

THE IMPERIAL OIL

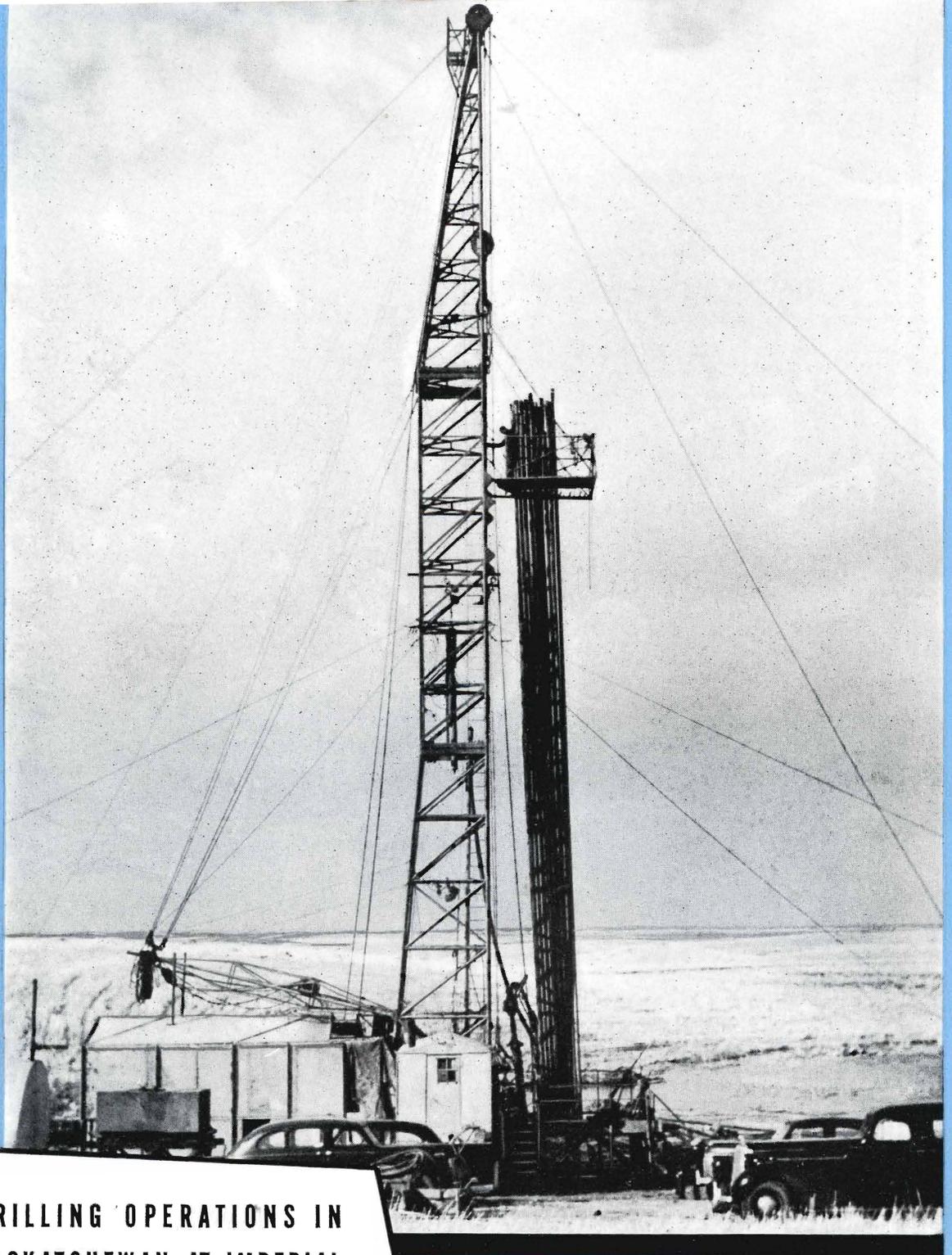
Review

SUMMER • 1943



IMPERIAL OIL'S BRIEF TO THE
NATIONAL WAR LABOR BOARD..

See page 1



**DRILLING OPERATIONS IN
SASKATCHEWAN AT IMPERIAL
OIL'S DAHINDA No. 1**

• The above picture of drilling operations at Dahinda No. 1 in the Coteau Hills of Southern Saskatchewan was sent to THE REVIEW by Dr. J. C. Sproule, who is directing Imperial Oil's exploration activities in that province.

The derrick is a new portable type. Used for drilling holes up to 5,000 feet in depth, it comes in three sections, and can be erected in less than an hour as compared to four days for the regular type of derrick. Mounted on skids, the drilling equipment is hauled from drilling site to drilling site either by large trucks or by tractors.

Imperial Oil Limited has two of these portable rigs, both purchased in 1941. The other, which is in use in Alberta, is mounted on a 12-ton truck.

Front cover photo courtesy United Kingdom Information Office

The REVIEW is published periodically by Imperial Oil Limited, in the interests of shareholders and employees. Correspondence should be addressed to the Editorial Office, 56 Church Street, Toronto, Ont.

IMPERIAL OIL LIMITED PRESENTS BRIEF ON EMPLOYEE-EMPLOYER JOINT COUNCIL PLAN TO NATIONAL WAR LABOR BOARD

THE National War Labor Board, at the reference of the Canadian Government, held public hearings at Ottawa for several weeks in May and June and received representations regarding labor conditions and industrial relations. Accordingly, on behalf of Imperial Oil Limited a Brief was presented to the Board on June 16th by Mr. H. H. Hewetson, Vice-President, which urged that in any legislation which might be introduced provision should be made for employees to deal cooperatively with their employers in their own way by any procedure they may choose.

Imperial Oil Limited instituted its first Joint Council under the industrial representation plan in Sarnia in 1919. The plans have been extended since that time to numerous points in the Company's operations and the Councils are being more and more actively used as a means of direct contact between employees and management in regard to matters and problems of concern and mutual interest.

The Brief, presented by Mr. Hewetson, is reproduced herewith:

THE CHAIRMAN AND MEMBERS, NATIONAL WAR LABOR BOARD:

Imperial Oil Limited appreciates the opportunity afforded to place before the Board its views with regard to employee-employer relations. These views are based upon the experience of many years of operations without labor disturbance. Accordingly, in making this presentation we pay tribute to the co-operation of the Company's many employees in achieving this record. For over twenty years employee representation through the Joint Council has provided the medium by which employees have at all times been able to approach and finalize with management matters of concern and mutual interest.

With this background, it is our purpose to deal primarily with the labor relations aspect of this inquiry, and, in so doing, we are particularly interested in protecting this method of dealing between employees and management. The fact that there

have been presented to the Board recommendations which if implemented might eliminate employee representation plans and the joint Council as a legal means of negotiation between employees and employers has caused us to feel that presentation by us at this time is necessary in order that the Board may, in preparing its report and recommendations, consider this procedure which has resulted for many years in both peaceful and harmonious labor-management relations.

Employees and employers generally desire industrial peace. So also, in the public interest, does a Government of the people. Industrial peace can be attained through co-operative effort on the part of both employee and employer, but where co-operation is absent there is necessarily essential conflict, and in such circumstances, even when there is no actual strife, there is not peace but a truce.

It is granted that the co-operative approach may not always be attainable under conditions obtaining in certain industries due to a variety of circumstances or attitudes involving both employer and employee. Nevertheless, legislation should provide that the way be left open at all times for employees to deal co-operatively with their employer in their own way by any procedure they may choose even though such employees are a minority group.

The Employee-Employer Joint Council is one form of organization which has demonstrated its usefulness in preserving peace and promoting justice, and any such organization, as well as the labor union, should be recognized and protected by law.

If industrial peace is an objective, the law should provide that all procedures helpful to attain same should be utilized between employees and employers before there is any recourse to strike or lockout. No matter what type of organization or plan may be chosen, a definite grievance procedure should be followed prior to breaking of negotiations, and a truce should be protected by procedure to which both sides should adhere. As a last resort, there should be an impartial body having jurisdiction to avoid or end strife by settling disputes between employee-representatives and employers, it being a requirement that before such body deals with the matter to effect settlement proof must be furnished that reasonable procedure had been followed by both parties in an effort to settle the grievance.

Legislation should by no means preclude the rights of employees to organize and by their own choice to arrange freely any form of collective dealing or bargaining. The law, however, should not compel an individual employee to be represented by some agency not of his choosing, as this would be coercive legislation in that such legislation would deprive him as a citizen of his freedom of action. The law should not recognize the closed shop unless voluntarily subscribed to by all employees and the employer. In certain organizations or plants there may be one group of employees who are members of unions and who choose to deal with the management through the medium of their union representation; also there may be another group who choose the Joint Council route; there should be no law to prevent this.

As we see it, the only fundamental legislation required so far as employees are concerned is that legislation which assures an employee the untrammelled legal right to:

- (1) Freedom of association in dealing with his employer, as for example, individually or through any group or union or

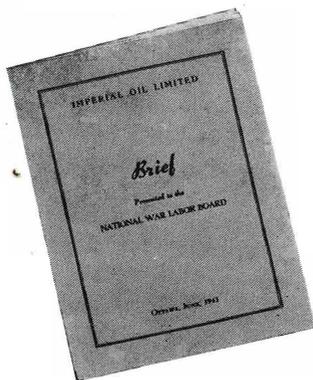
representative of his choosing.

- (2) Deal with his employer at his own choosing on—
 - (a) a co-operative basis.
 - (b) an essential conflict basis.

The rest of the legislation surrounding this matter, which has been so fully discussed and argued, can only provide the procedure for settlement of disputes between irreconcilable leaders among labor organizations and employers who are committed to dealing on an essential conflict basis. Referring only to such employers, they would include those who are either not willing or not prepared to face their employees in Joint Conference and approach their problems co-operatively on a mutual benefit basis, or those who cannot do so because of economic ills in their business. They must, therefore, resort to essential conflict in order to give in as little as possible to the demands of their employees. There is no question but that legislation should be provided in order to protect all concerned in such "at arm's length" situations, and also there must be laws to punish coercion and violence and amply protect the rights of all interested parties, including minorities.

As previously indicated, we are not here to deal with the provisions for these rights and responsibilities of both labor organizations and employers, which might be incorporated into legislation. We are here to recommend protection of the Joint Council as a well-tryed procedure in industrial relations that is based upon co-operation, good will and the community of interest between employees and employers.

Industrial representation through Joint Councils has brought industrial peace to workers and their families, and this method of dealing collectively or individually by employees should always be available to them when they are dealing with employers of the same spirit. There are many employees today who have achieved most desirable relations with their employers, and not only should they never be deprived of the result of their efforts, but the opportunity should be preserved for other employees, and their employers as well, to do likewise. It is essential, therefore, that the co-operative procedure as embodied in the Joint Council be protected by law for those who choose to make use of it.



A limited supply of copies of the Company's brief to the National War Labor Board are available. Address requests to 56 Church Street, Toronto, Ont.

IMPERIAL OIL LIMITED,
Henry H. Hewetson,
Vice-President.

THE SEARCH FOR OIL IN ALBERTA

Exploration and drilling extend over a wide area of Alberta in an effort to locate new sources of petroleum to meet Western Canada's wartime oil needs.

WAR, with its demand for oil, has focussed new attention on the province of Alberta as an important source of crude oil. Yielding around 10 million barrels of crude oil and naphtha a year, the Turner Valley and other Alberta fields now produce 97.5% of Canada's annual oil production.

While this production would be sufficient to care for the needs of the prairie provinces under normal conditions, the demands of war—and notably the Alaska Highway and the Air Training Program—together with several years of large crops, require more oil than the present fields are able to produce and an aggressive program of geological and exploratory drilling is being carried out in an effort to locate new sources of oil within that province.

Although oil was discovered in Alberta in Turner Valley in 1914, and the development of the oil resources of the province has progressed steadily in the intervening 29 years, it is only within quite recent years that the crude oil production of the Valley has reached the proportions of a major oil field. For more than 20 years the Valley consisted almost entirely of wells producing natural gas and naphtha, and it was not until the completion in 1936 of the Turner Valley Royalties Well No. 1 on the West Flank of the structure that active drilling for crude oil was initiated, and crude oil production rose from practically nothing in 1936 to where it is now around 25,000 barrels per day.

The years 1937-38 were the first "big" years for the Valley when crude oil production jumped from 2,767,221 barrels in 1937 to 6,691,075 barrels the following year, and for the first time in history production of Alberta crude was sufficient to take care of the entire West. This resulted in the displacement of Montana crude in Alberta and Saskatchewan refineries and the shipping of refined petroleum products from the Western refineries as far east as Kenora, Ont. In spite of the fact the output of the Valley has increased each year since, this has been insufficient to keep pace with the growing wartime needs of the West and consequently once again it is necessary to import crude. Production of Alberta crude oil, naphtha, and absorption plant product totalled 10,157,398 barrels in 1942, compared with 9,928,162 barrels in 1941, a gain of 2.3%.

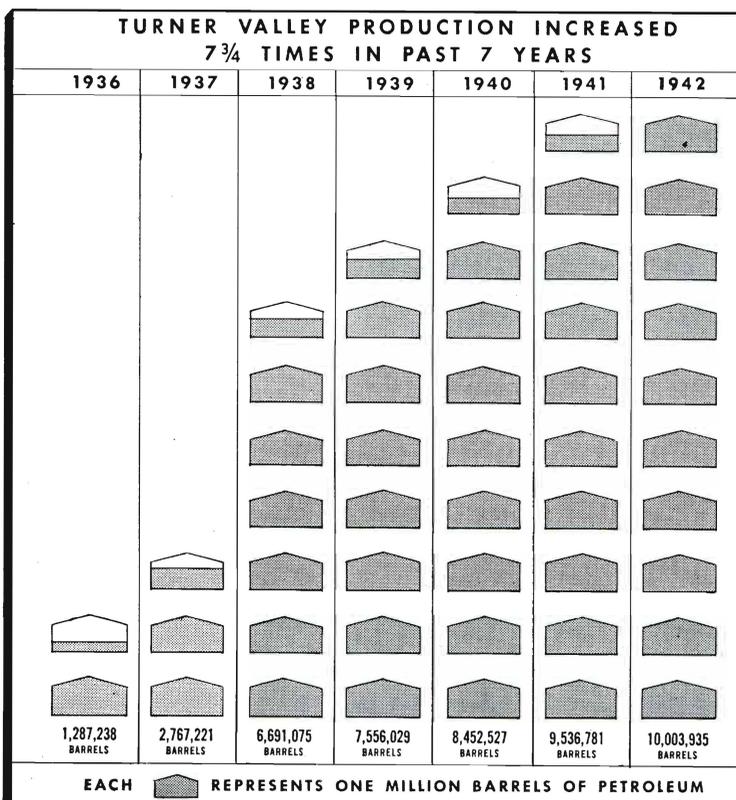
The immediate past years have been years of great drilling activity, both in the Valley proper and throughout those regions of the province where geological and geophysical surveys indicate areas favorable to prospecting with the drill. During

1942 a total of 501,940 feet of hole was drilled compared with 496,335 feet drilled the previous year. Drilling in the Valley proper in 1942 decreased from 368,568 feet drilled in 1941 to 250,975 feet as the more promising locations in the Valley became drilled up and drillers moved into what was thought to be a northward extension of the field.

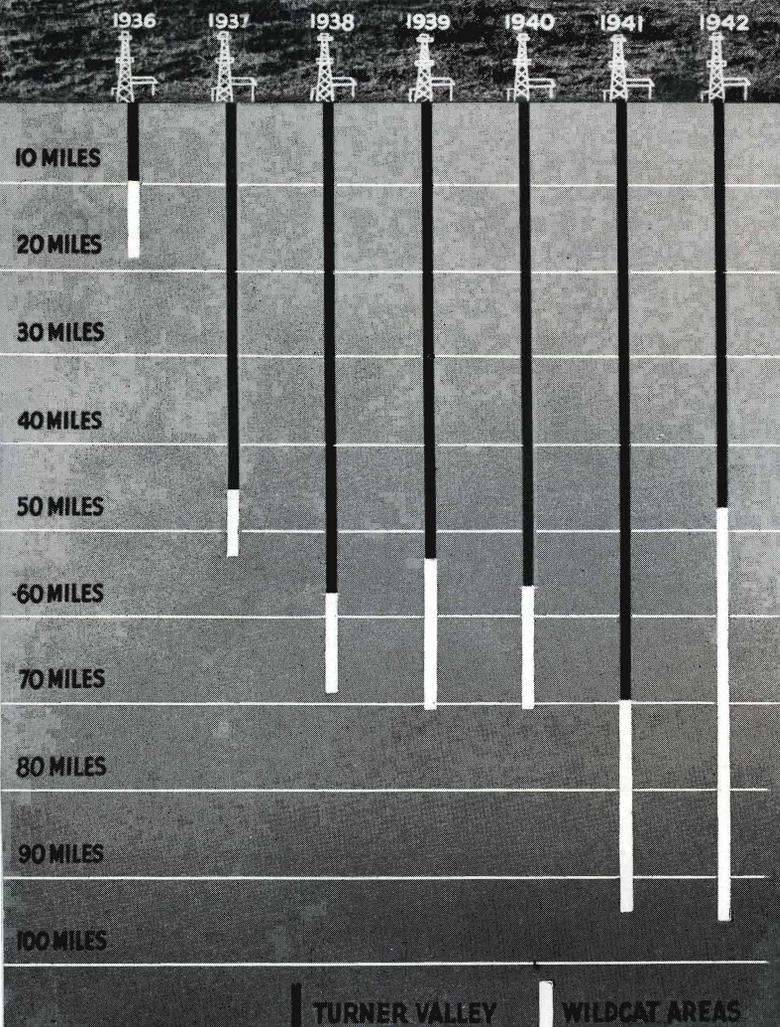
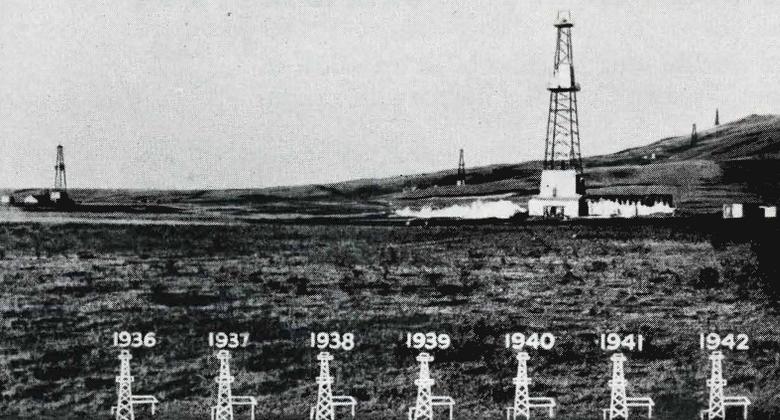
In the Turner Valley proper during 1942 twenty-eight wells were completed in the productive Madison limestone, one well was deepened, and one well was abandoned due to salt water in the limestone. This was a decided decrease from the 44 wells completed during 1941 and is explainable, in part, by the movement of drillers out of the Valley proper to drill exploratory holes in the area immediately to the north. At the end of the year 19 wells were actively drilling in the Turner Valley area and 3 wells were shut down. To the north of the Valley 12 holes were abandoned during the year when adverse geological conditions became evident.

In the crude oil producing zone of the Valley proper, (see map on pages 6 and 7) 205 crude oil wells had been completed to the end of 1942. Production from these wells, including naphtha and absorption plant product from the gas-naphtha zone, totalled 10,003,935 barrels in 1942, compared with 9,830,343 barrels in 1941, and accounted for more than 98% of the total crude production of the province.

On the basis of 40-acre well spacing, which is the accepted practice in the Valley, 60% of the locations



470 MILES OF OIL WELLS DRILLED IN ALBERTA IN THE PAST SEVEN YEARS



FOOTAGE DRILLED IN ALBERTA

(Seven year period 1936-42)

	TURNER VALLEY	WILDCAT AREAS	TOTAL FOOTAGE
1936	52,693	44,211	96,904
1937	240,478	38,901	279,379
1938	303,112	60,180	363,292
1939	281,274	93,013	374,287
1940	299,611	71,436	371,047
1941	368,568	127,767	496,335
1942	250,975	250,965	501,940
7-Year Total	1,796,711	686,473	2,483,184

within what is at present considered to be the limits of the crude oil zone, are now drilled up, and about one-half of the remaining undrilled locations are situated in areas where the evidence indicates a probably low yield per acre and are considered to be in the marginal class. Under ordinary conditions these marginal areas would, in all probability, remain undrilled because of the likelihood that the wells would not return sufficient oil to pay for their drilling costs.

In an effort to utilize the possibilities of this low-yield acreage to help meet Western Canada's ever-increasing wartime oil needs, a new Crown company, Wartime Oils Limited, has been formed to develop these marginal locations. The purpose of this company will be to take over marginal acreage and drill wells, and to operate these wells until such time as development and operating costs are recovered and then return the acreage to the original lease-holder.

In addition to production from the Turner Valley, small quantities of crude oil are recovered from the Red Coulee, Vermilion, Wainwright, Dina, Del Bonita, Lloydminster, Princess, Taber and Tilley fields. Locations of these fields in relation to Turner Valley are shown on the map on page 5. A total of 143,422 barrels of oil, equal to about 1½% of the total oil production of the province, was recovered from these areas in 1942, compared with 78,300 barrels in 1941. The most important of these minor fields is the Vermilion field which last year produced 63,793 barrels of oil from 17 wells, an average of 10 barrels per well per day.

In the Foothills region, outside of Turner Valley and what was thought to be the northward extension of the field, drilling was active on 10 wildcat wells during 1942, the footage drilled totalling 25,184 feet as compared with 16,157 feet drilled in the same area during 1941. Although several interesting showings were obtained as a result of this drilling, no commercial production had developed to the end of the year. It is interesting to note that the Maxmont No. 1 well, about 25 miles west of McLeod, reached a depth during the year of 9,430 feet and is believed to be the deepest hole in the world drilled with a cable tool rig.

In addition to exploratory drilling, the oil industry was very active in 1942 carrying out both reconnaissance and detailed geological and geophysical surveys over the more favorable areas.

Right—Map of the oil fields of Alberta, showing the location of the Red Coulee, Vermilion, Wainwright, Dina, Del Bonita, Lloydminster, Princess, Taber and Tilley fields in relation to Turner Valley.

In the Plains Area during 1942 drilling was active on 62 wells compared with 47 in 1941 and the total footage drilled amounted to 143,113 feet compared with 100,241 feet during the previous year. Of the 62 wells 7 were completed as producers, 4 of them in the Vermilion area and 1 in the Taber area as crude wells; 4 gas wells were completed, 3 of them being in the Kinsella Gas Field to augment the supply to the City of Edmonton with its gas requirements for industrial and domestic purposes. Of the remaining wells 36 were definitely abandoned and at the end of the year 15 were still drilling, testing or temporarily shut down.

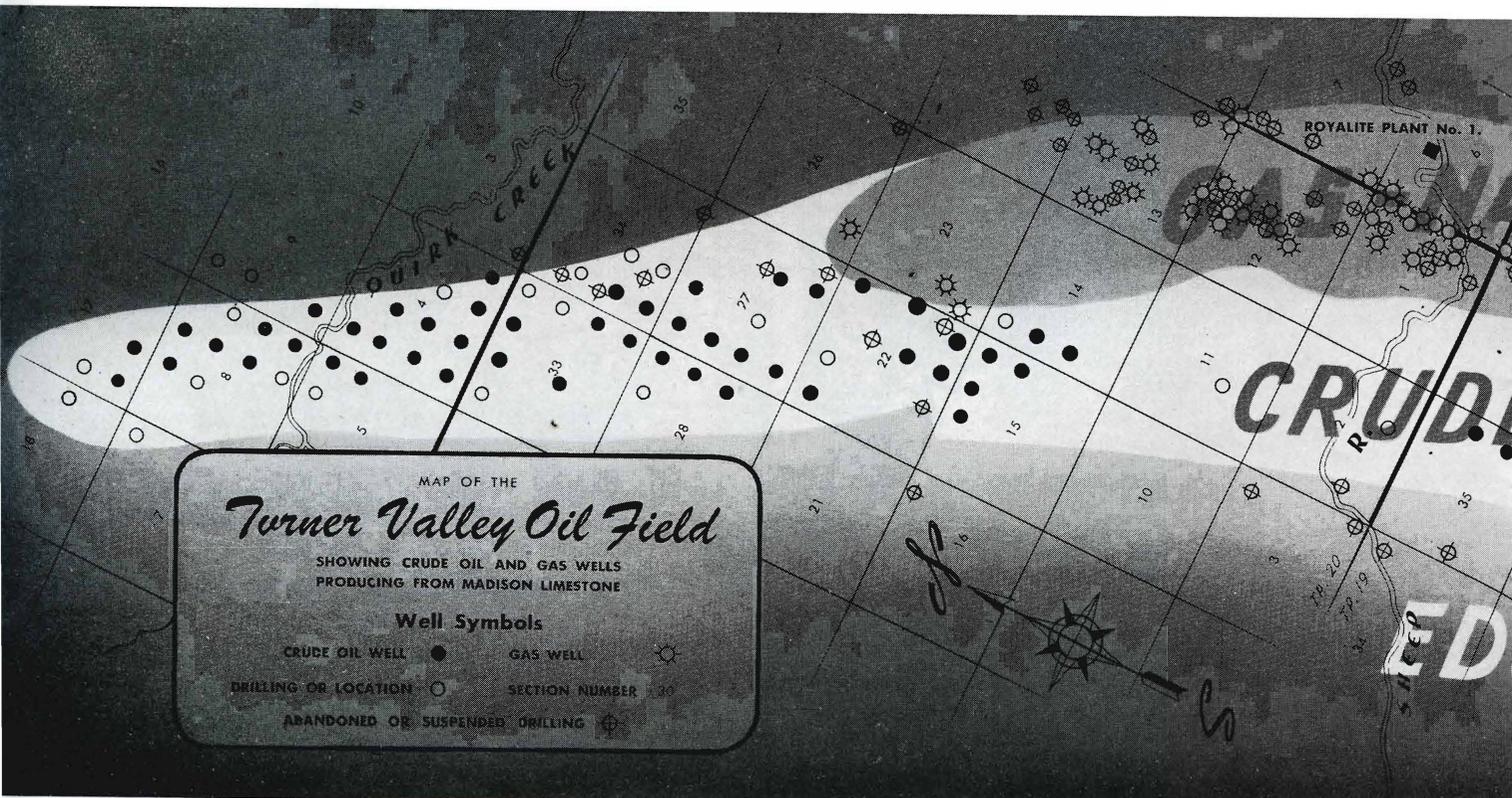
During the year an extensive program of surface and sub-surface prospecting was carried on in the Plains Area by the major oil development companies and the Dominion and Provincial Governments. Of the 214,000 square miles of sedimentary rocks which underlie the Plains Area in Alberta, 34,000 square miles were covered during 1942 by geological and geophysical crews in the search for favorable geological conditions which would warrant testing with the drill.

A considerable number of set-backs in drilling outside of the Valley were encountered last year due to the very wet summer and fall which resulted in bad conditions of the roads leading to the well sites, surface creeks overflowing and muddy conditions around the well sites. One of the coldest winters

in the history of Alberta drilling resulted in surface waters freezing solid, causing several drilling operations to suspend because of lack of water for the steam boilers. Government restrictions placed on well casing and drill pipe in the early part of the year added further to the troubles of the operators, but these restrictions have since been eased and a progressive program of drilling is now underway.

During 1942 Imperial Oil Limited and its subsidiary companies completed a total of 14 producing wells in Turner Valley. Exploratory drilling was carried out on a much greater scale than during any previous year, 18 wildcat wells being completed compared with 3 the previous year. Total footage drilled in 1942 by the Company outside the Valley amounted to 62,730 feet, or 25% of the total wildcat footage drilled in the province. Wildcat footage drilled by the Company in 1941 amounted to less than 18,000 feet.

In addition to its drilling programs in the Turner Valley field and the wildcat areas, the Company carried out extensive geological and geophysical surveys throughout both the Plains and the Foothills regions, and this work is being continued throughout 1943. To the end of 1942, Imperial Oil and subsidiary companies had drilled a total of 63 wildcat wells outside the Valley at a cost of approximately \$4,000,000, and had conducted geological and geophysical surveys costing in excess of \$600,000.



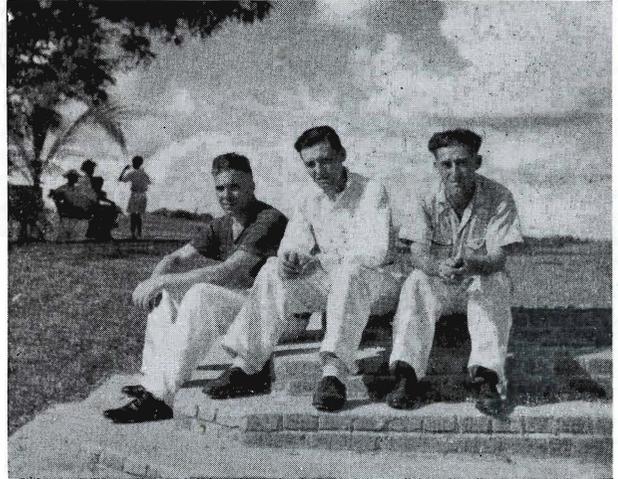
COLOMBIAN GOLFERS GUESTS OF TROPICAL OIL CO.

MEMBERS of the Tropical Oil Company's Barranca and El Centro golf clubs were hosts during the Easter week-end to golfers from Bogota, the capital of Colombia, and Medellin.

The Medellin Country Club was represented by eight golfers headed by Jaime Saenz, Bernardo Gaviria and Gonzalo Saenz. Alberto Gambao, Colombian amateur champion, and Tom Trendall, club professional, represented the Bogota Country Club. Several other members of the Bogota Club had looked forward to taking part in the tournament but were unable to arrange transportation. The Bucaramanga Country Club, while not actively participating in the tournament, was represented by three members, Manwell Pugana, Luis Silva and Gustavo Puyana.

The tournament consisted of 54 holes Medal play. The first 18 holes were played at the Miramer Club, in Barranca, where the Tropical Oil Company's refinery is located. The remaining 36 holes were played on the El Centro course, within sight of the oil fields.

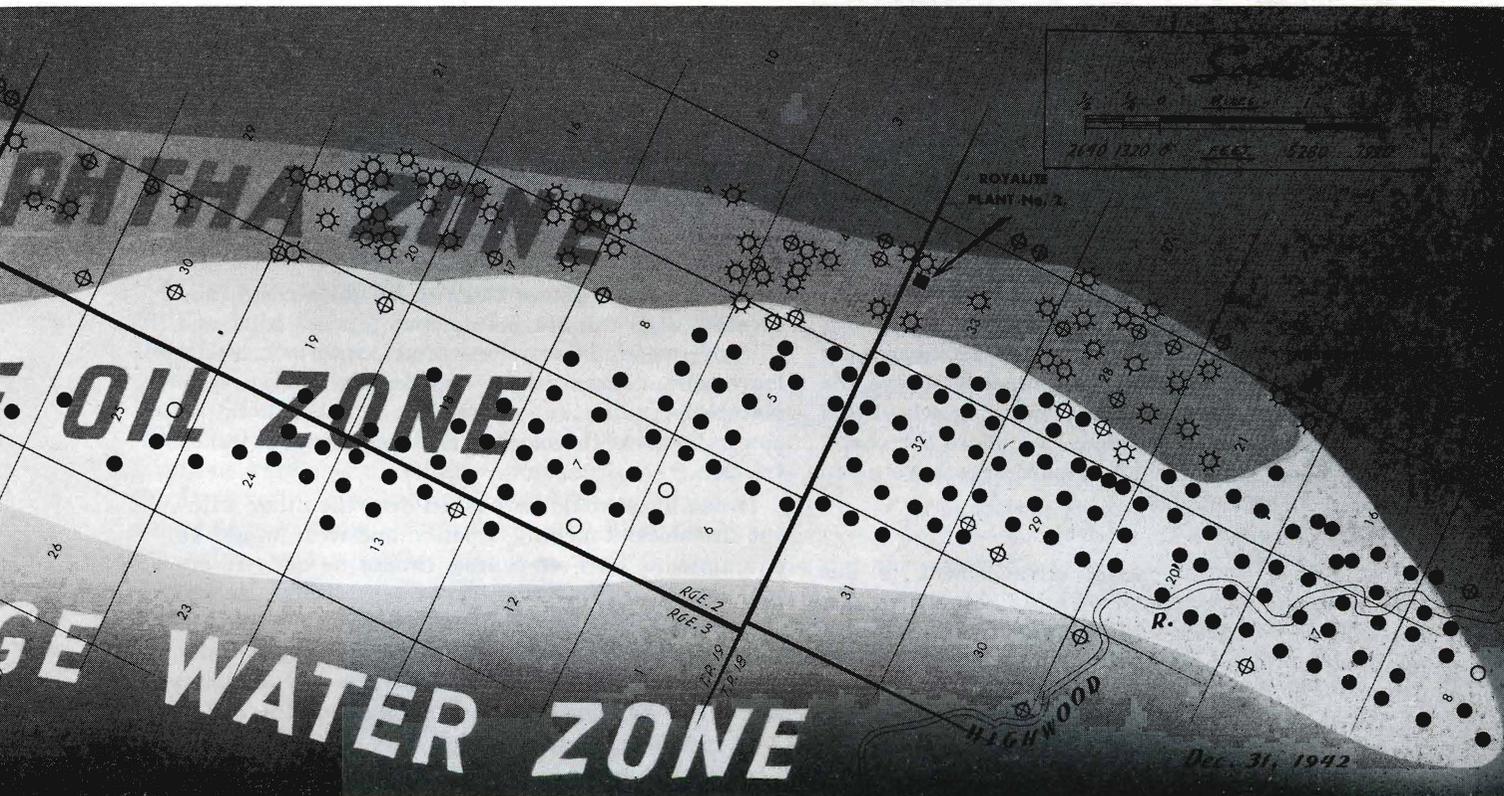
The Esso trophy for low gross amateur score was won by Alberto Gamboa of Bogota with 232. Ernie Trumper of El Centro turned in the low professional score of 217, while the Medellin golfers were headed by the Saenz brothers with scores of 252 and 253. Second and third low amateur scores of



Three of the Easter weekend tournament golfers. Mr. E. L. Trumper of El Centro; Mr. Alberto Gamboa of Bogota and amateur champion of Colombia; and Mr. M. D. Beyeler, El Centro.

the tournament were made by M. D. Beyeler (245) of El Centro and Murray Matheson (250) of Barranca.

It is hoped the tournament will become an annual event and members of the Barranca and El Centro Clubs look forward to active participation next year by the Bucaramanga Club and representatives from Cartagena, Barronquilla and Cali.





Refining

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FRICTION

To-day's great industrial advancement is due largely to the development of lubricants which successfully combat friction. If a block of smooth highly polished dry metal is pushed along another block of dry metal, it doesn't slide easily, because of friction. If these metal surfaces are examined under a microscope, the reason for this resistance becomes apparent. The magnification of the apparently

smooth surfaces shows them to be quite rough and covered with minute points and pits — hills and valleys—which in moving contact, interlock, resist movement, generate heat and destroy the surface. Naturally, with this resistance, it takes a lot of power to move the block. This resistance is called friction.

If one block could be pushed over the other without the blocks touching, friction and wear would be eliminated. This, of course, cannot be done in actual machinery but oil permits a close approach to this ideal. A layer of oil between the blocks prevents metal to metal contact and thus one block moves readily over the other with only a small amount of friction and with no wear of the metal.

If a load is placed on the moving block the oil tends to be squeezed out. The more effective the

layer of oil is between the blocks the less is the chance of metallic contact with increasing load.

Note that it is an "effective" oil that is required under more severe conditions of use. In other words, a "high quality" oil is necessary. It is to provide oils which form an effective layer between moving surfaces that modern methods of refining lubricating oils have been developed.

HISTORY

The oil which lubricated James Watt's first steam engine was a vegetable oil, and during the first decades of the industrial revolution machines got along on oils pressed from various seeds, fruits, fats and similar substances. Requirements, however, soon outran the amount of such oil that could be provided at reasonable cost. Then came sperm oil and the great days of the whaling fleets, but by the 1840's whales had become scarce and the price of sperm oil soared.

Before the crisis became acute French scientists had begun to advocate the production of oil from oil shale for illuminating and lubricating purposes and by 1845 had developed a small commercial production.

In 1847 James Young of England extracted on a commercial scale a light burning oil, a heavy lubricating oil and wax from a small stream of oil which flowed from the top of a coal-working in Derbyshire. This supply soon became exhausted, and Dr. Young developed a process by 1850 whereby he could produce these products from boghead coal and later from oil shale. Coals and shales suitable for Dr. Young's process were found in many places throughout the world. As a result more than 200 plants in Great Britain and the United States began making oils by the Young process. Even the proud whaling port of New Bedford, Massachusetts, had a plant operating on Scotch boghead coal. Nothing could better emphasize the need for a new source of oil to replace the diminishing supply from whales.

In 1857 E. L. Drake drilled for and found oil at Oil Creek in Pennsylvania. Almost overnight the United States plants making coal oil began using crude petroleum as their raw material. Illuminating oil (kerosene) was the most desired product from crude petroleum. The gasoline and heavy oily fractions were only unfortunate impurities so far as the first refiners were concerned. However, some enterprising individuals learned how to "adulterate" the animal and vegetable oils then used as lubricants with the unwanted "mineral" oils. It was soon found that for many lubricating tasks mineral oil was the superior lubricant and was sold on its own merits despite a reluctance of the early buyers to use "new fangled" oils.

As more efficient machines were designed, it became apparent that "raw" untreated petroleum oils such as produced by early refining methods could

not do a proper job of lubrication. Oils would break down and permit metal to metal contact, particularly at high temperatures. Some oils wouldn't flow freely at low temperatures — in fact, some oils wouldn't flow even at ordinary room temperatures. Some oils would oxidize to form corroding acidic compounds which would attack metal. Others would form watery sludges with water. Still others would deposit hard, abrasive compounds on the moving parts. Many would do all these harmful things at the same time.

It was early discovered that acid-treating of oils with strong sulphuric acid would improve their lubricating qualities. Also, ways were found to remove some of the wax from lubricating oil stock thus permitting the oil to flow more freely at lower temperatures. Later, operation of shell stills under vacuum produced higher viscosity distillate oils. While these methods greatly improved lubricating oils the continual improvements in machinery demanded still better oils, and with the introduction of the automobile the need for better lubricants became critical. Friction played havoc with the automobiles of twenty-five years ago. Ways had to be found of producing better lubricating oils. It was to this task that the petroleum chemists turned their efforts, and by their efforts found the means of extracting from raw lubricating distillates, lubricating oils to meet the toughest lubricating conditions encountered in any modern engine or machine.

CHEMISTRY OF LUBRICATING OILS

Aside from hydrocarbon gases and some of the lighter liquid hydrocarbons, very little is known about individual hydrocarbons in petroleum. Consequently, the chemistry of the composition of lubricating oils is rather vague. However, chemists have learned how to remove the undesirable components from raw lubricating oils and this, after all, is the important knowledge as far as producing high quality lubricating oils is concerned.

Although chemists may not know the individual hydrocarbons that make up lubricating oils, they know that the larger members of three hydrocarbon families are found in all raw lubricating oil distillates. These families are the Paraffinic, Naphthenic and Aromatic, the smaller members of which are found in naphthas, kerosene and diesel fuel as discussed in previous articles of this series. In general, the paraffinic type molecules have the best overall lubricating properties, naphthenic are a close second and aromatic a bad third. The relative amount of each type present depends on the geographical source of the crude. In earlier days the source of the crude determined the quality of the lubricating oil. Oils high in paraffinic type molecules such as produced from Pennsylvania crudes were rightly considered the finest lubricat-

ing oils. Oils high in aromatic type compounds such as occur in some Californian crudes, were almost useless as lubricating oils since they rapidly formed large amounts of carbonaceous sludge. Today modern refining methods have completely changed the picture since the aromatics (and other unknown undesirable hydrocarbons) can be removed from even Californian stocks to produce lubricating oils of the highest quality.

REDUCED CRUDE

Lubricating oils have boiling temperatures intermediate between those of gas oils and asphalts. They thus form a part of reduced crude, which is the portion of crude petroleum remaining after the gases, gasoline, kerosene and gas oils have been removed by distillation at essentially atmospheric pressure in the crude distillation unit. Reduced crude will have a composition depending upon the geographical source of the crude petroleum. Typical Mid-Continent reduced crude has the following approximate composition:

Heavy Gas Oils	14%
Lubricating Oil Components	54%
Waxes	7%
Asphalt	25%
	100%

The gas oils in reduced crude are the heavier ones which are not removed by distillation at atmospheric pressure.

Other reduced crudes contain various amounts of lubricating oil components, waxes and asphalts. Pennsylvania crude, for example, contains very little asphalt. Colombian crude contains very little wax. Since gas oils, wax and asphalt must be removed from reduced crude in the manufacture of lubricating oils, the manufacturing processes required will depend on the composition of the reduced crude concerned. For example, a dewaxing step is seldom required in the production of lubricating oils from Colombian reduced crude.

A variety of finished lubricating oils are made from the lubricating oil components of reduced crude. To these mineral oils, one or more other ingredients such as those derived from vegetable, animal or mineral substances may be added to give the finished oil special properties. Among the many products consisting entirely or in part of petroleum lubricating oils are motor oils, aviation oils, machine oils, cylinder oils, cable oils, turbine oils, cutting oils, textile oils, medicinal oils, quenching oils, switch oils, transformer oils, leather oils, etc. As the last few examples indicate, lubricating oils are used for purposes other than lubrication. However, the greatest part of lubricating oils are used as lubricants and these are mostly petroleum hydrocarbons.

According to the portion of the crude used in their manufacture, lubricating oils may be "residual oils" or "distillate oils". Residual oils are made by processing the total reduced crude. They are characterized by components with a wider range of boiling points than can be obtained in any distilled lubricating oil. The low volatility of these oils due to their high viscosity, high boiling components make residual oils of particular value in the lubrication of steam cylinders particularly where superheated steam is used. When used as such, residual oils are called "cylinder oils". Sometimes heavy distillate oils may be used as cylinder oils when saturated steam is used. Treated until they are transparent, residual oils are called "Bright Stocks". These are usually blended with distillate oils to increase the viscosity of the latter.

By far the greater proportion of lubricating oils are distillate oils. These are light (low viscosity), intermediate (medium viscosity) and heavy (high viscosity) fractions distilled from reduced crude by vacuum distillation. While the light lubricating oils could be distilled from crude oil by simple distillation at atmospheric pressure, fractional distillation under vacuum is much more efficient. Furthermore, the use of vacuum (very low pressure) is necessary to separate the higher boiling, intermediate and heavy lubricating oil fractions. Depending on the source of the crude, the several treating processes that may be used and the blending and compounding that may follow, a very large number of finished lubricating oils are made. The large number of finished oils are necessary to fill the many different lubricating needs of modern engines and machinery and to meet the requirements of industry for oils for processing purposes and special applications.

PROCESSING OF REDUCED CRUDE

Reduced crude may be processed in many ways in the manufacture of the various kinds of finished lubricating oils. The following is an account of the processes used in the production from Mid Continent reduced crude of the highest quality lubricating oils, of which Marvelube is an example. The processes concerned in the production of Marvelube are:

- (1) Vacuum Distillation
- (2) Phenol Treating
- (3) Solvent Dewaxing
- (4) Clay Contacting

VACUUM DISTILLATION

The first step in the manufacture of Marvelubes is to separate the raw waxy lubricating oil components from the gas oils and asphalt in reduced crude. This is done by fractional distillation in essentially the same manner as described for crude petroleum in the 1942 Winter issue of the Imperial Oil Review, with one important difference. The

bubble tower in the case of vacuum fractional distillation is maintained under very low pressure or vacuum. If the distillation of the reduced crude were attempted at atmospheric pressure, the high temperature required would decompose or crack the intermediate and heavy oil fractions into lighter materials with no lubricating properties. The lower the pressure over the reduced crude in the bubble tower, the lower the temperature at which it will change to vapour and pass up the tower. Thus by the use of vacuum, fractional distillation takes place at a temperature below harmful cracking temperatures.

Vacuum is produced in the bubble tower by pumping out uncondensable gases and air from the enclosed tank or receiver into which the condensed overhead gas oil is discharged. Since this tank is connected to the bubble tower, removal of gases and air from the tank also removes them from the bubble tower. The pump that does this is a steam ejector which operates on the same principle as an atomizer when it removes perfume from a bottle.

The reduced crude is heated to about 800°F. in a pipe still after which it discharges into the vacuum bubble tower. Here the portion that hasn't been vapourized by the heat flows to the bottom of the tower whence it is pumped as "pitch". The pitch is really a grade of asphalt. The vapourized portions of the reduced crude pass up the tower where they are separated into:

- (1) an overhead heavy gas oil fraction
- (2) an upper side stream product which is a light lubricating distillate
- (3) a middle side stream which is an intermediate lubricating oil distillate
- (4) a lower side stream product which is a heavy lubricating oil distillate.

The side stream products are the raw materials

for the manufacture of distillate lubricating oils. Each side stream is run into a separate tank and used as needed as a feed stock for subsequent processes.

PHENOL TREATING

The first of the subsequent treatments in the production of Marvelube is phenol treating. Each of the three raw lubricating oil distillates is passed in turn through the phenol plant for the purpose of:

(1) Removing aromatic and other unsuitable hydrocarbons which would decompose under the action of heat and air to form resinous and carbonaceous substances. Such substances cause rings and valves to stick, plug the oil filters and in extreme cases will prevent a motor from operating.

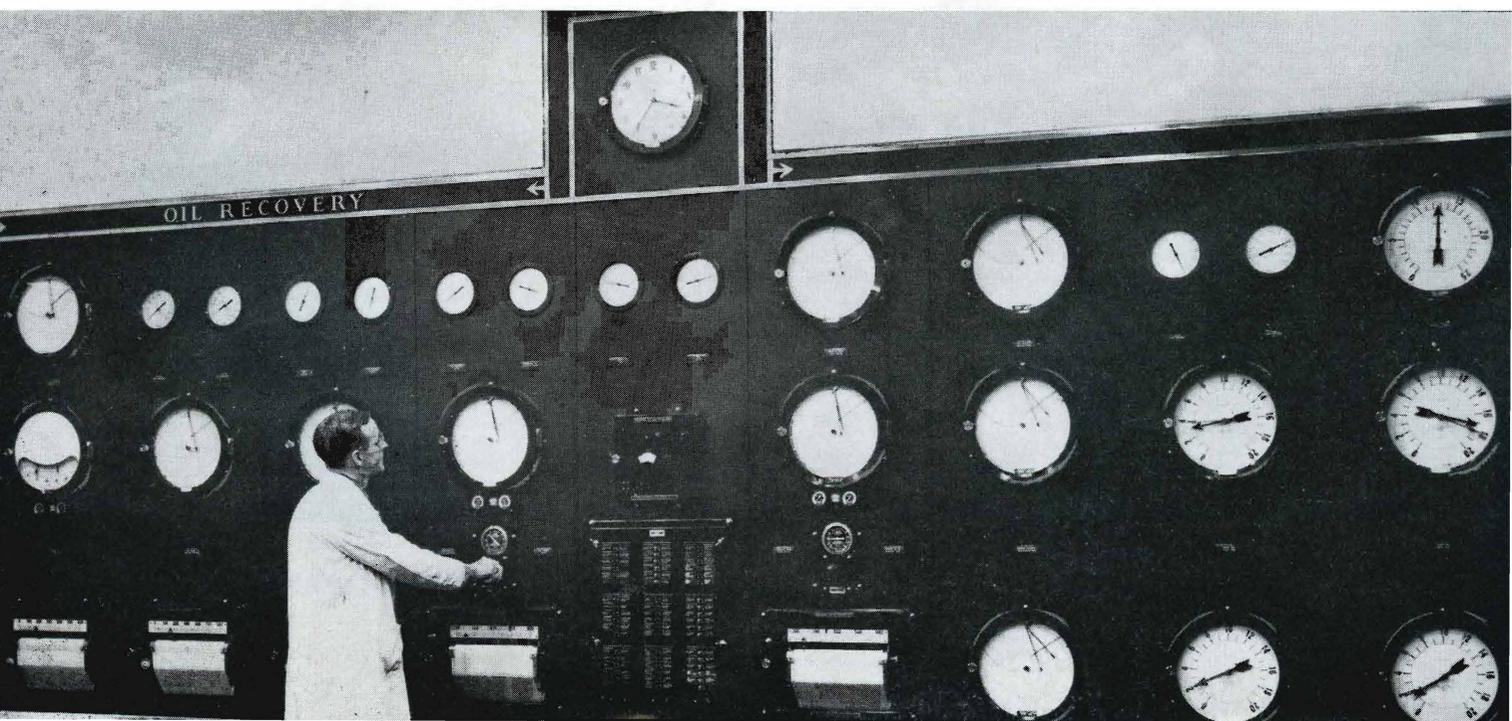
(2) To remove those components which cause an oil to thin out at higher temperatures and to thicken at lower temperatures.

The viscosity of a perfect oil would not change with a change in temperature. There is no such thing as a perfect oil and consequently all oils thicken when the temperature is lowered. This thickening or increase in viscosity is independent of the presence of wax. Different oils thicken to different extents when subjected to equal decreases in temperature. The extent to which an oil thickens is indicated by its Viscosity Index or V. I. as it is more usually called. The V. I. scale ranges from 0 to 100; the higher the V. I. of an oil the less the viscosity of an oil changes with a change in temperature. This is an important quality indication of oils such as motor oils subjected to wide temperature changes.

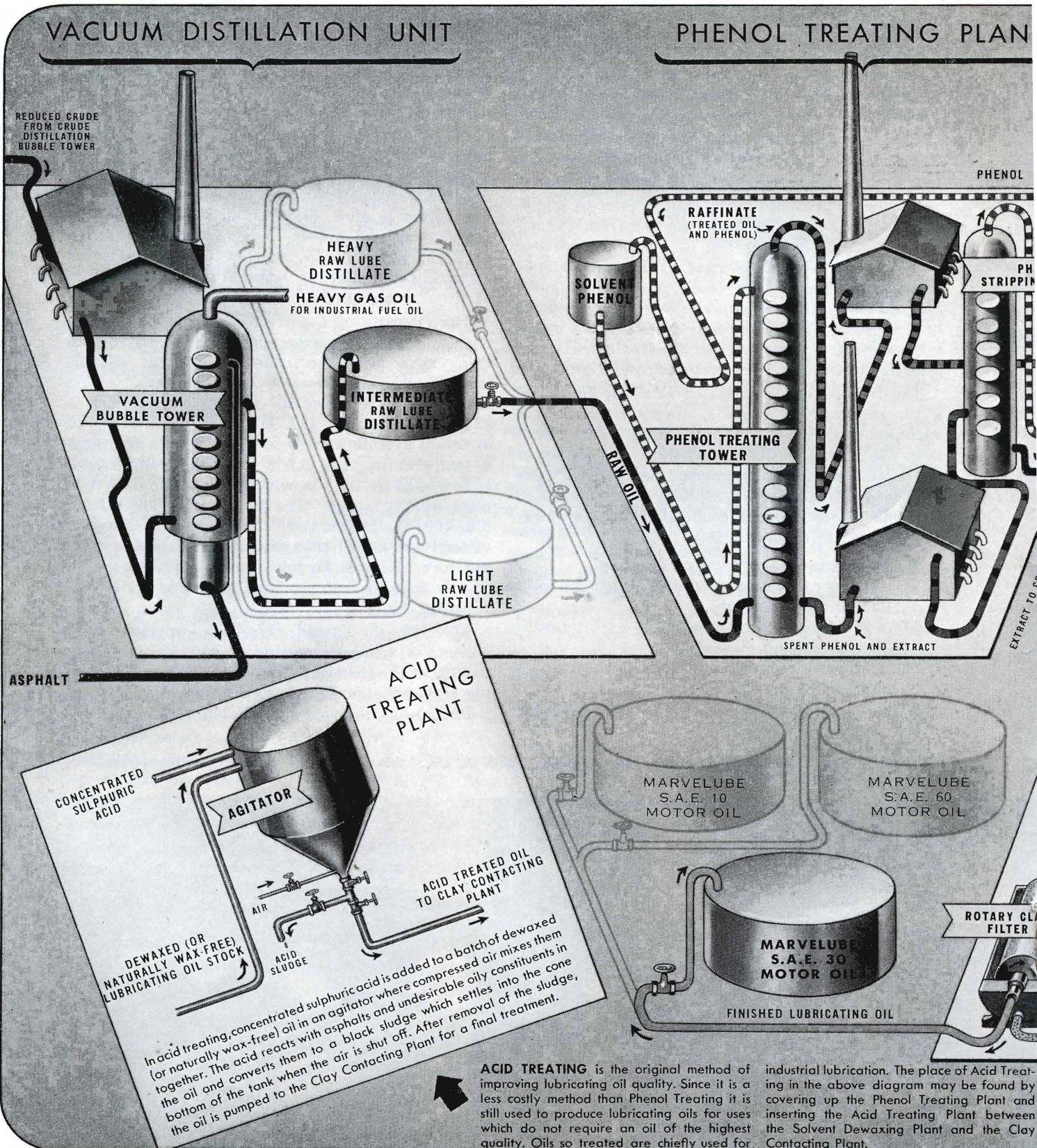
The low V. I., and chemically unstable components of a raw lubricating oil may make up 40% to 50% of the fraction. The more of these removed, the higher the quality of the finished oil.

Phenol has the remarkable ability of completely

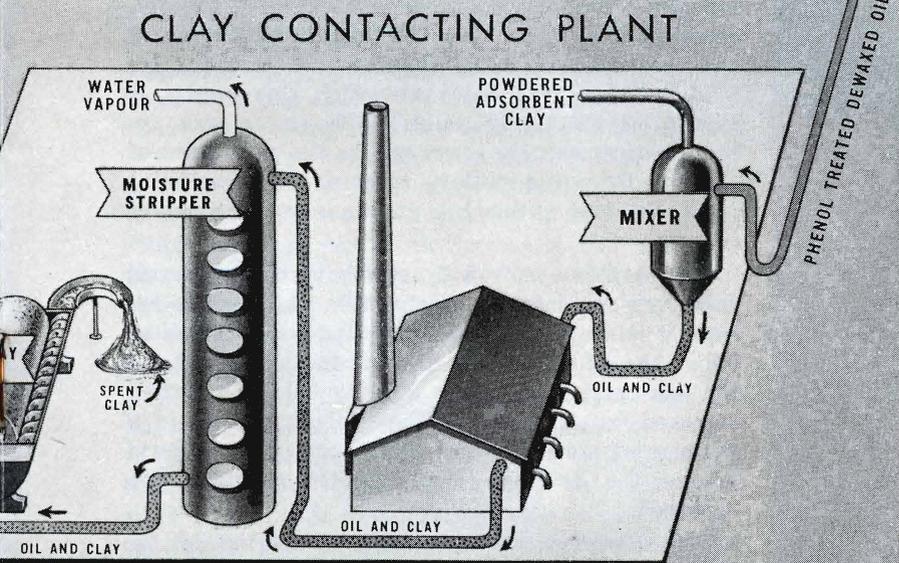
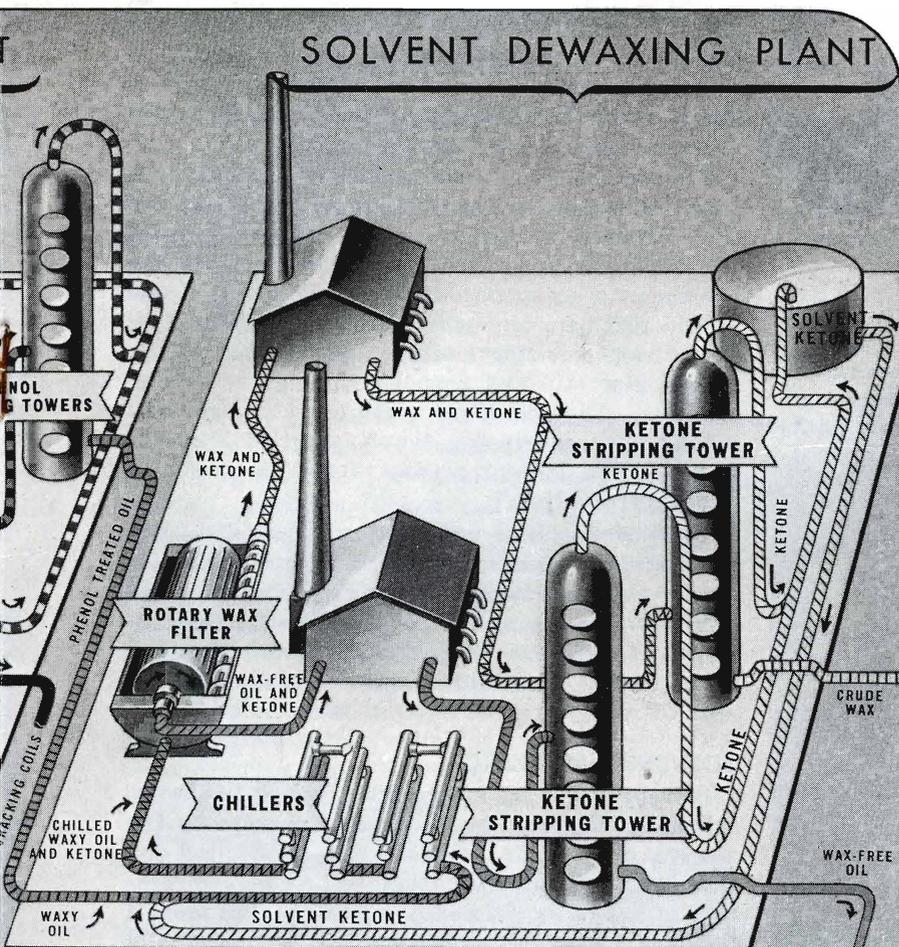
The control room of the Solvent Dewaxing Plant at Sarnia. With the aid of this maze of dials and recording instruments the operator controls every step of the unit's operation.



PRODUCTION OF LUBRI



CATING OILS



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Some Simple Definitions To Help You Find Your Way Around THE FLOW DIAGRAM

This diagram shows in much simplified form the steps in the manufacture of high quality lubricating oils. The starting material is reduced crude.

VACUUM DISTILLATION

The first step is to separate the heavy gas oil and asphalt from the reduced crude thus making the raw lubricating oil fractions available. This is done by fractional distillation in a bubble tower kept under very low pressure or vacuum. The lower the pressure in the tower, the lower the temperature at which the oil will change to vapour and pass up the tower. If distillation were attempted at atmospheric pressure, the temperatures necessary to cause vapourization would be so high the intermediate and heavier oil fractions would decompose or crack into lighter fractions with little or no lubricating properties.

As shown, three raw lubricating oil side streams are obtained from the Vacuum Bubble Tower. These must be treated in turn by the following processes to remove undesirable oily constituents and wax.

PHENOL TREATING

Phenol is a crystalline solid also known as carboic acid which melts at about 105°F. Molten phenol has the unique property of dissolving from raw lubricating oil fractions undesirable components that form resins, carbonaceous sludge and cause an oil to thicken excessively at low temperatures and thin out excessively at high temperatures. This is done in the phenol treating tower where molten phenol and raw oil are mixed as they pass one another in opposite directions. The phenol carries the undesirable components to the bottom of the tower whence it is pumped as "spent phenol" through a pipe still furnace and then into a bubble tower where the phenol is recovered. Phenol in the treated oil (known as "Raffinate") leaving the top of the phenol treating tower is recovered in a second recovery system in the same way. The phenol treated oil still contains wax which is removed in the next step.

SOLVENT DEWAXING

A special solvent known as "Ketone" is added to the waxy phenol-treated oil and chilled to approximately 0°F. at which temperature the wax crystallizes out as solid particles. The oil remains dissolved in the ketone. This mixture is then pumped into the bottom of a rotary filter which consists of a tank in which a canvas covered drum rotates. Suction inside the drum draws the oil-ketone solution through the canvas into the drum from whence it is discharged through an opening in the axle of the drum. The wax cake that collects on the canvas drops into a trough as the drum revolves. Both the wax cake and the oil-ketone mixture are passed through separate pipe still furnaces in order to recover the ketone.

CLAY CONTACTING

The dewaxed, phenol treated oil from the dewaxing plant contains dark coloured substances and other substances that cause oils to form emulsions with water. Special adsorbent clays are used to remove these substances. The oil and clay are mixed in a tank and then heated in a pipe still furnace after which it enters a bubble tower where moisture from the clay is distilled out. The clay with the adsorbed undesirable components is removed from the oil by filtration in a rotary filter which operates at temperatures as high as 425°F.

removing these undesirable components. At ordinary temperatures pure phenol is a crystalline solid. When made up in dilute solutions and sold in drug stores as an antiseptic, it is known by its other name, carbolic acid. Chemically, phenol is a combination of benzene and the OH of H₂O (water). Pure phenol melts to a liquid at about 105°F. and is used in the phenol treating of lubricating oils when in the liquid state. Phenol acts by simply taking the undesired components into solution without any chemical change. It can thus be recovered and re-used by simply distilling it from the undesired components.

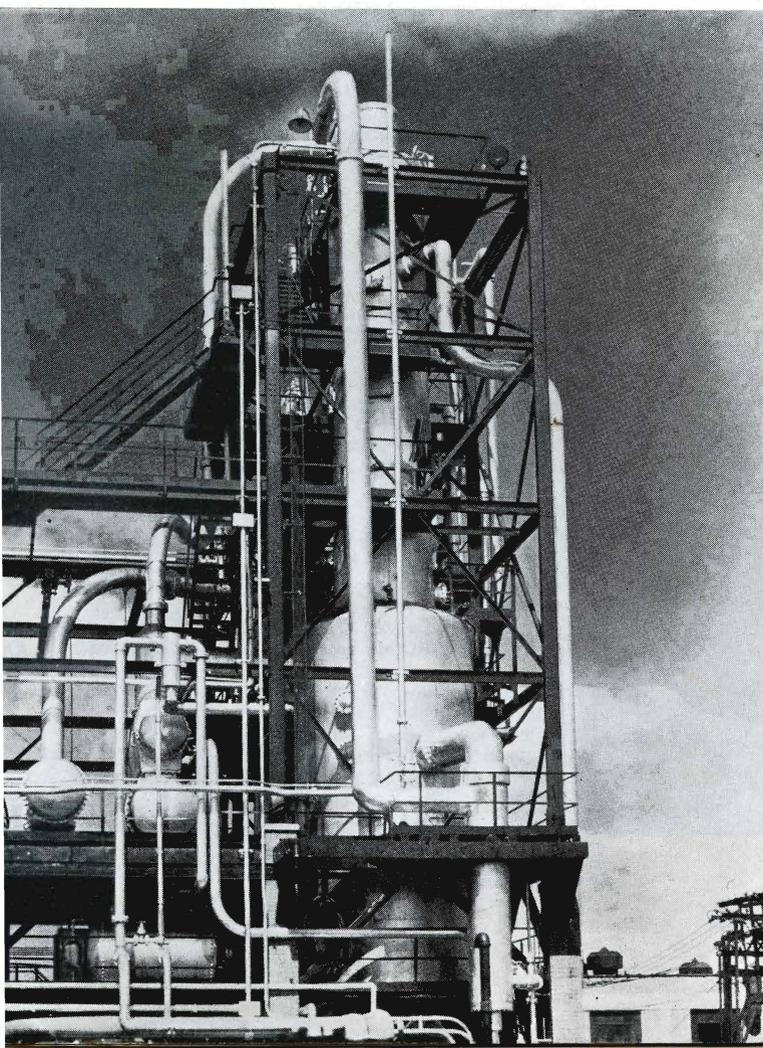
The phenol process is carried out by continuously mixing the melted phenol with the raw lubricating oil distillate in a phenol treating tower. The phenol is pumped into the top of the tower while the raw lubricating oil is pumped into the bottom of the tower. The phenol, being the heavier of the two, falls through the uprising oil. Special baffles and distributing arrangements cause the phenol and oil to be thoroughly mixed. The droplets of phenol pick out the undesirable components and carry them to the bottom of the tower where the mixture of phenol and undesirable components is known as "spent" phenol. This spent phenol is pumped to the "phenol recovery unit" which consists of a pipe still where the spent phenol is heated

to a suitable temperature, and a "phenol stripping tower" where the phenol is distilled from the undesirable components. The recovered phenol is cycled back for re-use in extracting more raw oil. The undesirable components leave the bottom of the phenol stripping tower as a product known as "extract". This may be used as a heavy fuel oil or cracked in the cracking coils to produce cracked naphtha and other cracked products.

The oil freed of undesirable components that leave the top of the phenol treating tower is known as "raffinate." This oil contains a small amount of phenol which must be removed. In much the same manner as spent phenol is distilled, the phenol in the raffinate is separated from the treated oil in a "dephenolizing unit." This consists of a second pipe still and phenol stripping tower combination. The phenol recovered overhead from the second phenol stripping tower is cycled back for re-use. The bottom product from the tower is "phenol treated oil."

Each of the three raw lubricating oil distillates is treated in turn in the phenol treating plant to yield light, intermediate and heavy phenol-treated oils. These oils are now almost completely chemically stable and have a high viscosity index but still contain large quantities of wax. The next process removes this wax.

A view of the Solvent Dewaxing Plant at Sarnia refinery.



SOLVENT DEWAXING

Solvent dewaxing makes little change in the lubricating oil except to lower its pour point by the removal of wax. In warm oil, wax is dissolved and thus behaves as an oily substance. As the temperature of the oil is reduced, the wax changes from a liquid to a solid. The solid form of wax is usually elongated crystals which, when enough are present, interlace to form an open but rigid structure which prevents the oil from flowing. A temperature slightly above the point at which this occurs is known as the "pour point." The more wax removed, of course, the lower will be the pour point of the oil. On a cold winter's morning, the pour point of the oil in an automobile engine is very important indeed.

The wax is removed by dissolving the waxy oil in a very special solvent and then chilling the resulting mixture to a predetermined temperature at which the oil remains in solution in the solvent and the wax crystallizes out as a solid. The wax is then removed by filtration. The special solvent is a mixture of normal propyl ketone and normal butyl ketone, the mixture being referred to simply as "ketone".

The solvent dewaxing process is carried out by mixing approximately two volumes of ketone with one volume of waxy oil at a temperature such that all the oil and wax is dissolved. The mixture is then passed through a "chiller" which slowly re-

duces its temperature. The chiller is essentially a large refrigerator. The slow cooling permits large wax crystals to grow. Shock chilling to temperatures of the order of 0°F. in a second chiller rapidly cools the mixture causing more wax to come out of solution. After the second chilling, the mixture has the appearance of rather watery oatmeal porridge.

The cold mixture is then pumped to a rotary filter which consists essentially of a tank in which a canvas covered drum rotates. Suction on the inside of the drum draws the ketone and dissolved oil through the canvas while the wax builds up on the outside of the canvas in the form of a wax cake. At the completion of one rotation of the drum the wax cake is forced to fall from the canvas into a trough where a screw conveyor delivers it away from the rotary filter.

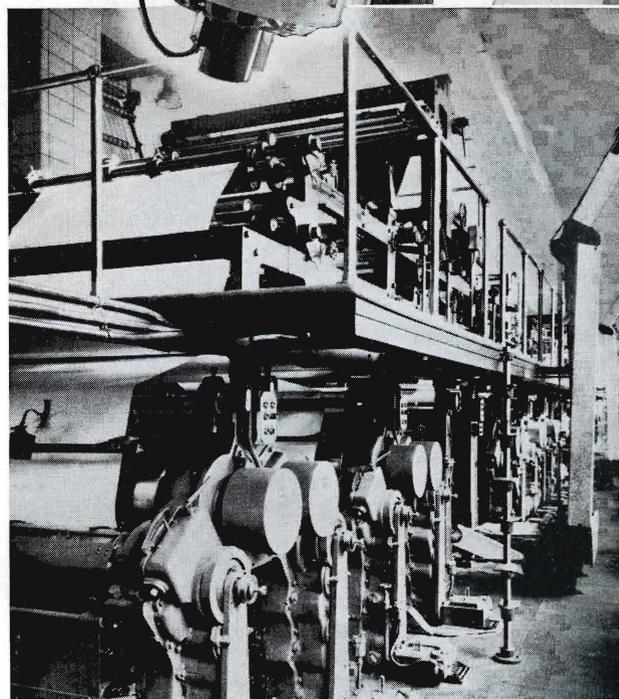
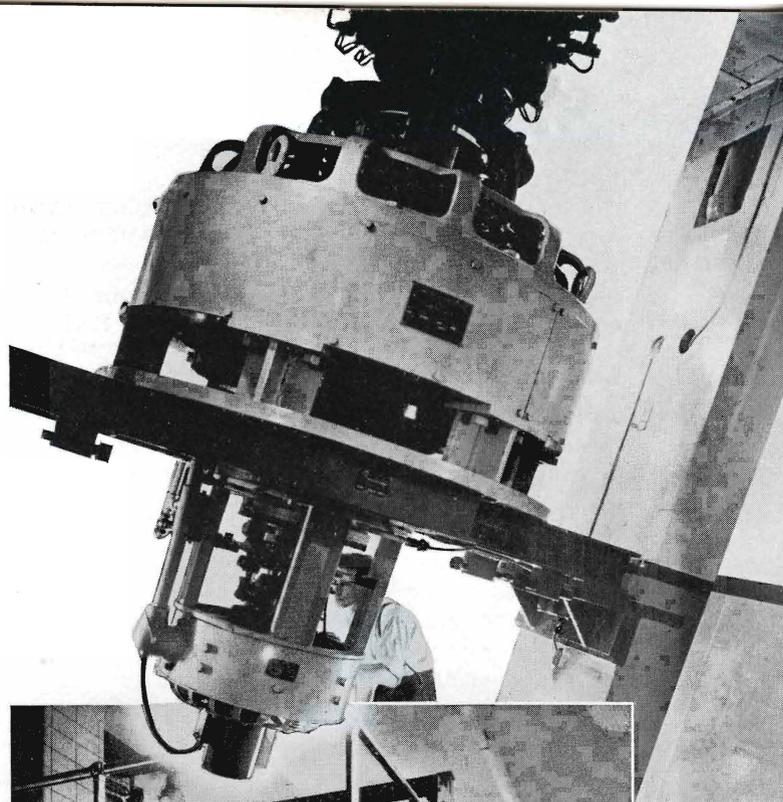
The ketone-oil mixture within the drum, known as filtrate, is pumped from the drum through an opening in the end of the shaft on which the drum rotates. Both the filtrate and the wax cake, of course, contain ketone. The wax cake is melted and pumped through a pipe still and then into a ketone stripping tower where the ketone is recovered as an overhead product and may be used again. Molten crude wax leaves the bottom of this stripping tower to be processed into commercial wax. In the same way filtrate passes through another pipe still and into a second ketone stripping tower where it is separated into ketone and wax-free oil.

As in the case of the phenol treating plant, each of the phenol treated light, intermediate and heavy distillates are passed in turn through the dewaxing plant. These oils are fine lubricating oils but can still be improved in quality. This is done in the clay contacting plant.

CLAY CONTACTING

Certain clays have the ability of picking out of lubricating oils substances which give the oil a dark colour and substances which turn dark in the course of time. They also remove substances which tend to cause the oil to form permanent emulsions with water. An emulsion is a mixture of oil and water which is sometimes so thick that it has the consistency of butter and in a motor is sometimes called watery sludge. Thus clay contacting improves emulsification characteristics of an oil and produces a lighter coloured oil.

The clays used in clay contacting may be special clays as found in nature known as "natural clays" or clays which have been subjected to a chemical treatment with acid and known as "activated clays". The clay contacting process is carried out by mixing phenol-treated-dewaxed-oil with a definite amount of clay as determined in the laboratory. The mixture is then passed through a pipe still where it is heated to almost 450°F. Moisture released from the clay is removed from the oil-clay



All industrial machinery requires lubrication for its operation. A film of oil 1/10,000 of an inch thick supports the entire weight of the 70-ton hydro-electric exciter in the top photo. The bearings and other moving parts of the 560-ton Globe and Mail press are lubricated from central oil reservoirs using Imperial DB Oil 61.

mixture (slurry) by passing the hot mixture into a moisture stripping tower where the water vapour is removed overhead. The moisture-free slurry leaves the bottom of the stripping tower to enter a rotary filter which operates on the same principle as the rotary wax filter in the solvent dewaxing plant. This filter, instead of operating in the neighbourhood of 0° as the case of the wax filter, operates at a temperature of about 400°F. The filtered oil is delivered to tankage while the clay

now known as spent clay, may be discarded or used for other purposes.

Each of the three phenol-treated-dewaxed-lubricating oils is clay contacted in turn to produce three base stocks. These three stocks and blends of them form the series of Marvelube Motor Oils ranging in viscosity from SAE 10 to SAE 60.

Other Lubricating Oil Treating Processes

ACID TREATING

Many oils used in industry are not subjected to severe operating conditions. Consequently, the quality given an oil by the phenol treating process is not necessary. Oils suitable for these industrial purposes are made by the less expensive sulphuric acid treating process.

Sulphuric acid is a heavy corrosive liquid which has the property of removing some of the undesirable components in a lubricating oil that form resins and carbonaceous deposits. Sulphuric acid, however, does not remove the components which cause the oil to thin out at high temperatures, (does not improve Viscosity Index). Furthermore, sulphuric acid removes some of the desirable oil components as well. Nevertheless, this process, due to its relative simplicity as compared to phenol treating, is less costly for the production of lubricating oils which are not subjected to severe operating conditions.

In the acid-treating process a batch of lubricating oil distillate, either naturally free of wax or dewaxed by the solvent dewaxing process, is run into a tank with a cone shaped bottom known as an "agitator." Sulphuric acid is also run into the tank and mixed with the oil by agitation with jets of air. The sulphuric acid reacts chemically with the undesirable constituents in the oil, forming flecks of black tarry material which when coagulated is known as sludge.

When the air jets are turned off the sludge settles into the cone at the bottom of the tank from which it is drawn through a valve at the bottom to sludge "cooking kettles". Here water and steam are added to the sludge causing unreacted but diluted acid to rise in the kettle where it can be drawn off and sent to the acid recovery plant. Here the unreacted sulphuric acid is re-concentrated for further use. The sludge remaining in the kettles is diluted with oil and is used as fuel for the refinery boiler house. The batch of acid-treated oil in the agitator is then pumped to the clay contacting plant for a final treatment. The clay not only improves the colour of the oil and takes out emulsifying substances but also removes any traces of sulphuric acid remaining after the acid treatment.

MANUFACTURE OF CYLINDER OILS

Cylinder oils are usually made from reduced crude. Reduced crude contains in addition to the desired lubricating oil components undesirable oily

constituents, gas oils, asphaltic materials, and, depending on the source of crude, more or less wax that crystallizes out in crystals so fine they cannot be removed by filtration. The asphaltic materials and undesirable oily constituents are removed by acid treating in an agitator as described above. This is followed by clay contacting also as described previously. This leaves a chemically stable oil fraction with a boiling temperature range extending from gas oils to components boiling at such high temperatures they will remain in place as lubricants despite the presence of high temperature superheated steam. The acid and clay treated reduced crude is then subjected to a batch vacuum distillation whereby as much of the lighter gas oils and lighter lubricating oils as necessary are distilled out to give the cylinder oil remaining in the still the desired viscosity.

Depending on the source of the crude, the acid and clay treated reduced crude after vacuum distillation will contain more or less of finely crystalline wax. This wax is removed by a centrifuge dewaxing process long used by the petroleum industry. In this process the oil is mixed with more than an equal volume of naphtha and chilled in chillers similar to those in the solvent dewaxing plant to a temperature of 0°F. or lower. At this temperature the mixture looks like watery mud. It is then fed into the centrifuges.

A centrifuge operates on the same principle as a cream separator. The naphtha-oil mixture with its suspension of exceedingly small wax crystals is fed into the bottom of a long vertical cylinder which rotates at high speed. This is called the bowl. Due to the rotational speed, the heavier wax-free oil portion rides over the waxy layer. Both layers move to the top of the bowl where the inner layer and outer layer are separated by a mechanical arrangement and caused to flow from separate spouts. Each stream is pumped to a separate batch still where the naphtha is distilled out. Removal of naphtha from the wax-containing portion leaves a form of dark petrolatum—a mixture of the exceedingly fine wax crystals in oil. Removal of naphtha from the oil-containing portion leaves a finished cylinder oil.

At the Sarnia refinery of Imperial Oil Limited, several raw lubricating oil stocks, by various treatments, blending, and compounding with non-petroleum substances, are eventually converted into many series of finished lubricants. Consequently, in an article of this length it is impossible to indicate all the processes used, let alone the properties of the various lubricating oils. The required properties are determined by field experience and the demands of modern engine and machine design. Research by petroleum chemists and engineers develops the processes capable of producing the required properties.



Above—Members of the Home Nursing Unit of the Ioco and Sunnyside Branch of the Red Cross. Right—Ioco employees subscribe 100% to the purchase of War Savings Certificates. Purchases passed the \$100,000 mark last February.

IOCO CO-OPERATES IN THE WAR EFFORT

A FINE example of what civilians can do to co-operate in the general war effort has been set by the employees of Imperial Oil Limited at Ioco, B.C. Community spirit has always been very high in the town of Ioco, and with the advent of war the employees determined to do everything they could to further the war effort. The results of their efforts show what co-operation and determination can do in this respect.

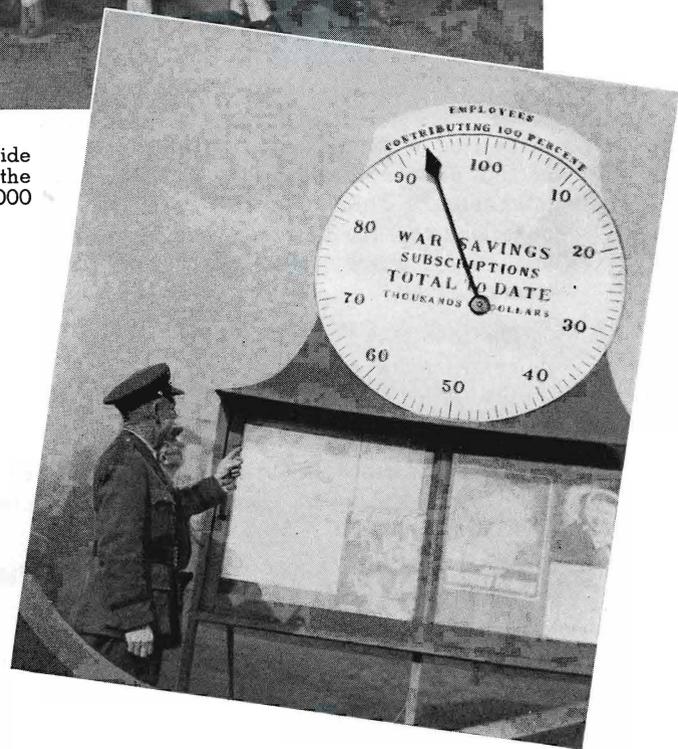
Red Cross Activity

Just two months after war was declared the Ioco and Sunnyside branch of the Red Cross was formed. Since that time the chapter has grown steadily both in membership and achievement, due to the loyal co-operation and unstinted support of the community. Close to 300 members are now enrolled, and cash receipts for the years 1940, 1941, and 1942

were \$743.24, \$750.14 and more than \$1,500.00 respectively.

Paralleling this financial growth has been the development and accomplishments of the Women's Work Committee which since its inauguration has completed 4,370 articles for the armed services, women's auxiliary services and for war refugees. The quality of the work done is of very high standard, some of the knitting having won first prize at the last Vancouver Exhibition.

A Home Nursing Unit of the Red Cross Corps was early established, and by means of regular instruction and practise meetings held under the direction of a registered nurse with the support of



the local doctor, a very efficient unit of over 24 members is now ready to serve either A.R.P. or the Disaster Relief organization. In May of this year when the Red Cross Society decided to receive blood donors from outside Vancouver, a male group was immediately formed by the Ioco Branch, followed later by the first women's organized group in British Columbia. Altogether some 100 donors have volunteered for this life saving work and many of them have already given their third donation—a really outstanding example from such a small community.

Regular monthly door-to-door household salvage collections are being made with gratifying results.

In 1942 the High School Girls Auxiliary raised \$160.00 for the Red Cross.

War Services Fund

In the spring of 1941 the Dominion Government announced the approval of a Dominion-wide drive for a consolidated War Services Fund, to replace individual canvasses. In April of that year, at an Ioco Industrial Council Meeting, a suggestion was made that a fund be started at Ioco to take care of this drive and any others that might come at a later date. The suggestion was that employees subscribe to such a fund every payday by payroll deduction, thereby eliminating any further canvassing.

The idea was received favorably and the elected delegates made a canvass of the yard. Each employee signed a payroll deduction slip for the amount he felt he could subscribe.

The Industrial Council as a body act as trustees, and any allocation of the funds must first be approved of by them.

This fund has proved to be a great success as the following figures will show:

RECEIPTS since Inception to December 31, 1942.. \$3,209.55

DISBURSEMENTS

Canadian War Services Fund, 1941..	\$600.00
Membership Red Cross, 1941-42.....	400.00
Canadian Red Cross Blanket Appeal..	150.00
Donation to the Civil Protection Committee (A.R.P.)	142.50
Canadian Red Cross Appeal 1942 Drive (The Council voted \$1000.00 to the above Fund to be paid in monthly instalments of \$100.00. In Decem- ber 31, 1942 eight payments had been made, as above.)	800.00
Blood Donor's Transportation.....	69.12
Donation to the Salvation Army....	200.00

Total Contributions to December 31, 1942.. 2,361.62

Balance in Fund December 31, 1942.....\$ 847.93

Ioco Social Club

During the late summer of 1941, it became apparent that war conditions would have a very marked effect on the movement of the Ioco employees to Vancouver and surrounding areas, where they were accustomed to find their amusements. A canvass of the employees was made to see if a Social Club could be formed to provide local entertainment, and the canvass was so successful a general meeting was called to outline a programme.

The Club is now incorporated under the Societies Act of British Columbia. The officers consist of seven Directors, a Secretary and Treasurer. All Ioco employees are entitled to become regular members and can vote at meetings. People living and working in the immediate vicinity of Ioco are also eligible to join as associate members. Dues are one dollar per month per family, and at present the club has 125 members, all of whom live in Ioco or close by.

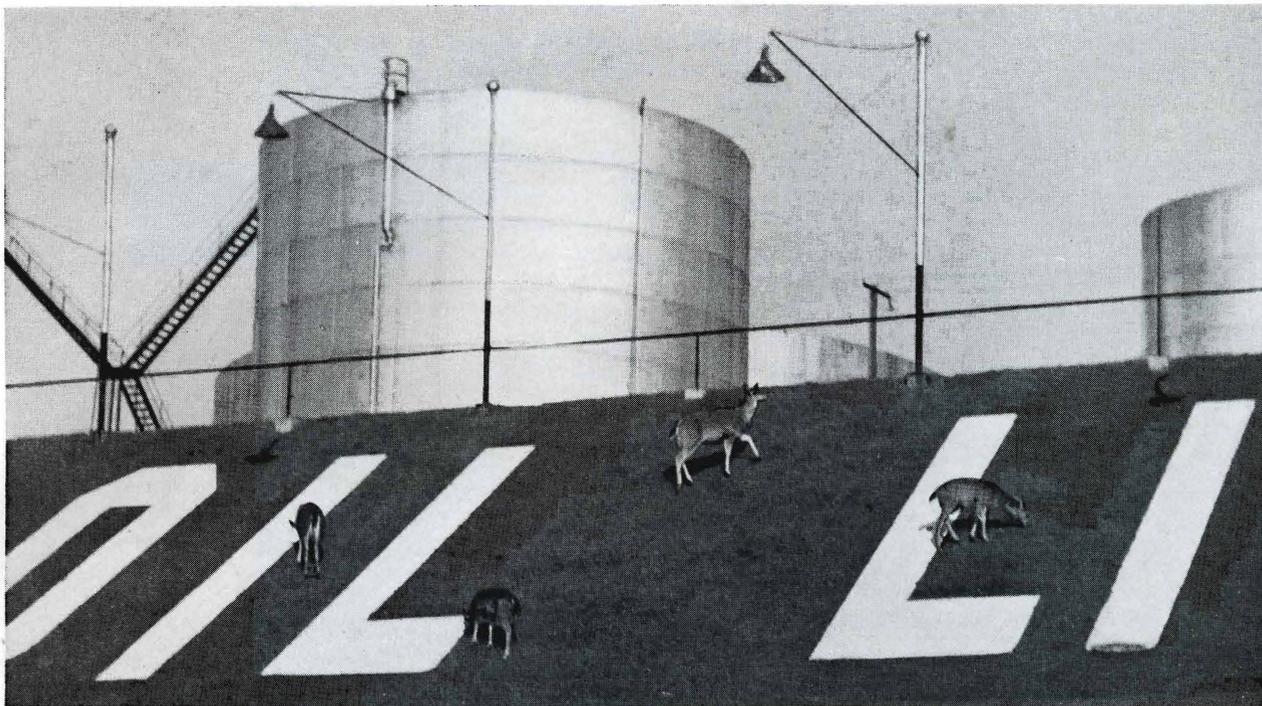
When the club started, funds in the hands of other local organizations were turned over to the club and with these as a starting point a moving picture machine with sound equipment was purchased. So far the Club has provided a picture show every Friday evening at which up-to-date sound films are shown. Several dances have been sponsored, with the result that there were more dances at Ioco in 1942 than ever before. The club operates a lending library with more than 1000 books.

At the local bathing beach the club has built bath houses for changing, and generally improved the surroundings. When the club funds permit it is the intention to sponsor other athletic and welfare activities.

The Directors meet once a month to transact business, each Director being responsible for some particular phase of local activity. The club has been operating now for more than a year and is a very fine example of what can be done through co-operation and small dues.

War Savings Reach High Total

Mention should also be made of the participation of the employees at Ioco in War Savings Certificates and Victory Loans. Ioco employees subscribe 100% to War Savings Certificates, and have made substantial purchases of Victory Bonds. On February 1, 1943, subscriptions totalled more than \$100,000.00.



FROM OUR IOCO ALBUM

Despite the fact that Ioco Refinery is only ten miles by water from the centre of the city of Vancouver, it has at its back door a wilderness strip of several hundred miles unsettled except for an occasional small village.

Wild game of all kinds is plentiful. Small black bears are quite frequently seen, cougars are not uncommon and deer are fairly plentiful. The winter of 1942-43 was very severe, and the deer were driven down to the settlements, partly for food and partly

to avoid the cougars. A small herd of them spent the winter in the immediate vicinity of Ioco Refinery, and as they can easily jump the fence they spent a good deal of the time browsing on the lawns and firebanks within the plant. They became very tame and it was possible to get within ten or fifteen feet of some of them providing they were approached slowly. The photograph above was taken of a group feeding on the lawn and firebank immediately above the office.

MISS HELEN RIX WINS EXPERTS' SHIELD AS MARKSWOMAN

SHOOTING a perfect score of 6,000 out of 6,000, Miss Helen Rix has won the Experts' Shield offered by the Dominion Marksmen of Montreal.

Miss Rix, who is with the Tax Department of Imperial Oil Limited, in Toronto, took up rifle shooting only two years ago, when she joined the Irish Rifle Association in Toronto. Last year she qualified to try for the shield, and set as her goal winning it with a perfect score.

To qualify as an Expert, a competitor must turn in a perfect score from the prone position, 98 or better on each shot from the sitting or kneeling position, 95 or better on each shot from the standing position, and a total of 5,820 out of the possible 6,000.

While 13 perfect scores have been turned in during the history of the competition, Miss Rix is the first woman to score a possible. In 361 out of her 600 shots she struck the dead centre of the bullseye.





Guardians of the North Atlantic. Sleek, efficient Canadian-built Corvettes escort convoys in many waters of the world, patrol Canadian coast lines. Nearly one-half of all convoy protection work on the vital North Atlantic route is now in charge of the Royal Canadian Navy.
—Public Information Photo.



THEY'VE GOT TO

Float to Fight...

Most critical moment in a new vessel's life is her launching—60 seconds of shipyard drama when anything may happen, but usually doesn't—thanks in no small part to good launching greases.

AN OMINOUS crescendo of *ships, ships, ships*, is rising from Canadian shipyards. On both our coasts, on the Saint Lawrence and on the Great Lakes armies of ship builders swarm over the rapidly rising hulls—fitting sections together, welding, launching and then on to the next one. In the four years of the war Canada has become the third largest ship-building nation of the world.

Launchings are now at the rate of six a week. Since the beginning of the war, Canada has launched

500 ships, including corvettes, minesweepers, patrol boats, base ships, cargo vessels and other craft. Progress is well advanced on the construction of two destroyers of the Tribal class. In addition, hundreds of smaller vessels, ranging from lifeboats to motor torpedo boats, have been built.

The versatile corvette, essentially Canadian, is one of the most effective answers to the enemy submarine menace. The corvette escorts convoys, patrols coast lines, and fulfills the primary functions

of a fighting ship—to seek out and destroy the enemy. The cost of a corvette is approximately \$700,000, and its construction requires some 375,000 man-hours.

The small boat program involves an expenditure of some \$13,000,000 and is now approximately 75 per cent complete. It includes crash boats, aircraft tenders, bomb-loading dinghies, salvage and supply boats, refuelling scows, flat scows, and derrick scows for the Royal Canadian Air Force; harbour utility craft, motor torpedo boats, gate vessels, whalers, pulling boats, and service dinghies for the Royal Canadian Navy; service boats and collapsible assault boats for the Canadian Army; battle practice targets for the British Admiralty; and rescue launches for the British Air Mission.

Collapsible Assault Boats

One of the more interesting of the smaller craft is the collapsible assault boat. Twelve feet in length, this multiple purpose craft will carry a load of 2,000 pounds and still show a 10-inch freeboard.

Its bottom is constructed of stiff plywood and its rigid laminated wooden gunwales are connected by collapsible canvas sides.

Mass Production Methods

Traditionally, shipbuilding has been a hand-tailoring job. It is so no longer. Mass production methods have invaded the shipyards. Only one set of plans is necessary for a hundred ships. Engines, pumps and turbines built in one of a dozen different plants will fit any one of a class of vessels. Welding tools have outdistanced riveting guns.

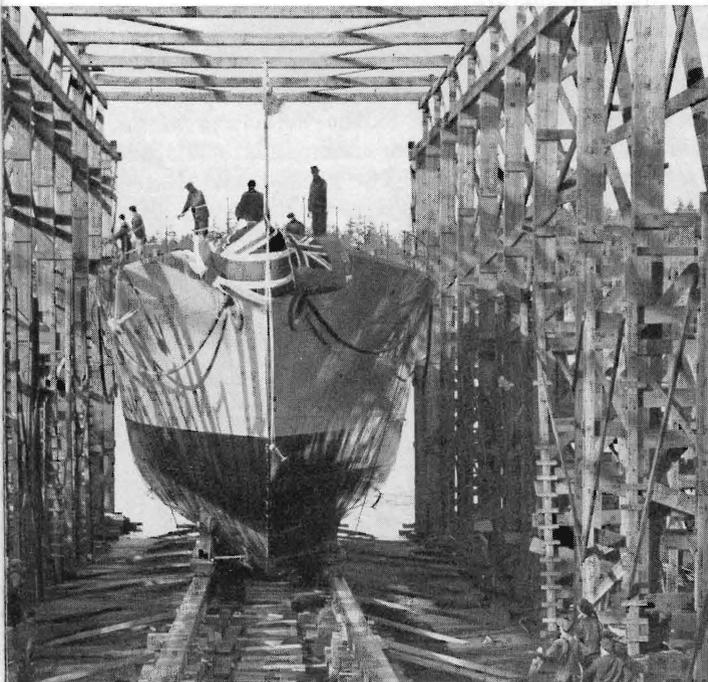
Pre-fabrication is the secret to mass shipbuilding. It makes the job more one of assembly than construction. Some vessels have been built entirely in large sections before the keels were laid. The completed sections are stored nearby and swung into place by giant cranes as welders move swiftly to make them fast.

Even after 40 years of shipbuilding, one grizzled shipwright foreman crosses his fingers every time a new ship starts down the ways. Anything can happen when that ponderous dead weight obeys the pull of gravity. Friction may set the ways on fire. Faulty timbers in the ground ways may collapse and send the ship crashing sideways to the earth. The vessel may pick up too much momentum and ram her stern against the far bank of the river. Even in a normal launching she may be seriously strained as the water buoys up the stern, pivoting the ship on the bow section alone.

Lubricating the Ways

The first and most important step in preparing for a launching is the construction of the groundways, parallel tracks on which the ship will slide into the water. Usually tilted slightly inboard towards the hull, they slope toward the water, the steepness depending on the size of the ship and the depth and width of water. Usually two groundways are sufficient but for exceptionally large and wide-beamed vessels four ways may be required.

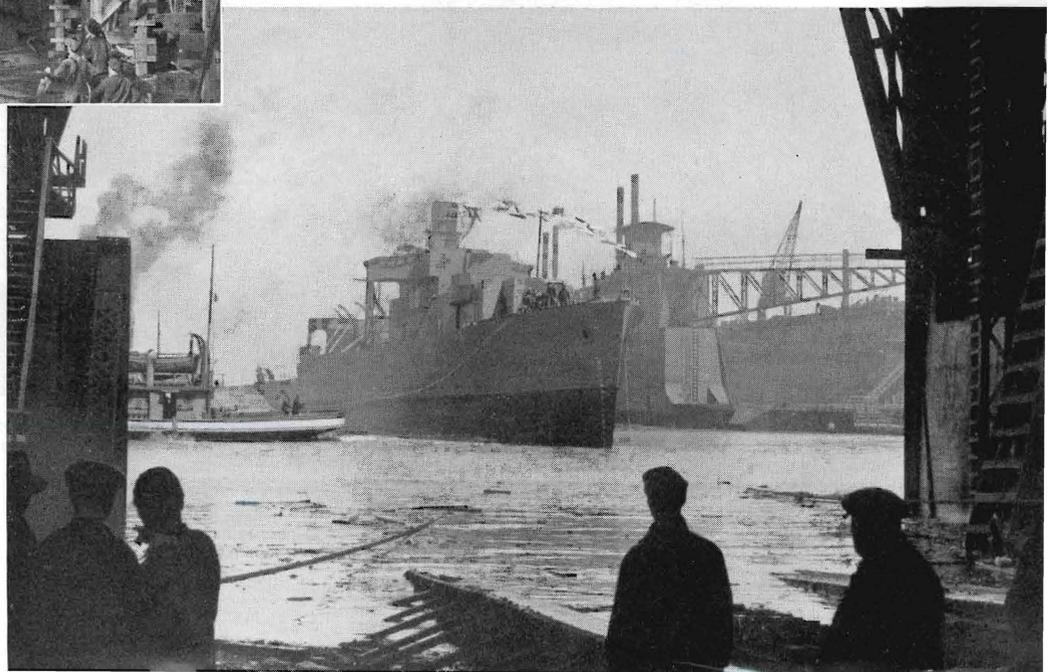
As soon as the groundways have been built and



Above—Another addition to Canada's fast-growing Navy slides gracefully into the water. Workmen watch her closely as she emerges from the shadow of the stocks.

—Public Information Photo.

Right—Launched with the aid of Imperial launching lubricants, H.M.C.S. "Lossie" is moved to the fitting-out basin where she will be made ready for service.





Public Information photo.

Some hours before the launching is to take place, workmen knock out the keel blocks, shores and cribbing that supported the hull during construction.

accurately aligned they are covered with launching grease. There is vastly more to this than merely smearing on some lubricant, so we'll come back to it.

The hull of a ship doesn't actually rest on the ways and slide into the water. It is held in a launching cradle, a stout, snug-fitting wood framework. This in turn rests on what are called the sliding ways. These might be compared to a set of skis fastened to the under side of the ship, with the groundways as a giant ski run. The sliding ways are held in place by triggers and other devices which are removed when the vessel is ready for launching.

At the bow of the launching cradle are so-called crushing strips so that during the launching, when the full weight rests on the fore-poppet as water buoys up the stern, the ship can pivot.

Ready to Launch

When the great day arrives one crew of workmen wedges the launching cradle securely against the hull, while another removes the keel blocks, shores and cribbing so that the entire weight of the ship and cradle rests upon the ways. If the water area into which the ship is to slide is so narrow that there is danger of her ramming the far bank, weights or drags are attached to the ship by heavy cables.

When all preparations have been completed the ship is held on the ways by only the releasing gear. Then, a signal is flashed to the launching stand, where the sponsor grips the champagne bottle and the triggers are released. The great mass of steel stirs, the ways creak, champagne splashes and ship, cradle and sliding ways slip into the water—a sixty-second slide to glory.



First step in preparing the groundways down which the new vessel will slide is to melt the base coat.



The melted base coat is applied while hot to the surface of the groundways. Successive layers of the hard, resistant grease are built up to support the weight of the ship.

Stern-first launchings still are the most numerous, but where limited water areas exist, side launchings become necessary. This ship is built parallel to the waterline and a large number of groundways are required, extending from the far side of the ship to the waterline, or even into the water for a short distance. The general practice is to have the ways end one to three feet above the water level. In some side launchings, ships have dropped as far as 13 feet into the water.

A Quick Slide

It usually takes a ship less than a minute to slide down the ways. Yet as much as 45 tons of launching greases may be needed to get her safely into the water, and during those vital seconds the care with which they are compounded and applied may spell the difference between success and costly failure. They must support the entire weight of the ship, prevent wood to wood contact as one set of ways slides on the other and provide a lubricating surface exactly suited to the launching conditions.

Early Launching Greases

In olden days, wooden ships were launched on soft soap mixed with common axle grease. Even when the first iron and steel ships took to the water, tallow, green soap and any kind of grease served as a launching lubricant. As ships grew larger and heavier, tallow proved too soft, it squeezed out from between

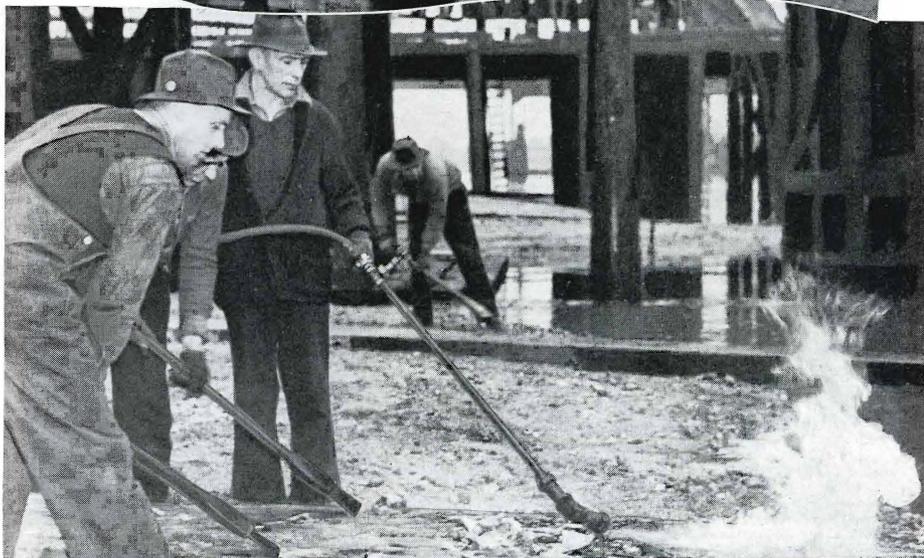
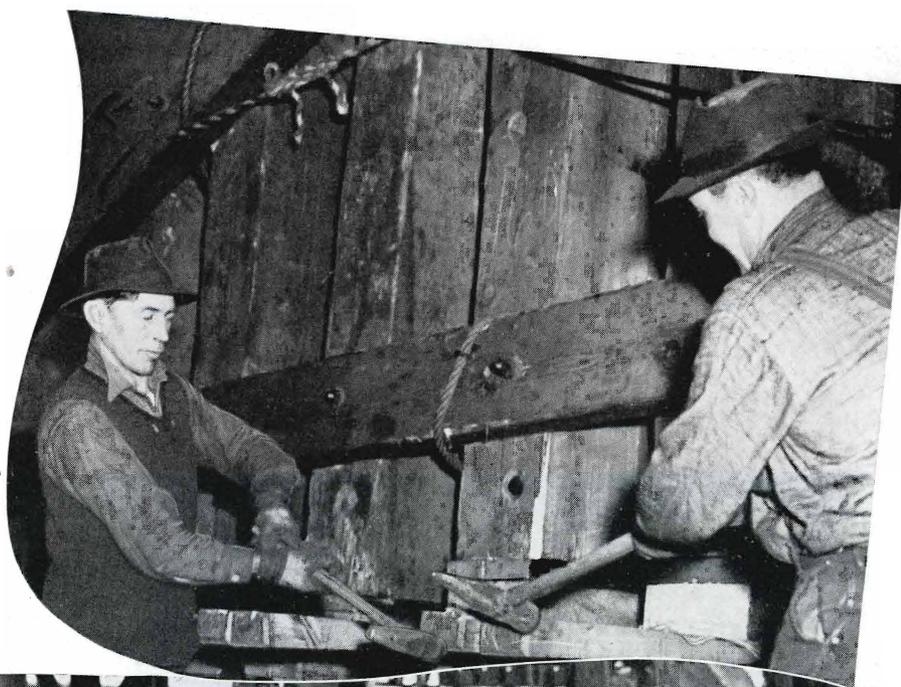
the ways, provided insufficient lubrication. So builders added stearic acid. The result was a harder, tougher product but one that lacked the slipperiness of plain tallow. To overcome that shortcoming, shipbuilders adopted two greases—a hard, resistant base, covered with a softer slip coat.

This worked for a while, but ships grew even larger and heavier, and launching greases revealed further serious shortcomings. They lacked load-carrying ability and reacted too greatly to temperature changes.

Modern Launching Lubricants

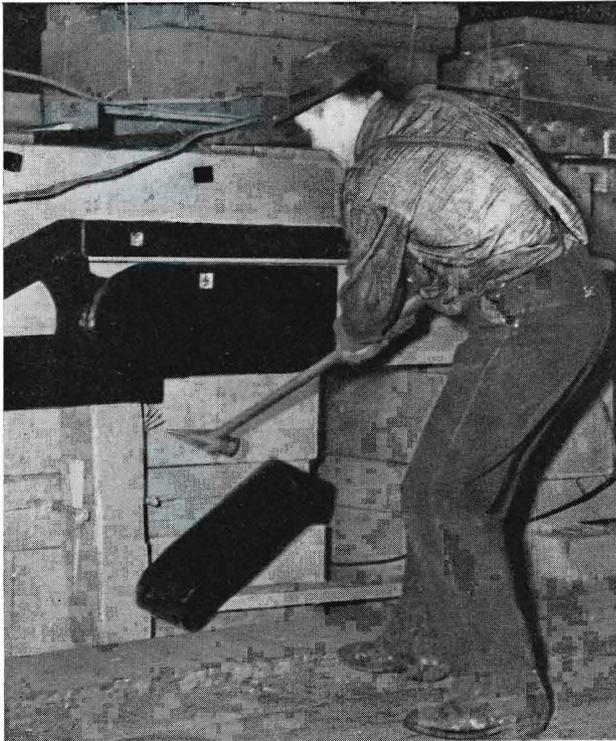
In its research on new launching greases the petroleum industry worked to develop a firm resist-

During the launching the hull of the ship doesn't actually rest on the groundways. It is held in a launching cradle, a stout, snug-fitting wood framework with ski-like runners. Here workmen wedge the cradle against the hull preparatory to launching.

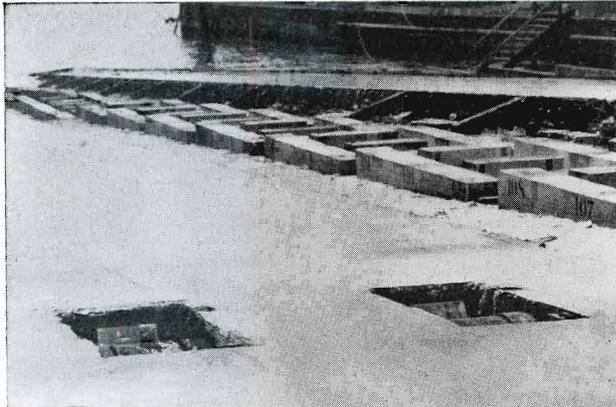


The ship safely launched, the surplus slip coat is salvaged. The ways are then prepared for the laying of the next keel.

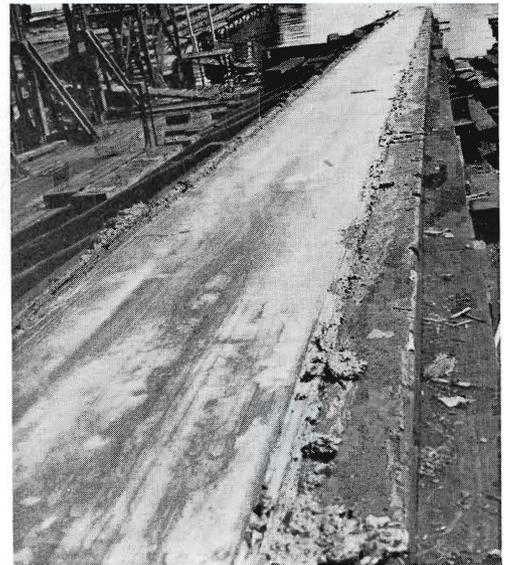
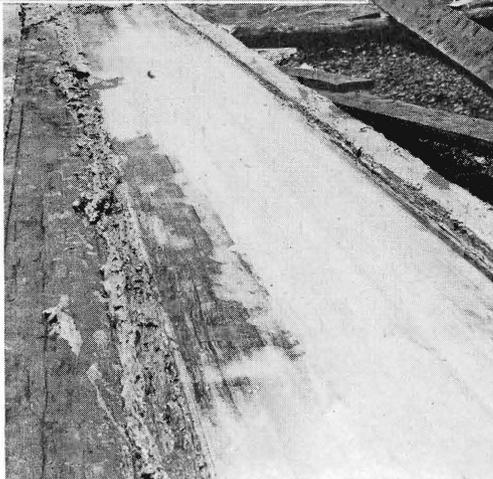
A softer, slippery grease, known as a slip coat, is applied to the base coat by hand or paddle.
Photos courtesy C. Greenwood, West Coast Shipbuilders Ltd.



While the sponsor on the launching platform stands ready to crash the champagne against the prow of the vessel, workmen (above) release the triggers that hold the ship on the ways. Below is a type of mechanical trigger used in some shipyards.



Unable to support the weight of a large ship the greases in the photo on the left squeezed out excessively, permitting wood to wood contact between the ways which might seriously have interfered with the launching. The greases in the right photo also squeezed out under the pressure but maintained a sturdy film of lubrication between the ways necessary for safety.



ant base coat which could be applied directly to the wooden surface of the groundways and be capable of supporting high pressures without softening, squeezing out, cracking or lifting from the ways. The slip coat, on the other hand, should be a relatively soft lubricant designed primarily to reduce friction between the sliding ways and the base coat.

A Grade for Every Season

To supply the needs of Canadian shipyards, Imperial Oil Limited supplies launching lubricants which are the result of years of research. Imperial Basekote No. 31 carries higher loads, resists softening at higher temperatures or becoming brittle in cold weather, withstands the effects of both salt and fresh water and adheres firmly to wooden surfaces.

Its running mate, Imperial Arctic 3, is a smooth, buttery, amber-colored lime base grease that offers the maximum lubrication, resists water, is adhesive to the base coat, does not squeeze out excessively under heavy loads and is soft for easy application. To make doubly sure that shipyards could choose the grease best suited to their particular launching problems this product was made available in three grades. One is softer and better suited to cold weather launchings, another is firmer and designed for hot summer use under heavy loads, and so on.

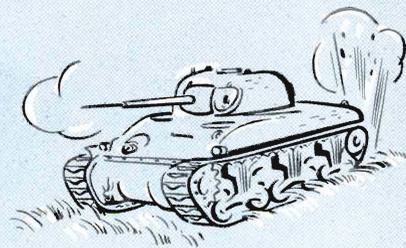
Applying the Basecoat

In the usual application, Imperial Basekote is melted in large kettles and applied while hot directly to the surface of the groundways. Successive layers are built up to a total thickness of from $\frac{3}{8}$ to $\frac{5}{8}$ of an inch. When the base coat has cooled and hardened, a $\frac{1}{4}$ to $\frac{3}{8}$ inch layer of soft Imperial Arctic 3 is laid on top. At the most, only one inch of these launching greases is sufficient to insure perfect lubrication of the ways.

When a battle depends on a bearing . . .



In PEACE the value of a bearing is measured in dollars. In WAR a bearing may win or lose a battle. The fate of armies may depend on the output of one machine.



That is why the lubrication problems of industry are now CANADA'S problems. That is why Imperial Oil's great research laboratories are concentrated on keeping one jump ahead of the ever-changing lubrication needs of Canada's war producers.

In its long years of industrial lubrication experience, Imperial Oil has accumulated a vast library of information — practical solutions to lubrication problems—which is readily available to help solve the immediate or future problems of industry.

OIL IS AMMUNITION

USE IT WISELY

Conservation of gasoline and oil fuel is necessary to make sure that adequate supplies are available for the continuous prosecution of the war.

Heavy bombers — like the Sterling bomber on the front cover being fueled and bombed-up ready for a raid over Germany—require 1,500,000 gallons of high Octane aviation gasoline for a 1,000 plane night raid.

The Corvette and Minesweeper (below) being refueled from a tanker before setting out for sea, each use from 50,000 to 60,000 gallons of oil fuel every 10 days.

