial Oil which a few weeks earlier had been struck by lightning and burned to the ground.

Imperial continued a small plant in London, manufacturing an early warehouse. London still houses key Imperial operations.
Veteran Taylor has been appointed western Canada regional manager in charge of the company’s producing operations in the four Western provinces and the territories. Formerly management assistant, Mr. Taylor succeeds W. J. C. Mackenzie who was elected a director in April and who was later appointed general manager of the producing department.

Borns in Winnipeg, Mr. Taylor holds a B.A. and B.Sc. in geology from the University of Manitoba. After working for eight years as a subsurface geologist, for the federal and Alberta governments, mostly in the Turner Valley field, he joined Imperial in 1937 as a petroleum engineer. In 1945 he became operations manager of the western producing division in Calgary and held this position when the Lewis field was brought in on Feb. 13, 1947. He held a similar position in the producing department in Toronto for three years and in 1951 returned to Calgary as management assistant.

Jack A. Armstrong has been appointed to the new position of western Canada assistant regional manager. He was the assistant exploration manager of western producing.

Mr. Armstrong joined the company in 1942 as a geologist. He served for a few years with affiliated companies in Oklahoma and Kansas, and returned to Imperial in 1947 to take a senior geophysical position. When the Edmonton exploration district was formed in 1951, Mr. Armstrong became its manager. Two years later he transferred to Calgary as assistant exploration manager of western producing.

Mr. Armstrong comes from Dauphin, Man. He holds a degree in geology from the University of Alberta and is one in chemical engineering from Queen’s University.

Douglas B. Loyer, manager of the Regina district exploration office for the past year, has been named western Canada regional exploration manager. A native of Winnipeg, Man., Mr. Loyer received his early education in Bantff. He graduated in geology from the University of Alberta and took one year post-graduate work.

Before joining Imperial as a geologist in 1945, he was with the Alberta Conservation Board for three years. Since that time he has worked as a site-technologist and with the subsurface and research departments in Calgary. He also was division geologist in Calgary for four years. In his new post he succeeds R. A. Watters who left the company to become general manager of International Petroleum Ltd. at Bogota, Colombia.
Potentially a major field, Golden Spike seemed doomed to leave half its oil in the ground. But engineers of Canada's largest oil producing research laboratory and field men devised a way to get more crude from this reluctant producer

by ROBERT COLLINS

how they revived golden spike

When an Imperial wildcard well "came in" 25 miles south-west of Edmonton in early spring, 1949, it looked as though Imperial had scored again. First, the Leduc field; then, Redwater; now this small but healthy brother which in a six day test period produced 8,647 barrels of crude oil. This was the beginning of a major field, later known as Golden Spike, with estimated reserves of more than 150 million barrels.

But, within three years, Golden Spike was giving its producers serious concern. The underground pressure which forces oil to the surface was declining rapidly. More than half the oil in the reservoir would remain there forever if production depended on natural pressures alone.

Today Golden Spike producers are confident that about two-thirds of the field's oil will be brought to the surface: an addition of millions of barrels to the estimated ultimate recovery.

What happened in the interval—the story of how Golden Spike was rejuvenated—is, to some extent, a story of Imperial's eight-year-old research and technical service department which this summer brought all its branches under one Calgary roof—the largest and best equipped oil exploitation and producing laboratory in Canada.

The theme of the Golden Spike tale is conservation and the fullest possible use of a valuable natural resource. Nowadays, companies don't merely drill holes in the earth, draw out what oil they can and turn their backs on the rest. They're concerned with two questions: how much oil does a field contain and how can the most of it be recovered?

It was by answering these questions that the research and technical service department, teamed with engineers, geologists and drillers in the field, proved its worth in the Golden Spike incident. The department has four main divisions: geophysical (where technical information and equipment is supplied to the oil seeking seismograph crews), laboratories (there are five—chemical, physical, gas analysis, core analysis, and materials testing), project engineers division (these men deal in mathematics, electronic machines and process development) and a fourth division which includes geology.

The department was born as a mostel laboratory in Turner Valley after the now famous 1947 Leduc oil discovery. The lab was run by the Royalite Oil Co., then an Imperial subsidiary. When Imperial sold its Royalite interests in 1949, another group was organized and laboratories were set up in rented space in downtown Calgary. About the same time a geophysical section was established in Edmonton. Today the whole department is housed in a new one-storey L-shaped brick building in southeast Calgary—about one million dollars worth of gleaming airy offices, laboratories and intricate equipment.

Although the department didn't have so modern a home in 1950, the job it did for Golden Spike is the best example of the work it does now. It illustrates how men in the labs and men in the oil fields work together to conserve our natural resources.

Golden Spike is an unusual field. It has only nine wells, compared to about 500 in the Leduc "D3 zone," it covers only 1,116 acres, against Leduc-Youbouch's 23,000 acres. But, while the "pay", or oil-bearing zone in Leduc averages about 38 feet in thickness, the Golden Spike pay zone is 545 feet thick. Some oil men call it "an oil field on end."

Wherever found, crude oil lies in the pores of some forms of rock. The oil itself has no "life." It must be forced to the surface by pressure. The pressure may come from water lying under the oil-bearing rock, or from gas lying above it, or from gas in solution with the oil, which acts much like the fizz in a bottle of soda-pop.

Gas in solution provided Golden Spike's main pressure—originally 2,095 pounds per square inch. But the pressure soon dropped alarmingly. Within five years it sank to 1,350—an average decrease of a pound per square inch every two years or three days. At this rate the driving force would soon be exhausted and most of the oil would be left in the ground.

In the early days, such a field would simply have petered out. But in 1950 information from the field began to be assembled in the research department where a team of human and electrical wizards went to work to see what could be done to prolong its life.

One key man on this job is now the research and technical service manager, J. W. "Jim" Young, a lean man of 50 with deep-set eyes, a trimmed beard and a varied background, born in Mustwawa, Ont., of a railroad family. Young junketed all over Ontario and the prairies as a boy. His formal education ended with high school. Then he went on to educate himself, and eventually passed an exam which qualified him for the Association of Professional Engineers.
Young worked as chemical engineer for the city of Calgary prior to World War II. He spent four wartime years with the Canadian army engineers on special weapons research, joined Royalite in Turner Valley in 1945 and came to Imperial's Calgary office as research chemist in 1946.

He's a man of catholic tastes. He likes photography, fencing and mountain climbing but he's a scientist at heart. On his bookshelf is a volume entitled The Theory of Games. Young browses through this weighty tome—a breakdown of games into complicated mathematical form—the way most people read a "who-dun-it".

Another expert on the Golden Spike research was pipe-smoking Tom Martin, a master's graduate in chemistry, who now supervises the department's five laboratories. He is one of the better known radio "hams" in the Calgary area and he keeps up contacts with other oil engineers throughout North America via the amateur airways. Martin, after 11 years in Iran, went to Turner Valley in 1948. Of the 38 people now in the department, he and Young are the only Turner Valley alums.

When the Golden Spike problem arose, one of the first questions asked was "How much oil is down there?" Martin's core test laboratory answers such questions. A core is a pillar of hard porous rock, about as thick as a small fence post, which a drill cuts to any given length and draws up from far below ground. This is the kind of rock in which oil is found. Broken down into its basics, a core test goes like this: a lab man meticulously cleans the cores and bakes them in a tin, standardized oven to remove all the oil content. Then the porous rock is saturated with crude oil of the right properties. (No two fields contain exactly the same type of crude.) The cores then go into pressure containers that resemble oversize jam jars. There the oil absorbed by the core is forced out and then measured.

Meanwhile, geologists and seismic crews have roughly estimated the depth and boundaries of the field, and so, the field's oil content can be calculated. In some cases these tests take months, or even years of work. To determine the oil reserves of Redwater, for instance, more than 17,000 cores were tested by the oil industry over a four-year period.

Armed with their data about Golden Spike, the engineers now asked, "How long will the field last under present conditions?" In Tulsa, Okla., was a machine that could tell them—a sort of super electronic brain called the "reservoir analyzer", which predicts the life span of oil fields. Today, the Calgary research building has its own analyzer, the only one in Canada.

The analyzer is a bulky box-like machine, taller than a man and four feet wide. It consists of three tall machines straight out of Buck Rogers—a labyrinth of dials, wires, lights, knobs and a circular glass-encased charts. Imperial's visiting experts fed Golden Spike data into the Tulsa "brain". The machine became an electrical replica of the Spike field. An electrical condenser in its complicated innards represented the field's oil content and other condensers, charged with given voltages, represented the field's pressure. When the machine started, current would be withdrawn from the "oil" condenser, at the rate that oil is withdrawn from the wells. The electrical "pressure" would decrease at a rate corresponding with actual pressure declines in the field.

The engineers flipped the analyzer's switch. Colored lights blinked on. The monster hummed into action, uttering sharp clicks every two and one-half seconds. Each click ticked off a month of the oil field's life. On the charts, the brain recorded the results in the form of graphs.

**BRAIN PREDICTS FUTURE**

The experts let the brain run through the first year or two of Golden Spike oil's life (this took about a minute). Then they compared the answers with the known history of the field for the same period. The brain was fairly accurate but it needed a few adjustments. It made a few more trial runs. Now it duplicated exactly the known history of Golden Spike, so the engineers "turned it loose" to predict the future. They learned that, unless something was done, the field's pressure would die when only about 20 percent of the oil had been recovered.

Back at Calgary, the research department sought a means of "secondary recovery"—a new, important phase in this age of oil conservation. It means rebuilding pressure in a field by injecting gas or water.

To determine whether gas or water would better serve Golden Spike, the core lab made some tests. This time it was wanted to know which agent displaced the oil from the saturated test cores more effectively. The answer was natural gas.

Imperial looked around for a gas supply. Some would come from wells in the Golden Spike area. Much of it could be piped in from Imperial's $7 million gas conservation plant at Devon, 12 miles away. The conservation plant, built in 1950, is an impressive side line to the Golden Spike story. It is another example of how the oil industry, aided by research is conserving resources that would otherwise be wasted.

When Leduc "came in" in 1947 Imperial realized that natural gas would flow from the wells along with the oil. The research lab took the problem to its Podbielniak apparatus, named after the manufacturer. It consists of three tall machines straight out of Buck Rogers—a labyrinth of dials, wires, lights and some gadgets that look like ordinary thermos bottles.

A field engineer brought in "gas bombs"—bomb-shaped containers of gas from the field into the Podbielniak which liquefied and analyzed it at temperatures as low as -200 degrees below zero. (The Pod also tests and analyzes oil.) The gas was fed off its findings on a graph. With these findings from the Pod the research department had a complete breakdown on the Leduc gas' content: mostly ethane and methane, but also butane, propane and pentane. It warranted planning a plant to produce these components in marketable quantities.

The next step is to study these products and to establish the best operating methods. This involved many complex calculations and brought another electronic brain into operation. The figures from the Pod were fed into a small square-shaped gadget called the "phase equilibrium computer". It works away quietly by itself for a week and the answers come out in the form of settings on dials.

"It can solve 10 equations with 10 unknowns," says Doug Hay, head of the gas lab, proudly. "A man with a calculating machine could do it by trial and error but this cuts time on a problem from two or three months to about 10 minutes."

Ethane and methane from the gas conservation plant now heat homes and factories in the Edmonton area. Some ethane is used in a Canadian Industries polyethylene plant at Edmonton. The butane is raw material for the $70 million plant of the Canadian Chemical Co. in Edmonton. The propane is fuel for farm homes. The pentane is used by refineries for blending with motor gasoline.

Even after meeting these requirements there would be enough gas to help re-pressure Golden Spike, so Imperial built a gas injection plant that cost nearly two and a half million dollars. It began operations in the spring of 1954. It's an ordinary-looking building connected to a maze of pipes. One resident eng- iner handles most of the work. Eventually, much of the job may be done, via gashousers, from Devon. Up to 30 million cubic feet of gas per day can be forced down a well to the pay zone below. This injection keeps the pressure at approximately 1,800 pounds per square inch, which will give the new-expected 60 percent recovery. When oil production comes to an end, there will be about 150 million barrels of natural gas stored in the underground reservoir for future use.

Meanwhile, in their new Calgary home, members of the research staff are studying other fields and other problems. They're learning the different behaviors of different types of crude oil underground and the different influences of various rock formations. They study minute million-year-old fossils, too small to see with the naked eye, and they detect invisible flaws in metal with the aid of sensitive instruments.

They haven't laid aside the four-inch-thick volume of data already acquired from Golden Spike, either. "The analyzer tells us that we can expect 60 percent recovery," says the engineers. "But we're not stopping there. We're trying to get 80 percent of the oil from Golden Spike!"