MECHANIZED WARFARE DEPENDS ON PETROLEUM

OIL IS AMMUNITION

Use it Wisely!

SIXTY thousand gallons of gasoline is a lot of gasoline. It would take the average corner service station almost a year to sell that much motor fuel. It is a year’s supply for more than 220 family automobiles today. To transport it all at one time would require ten of the largest tank trucks available, or six railway tank cars.

Sixty thousand gallons is a lot of gasoline—but that is the amount that is needed just to fill the tanks of the mechanized vehicles which make up one mechanized division of the Canadian Army.

Figures on total consumption of petroleum products by our armed forces are considered security information, not to be publicized. But when one realizes how much gasoline a mechanized division alone needs just to fill its tanks, some idea may be gained of the tremendous amounts of petroleum products our oil-powered army uses in its operations. On manoeuvres and in battle the amount of gasoline used mounts to astronomical figures.

Tremendous quantities of oil and greases also are needed to provide adequate lubrication for our army vehicles. Here again total figures on consumption are not available, but thousands of gallons of motor oil, and thousands of pounds of greases are needed to make the initial fill of crankcase, transmission and differential, and chassis, of our mechanized units.

Except for a few special greases, the army relies on standard lubricants for its mechanized equipment. At first glance it would appear that lubricants for army vehicles would have to be of a very special type, for army equipment is driven under conditions that the average automobile or truck never encounters. These conditions include terrain varying from swamps and rivers to dusty, sun-
baked desert; and temperatures which range from below zero to arroving summer heat. Fortunately, in the majority of cases the oils and greases which the petroleum industry has developed for the modern automobile lubricate successfully under even these exacting conditions.

The many years and the millions of dollars which the petroleum industry has spent in research to produce modern motor oils and greases is helping the war effort in a big way. Army lubrication experts shudder to think what they would be up against if standard automobile oils and greases wouldn't stand up in conditions under which army vehicles operate. It would mean the development of a whole new line of products. As things are, the Army technicians rely mainly on standard products to meet their lubrication specifications. In the records of breakdowns of mechanized equipment, none were caused by lubricants when the correct lubricants were used and properly applied.

Standard petroleum hydraulic oils are used as the hydraulic medium which swings the heavy tur-

smoke screen generators pour out their dense, concealing clouds. Oil is used as a base material to produce the smoke.

Universal Carriers ford a river. To lubricate hoopy wheels and tracks on our 30-ton tanks. In other branches of the army, standard products are meeting the specifications set up by the engineers. Standard hydraulic oils are used as the hydraulic medium in the recoil chambers of anti-aircraft, field, and coast defense guns. And these oils have to be good. Every time a shell is fired, the recoil buffer slams back into the hydraulic medium, which cushions the recoil. In guns such as the Bofors Anti-Aircraft, where the rule of fire is extremely rapid, the hydraulic oil takes a heavy beating. Poor oils wouldn't stand the punishment—they would quickly break down and the guns would be ruined. Hydraulic oils which were developed for industry are meeting successfully the exacting requirements of the guns.

Small arms call for a low pour test, low viscosity oil. Here again a standard lubricating oil was found to fit the bill.

A Canadian gun crew makes a Bofors Anti-Aircraft gun. For this and other artillery weapons oil is used as the hydraulic medium in the recoil chamber.

Where the petroleum industry had no standard products to meet special requirements, the techni-

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carriers and tanks, the petroleum industry supplies water-resistant greases.

icians got busy and developed the products needed. One instance was a special extreme pressure lubricant for wheel bearings and for the front axle universal joints of certain types of four and six wheel

drive trucks.

Oil is helping to feed our boys in khaki. No—
you'ven't developed substitutes for food from petroleum, but in army camps across Canada the refrigeration machines of the huge storehouses are lubricated by low pour compressor oils. In the same army camps, hundreds of gallons of transformer oils insulate and cool the power transform-
erers which supply the thousands of kilowatts to the lights and equipment. In camp workshops, one finds solvent mupihuse for painting and camou-
flage work; cutting oils, quenching and tempering oils for machining and heat treatment.

Cutting oils are standard equipment in Ordnance field workshops—those marvels of compact efficiency which transport a complete machine shop into battle for the maintenance and repair of fighting vehicles.

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Canadian soldiers learn how to use the "Molotoff Cocktail". Prime ingredient of this anti-tank device is gasoline.

Shells in storage and in shipment are protected from rust with petroleum rust preventives.
In Toronto’s Union Station the Model Railroad Club of Toronto has Built a Miniature Railroad Empire.

Whether model railway building is a hobby or a disease has never been determined. If train arrivals and departures leave you cold, the popularity of model railroading may give you cause to scoff, but to 25,000 men on this continent it is a serious hobby. Model engine building and model railway operation have long had their devotees in the British Isles, where the hobbies had their birth. Just when and where they originated on this side of the Atlantic is obscure. Railway models are still being unearthed in attics of old homes. One instance was the discovery, in an ancient and long-vacant hotel, of a complete model layout griny with the dust of years. It is only in recent years, however, that model railroading has come into popularity on this side of the Atlantic.

Typical of the many model railway clubs on the North American continent, is the Model Railroad Club of Toronto. In January of 1938 four ardent hobbyists organized the club. This group of enthusiasts has grown until today the club numbers 28 members, including an architect, a construction contractor, several electrical engineers, a dentist, a physician, an advertising executive, a statistician and others.

Appropriately enough, the Model Railroad Club of Toronto has its quarters high in the Union Station in Toronto. Here, through the courtesy of the Toronto Terminal Railways, the club acquired an ideal room for their set-up. A space 40 feet by 40 feet is ample for the average model railway system. Owing to the architectural arrangement of the Union Station the club was able to acquire a room 15 feet wide by 165 feet long — permitting a continuous layout which includes 1,900 feet of track.

The Canadian Great Western, as the Toronto Club calls its railway, includes nine locomotives, some fifty old freight cars, two complete passenger trains, a maintenance-of-way train, and miscellaneous pieces of rolling stock. All have been constructed by the members.

The scale of this miniature railway empire is 60-gauge — 1/2 to the foot. This means that everything is 1 1/2th of normal size. In case of dimension is hazy, it might be pointed out that in this scale the average model locomotive is from 18 to 32 inches in length depending on the type. So delicate are the mathematical proportions of the details that the builders work to 1/100th of an inch, and even the depth of the paint counts.

The same meticulous detail in construction applies to the other items of equipment. The cars are fitted with accurate scale automatic couplers which work exactly to prototype. The passenger coaches are fitted inside with chairs and tables. In one of the dining cars a lamp stands on every table! The track is built of steel rail, and roadway problems on grades and curves had to be solved by the builders to keep the diminutive locomotives and their cars on the track. You can lose beneath a fingernail the tiny scale spindles that hold the track to the fibre ties. In 1,900 feet of track some 88,000 of these infinitesimal spindles are permanently hammered into some 22,000 ties! The railroad ballast is very effectively simulated by the use of roofing material with a gravelly surface.

To your model railway fan, the landscaping of the layout is as important as the rolling stock itself. Lining the right-of-way are model stations, roads, roundhouses, bridges, water tanks, oil tanks, and power stations. The scenic effects are obtained in many different ways. The hills and contours of the landscape are modelled in papier mache with a layer of asbestos plaster, and painted to represent grass and sand. Trees are built of several kinds of moss and lichen; and steel wool, sponges and sawdust become realistic shrubbery.

The mountains are staggered to lend greater scenic depth. The long arched bridge which crosses one of the gorges is of bull brass and is built to scale. A leading Canadian bridge builder supervised the creation of this authentic item.

The President of the Model Railway Club of Toronto is Larry Hayes, draughtsman for the statistical department of Imperial Oil Limited at 56 Church Street. The road name which Larry has adopted for his rolling stock is the "Mountain Pacific & Erie," and cars and engines bearing this designation are very much in evidence in the Club's layout. In the long line of freight cars built by Larry, one sees an Imperial Oil tank car, accurately reproduced in scale. On one of the sidings he has constructed a model of an Imperial Oil bulk plant, complete with tanks, loading rack, hercules and warehouses. On one of the many roads which wind through the landscape there is a model of an Imperial Oil Service Station, complete in every detail. Both the bulk plant and the service station are in exact scale.
BACKSTAGE AT AN OIL REFINERY

TO THE casual visitor, a modern oil refinery seems to be a place of unhurried, almost leisurely, operation. A visit to any one of the great processing units reveals little apparent activity. In the control room, the operator in charge keeps a watchful eye on the many gauges and dials, occasionally adjusting one on the panel. Indeed, to the casual visitor the men about the unit seem to be more concerned in seeing that their plant is kept spick and span than in its actual operation, for the unit seems to run itself. There is no shouting—no rush. This is the strange silent hum of the hot gases coursing through the pipes.

Like the modern automobile engine, a modern refinery runs smoothly, quietly and apparently without effort. Each part of the refinery meshes with other parts to convert crude petroleum into finished products.

But it is "behind the scenes" that one finds the hustle and bustle of the modern refinery. Here is where problems are met and overcome, where new processes are developed, and where these new processes are tested and shaped until finally they result in the huge processing units which are run with such apparent lack of effort.

This is the story of one process plant at the Imperial Oil Refinery at Sarnia, and the idea which brought it to life. It is the picture of the wheels within wheels of a modern oil refinery, which starting with an idea, convert that idea into a steel and concrete reality.

The idea was born of a need. Chemists knew that motors would be more efficient if they could be made to lubricate them that would not thin out at high operating temperatures. They had on hand an oil stock that looked as though it might be the answer. It would stand up very well to high temperatures. But there was a catch to it—this same oil stock had such a high wax content it was practically solid at room temperature. Obviously this wouldn't do.

One idea was to get rid of the wax. The research chemists at Sarnia put their heads together and pondered the problem. Soon they hit on the advanced idea that the best way to separate the wax from the oil was to dissolve out the oil with a select special solvent. They visualized the mixing of the waxy lubricating oil stock with the solvent, chilling it down until the wax crystallized as solid particles, and then filtering the wax from the oil stock by distillation. The oil-free wax could be easily separated from the solvent.

The problem now was—what could be used as the special solvent? The chemists made a list of all the properties this solvent should possess—the boiling point, freezing point, cost, corrosiveness, toxicity, solvent power etc. The list showed a very special solvent, indeed, was required.

The hunt began. The chemical stock room was ransacked—scientific journals were perused—the chemical catalogues were gone through. Soon dozens of "possibilities" were passing in and out of the chemists' test tubes as test after test was run. One solvent dissolved the oil but unfortunately dissolved too much of the wax as well. Another was poisonous—also no good because it was too dangerous. This one worked well except that very low temperatures were needed to make the wax separate as solid particles.

Eventually two little known solvents with impressive names defined all efforts by the chemists to toss them into the discard. They were methyl propyl ketone and its bigger brother methyl normal butyl ketone. The special solvent had been found—or had it? The research chemists were very non-committal about the whole matter. They knew that what works in a test tube doesn't always work in a large scale plant. They wouldn't say "This is the solvent" until they had tried it out in at least a small sized plant.

So the research chemists built a "pilot" plant—a small replica of the potential large plant. How they verified their laboratory work—and proved the solvent to be as good in the larger scale operation as it had been in the test tubes. The chemists announced, "This is the solvent". The idea was well on its way to reality.

With the pilot plant the chemists checked the operating details of the dewaxing process—the amount of solvent, the temperatures at which the wax crystallized out, the means of filtering off the wax, etc. Almost two years had passed since the idea was conceived. Now it had grown from a thought to a scientific report telling exactly how the wax could be taken out of the lubricating oil stock. However, a report was a long way from a lubricating oil processing plant. The design engineers next inherited the idea. They expanded it to a full scale plant—but only on paper. The design engineers created a diagram of the dewaxing plant in which the size and kind of all the major parts of the plant, the refrigeration equipment, filters, distillation towers, furnaces, tanks, etc., were shown. Here also they noted the amount of steam, electricity, feed, fuel gas, water and so forth, necessary to operate the plant. The special abilities and the side rules of the design engineers had partly bridged the gap between the scientific report and plant construction.

The drafting engineers completed the bridge. On communication from the design engineers, they drew scale plans, putting in every detail. The size and location of every window and door, the kind and size of equipment, the position, shape and size of every pipe, the number and kind of rivets and the routes that all meticulously recorded in a full of blueprints. The idea was now a detailed reality on paper.

The next step was to duplicate in steel and bricks the white lines on the blueprints. This was the job of another group—the construction engineers.

These are the generals of the refinery's mechanized industrial armies—men and men of infinite experience. The men, the machines and the departments who made or provided the thousands of parts which eventually combined and entered into the operating production. Construction of the plant took place both on the actual site and in a down or so refinery work-shops. When blueprints and instructions went to the various refinery departments to make parts, the "bull gang" moved onto the site. This brawny advance crew cleared the site and with the aid of power driven scoops dug excavations for foundations, trenches and buildings. Then came the masons with concrete and bricks and the structural steel workers with steel beams and rivets.

As the plant progressed, other refinery crews such as the carpenters, insulators, hur burners, painters, etc. moved in and did their part. In the meantime the refinery workshops were interpreting the lines and figures on the blueprints of steel. In the blacksmith shop half a dozen forges, a ton ten steam hammer and a dozen blacksmiths with ring hammer forge shaped hull plates, reduction joints, pipe hangars and a hundred other parts. The pipe hangers with wish and tactic pulled a glowing sand packed pipe around the forms planed to a steel floor. When cooled, the pipe, a giant 12 inches in diameter, was curved as gracefully as the draftsmen had traced it with a drafting pen.

Oil tanks, receivers and the great distillation towers were made by the refinery shops. A distillation tower is a series of glistening piles of steel plates, outside a boilermakers' shop. When the sheaf of blueprints describing the distillation tower have been digested, the boilermakers' department takes action. First the boilermaker in his small car rides an overhead track to the pile of steel plates. Steel girders are fastened to the boilermaker's hoist, lift and carry a ton or so of plates into the shop. Here metal men weld sheets or flame cut inch-thick plates to size. A great hydraulic press shapes a plate to fit a tower bottom while sixteen foot rollers smooth out its diameter. Plates are punched for rivets or bevelled for welding. As fast as the plates are finished the welders and riveters move them into the distillation tower. When finished it is up to the "riggers", specialists in handing great and awkward weights, to top-giant the site and set it in place.

In contrast to the massive equipment installed by the riggers were the smaller, more delicate instruments installed by the Process Control Department. In a central control room dozens of thermometers, pressure, flow and liquid level recorders and controllers line the walls. Like nerves from a brain dozens of electric and air lines ran to all parts of the complex plant bringing vital information to the control room and carrying back commands to the automatic valves and regulators.

(Continued on Next Page)
Electricians, pattern makers, pipefitters, machinists, tool makers, sandblasters and pipe coverers, all part of the refinery's army of specialists, contributed the material and skill of their trades to complete the idea. The Solvent Dewaxing Plant was a finished reality.

Although it was a completed reality, it wasn't yet an operating reality. The refinery "runners", at first under the watchful eyes of the research chemists and design engineers, put the plant to work. Pumps were started and oil circulated throughout the plant. Then the special solvent was mixed with the waxy lubricating oil stock and passed into the great refrigerating system. Down dropped the temperature of the mixture: 80, 50, 30, 10, 0° Fahrenheit. At this temperature the solidified wax causes the mixture to look like oatmeal porridge stirred up in a little more milk than usual. The cold mixture then passed to great rotating filter drums where the wax parted company with the lubricating oil. Both the wax, now re-melted, and the lubricating oil steams passed through re-heating furnaces and then to the distillation towers where they were stripped of the special solvent. The Solvent Dewaxing Plant was "on stream"—operating just as planned. A new processing plant, a better lubricating oil—the idea had grown up.

A REFINERY BUILDS A NEW UNIT

The story of the building of the huge processing plants which make up the modern oil refinery is a story of the co-ordination of many different departments. Pictures here is the story of the building of one unit—the solvent dewaxing plant—at the Imperial Oil Refinery at Sarnia.

1. The idea of the solvent dewaxing process was born in the laboratory. The problem was to get rid of the wax in an otherwise seemingly promising oil stock. After two years of research, the process was perfected.

2. In report form, the chemists handed their verified technical details of the idea to the design engineers. They in turn translated these details into a thermodynamically designed commercial unit.

3. Receiving the data from the design engineers, the commercial engineers and draughtsmen drew detailed working plans of the unit.

4. Plans completed, they were given to the construction engineers. Under their direction actual construction was started.

5. The refinery workshops contributed their collective skill. Here in the blacksmith shop a steam hammer forms one of the millions of parts entering into the construction.

6. Next door to the blacksmiths the boiler makers cut the plates for the distillation towers, tanks and receivers. Here an acetylene torch shapes thick sheet steel plate.

7. In the yard the plates from the boiler shops were fitted together to form the huge towers and tanks.

8. Rough castings of thousands of parts for the unit were turned and finished by the fully-equipped machine shop.

9. In the welding shop electrical arc welding helped in the assembly of the unit.

10. The riveters set the finished equipment in place. Here a bubble tower is being hoisted into position.

11. The solvent dewaxing plant was a completed unit, waiting only final tests before being put into production.

12. Tests completed, the unit was put "on stream." Here in the central control room the operator in charge adjusts one of the many instruments that control the operation of the plant.
Public Information Photo

Low pour compressor oils lubricate the refrigeration equipment in giant army camp refrigerators.

**OIL ON THE FIRING LINE**

(Continued from Page 3)

Oil plays an important part in chemical warfare. Smoke screen generators use oil as a base material. The destructive work of flame throwers is due to burning petroleum fuels. The prime ingredient of that vicious little anti-tank device— the Molotov Cocktail—is gasoline.

In many other ways petroleum plays a vital part on the firing line. Canvas equipment such as tents, tarpsaulines, guns and aeroplane covers, are protected from fabric-rotting parasites with copper naphthenate. The naphthenic acids used to make this fabric-protecting liquid are obtained from petroleum. Copper naphthenate's property of making fabrics resistant to moldew is used to good advantage in treating sandbags. Untreated bags soon rot, tear and spill their contents. Asphalt also is used to impregnate sandbag material, supplying added strength.

For waterproofing canvas and similar fabrics paraffin wax is used. This is also present in the shoe polish used by the troops. As well as producing a shine, this product helps to protect the soldier from poison gases. When leather is coated with a sufficient amount of it, poisonous gases such as mustard gas do not penetrate and burn the soldier's feet. Untreated leather, attacked by such gases, which are absorbed by the soil, becomes porous, shrivels and even disintegrates. To waterproof army boots, they are oil-treated during manufacture.

To protect shells of all types in storage and in shipment the petroleum industry supplies special rust-preventive compounds.

A mixture of chlorinated petroleum wax, chlorinated rubber and a petroleum solvent is used to impregnate canvas to make it fire proof.

"Oil is Ammunition—Use It Wisely", is no idle slogan. Realizing the tremendous importance of petroleum in wartime, the Canadian Army is making every effort to eliminate unnecessary use of this vital product. Early last Spring Defence Minister Ralston ordered that steps be taken to eliminate completely any uneconomical and unnecessary operation of military transport vehicles.

**Refining**

An oil refinery is one of the seven wonders of the modern world. This is the first of a series of articles on how it transforms crude oil into finished petroleum products.

**TO UNDERSTAND** petroleum refining, one must first understand the nature of the material from which the refiner makes his finished products. Crude oil is composed essentially of carbon and hydrogen. Thus, crude oil would be a very simple material if it were not for the remarkable ability of carbon and hydrogen to combine chemically in a thousand different ways to form a thousand different hydrocarbon compounds. Each of these has its own characteristics and a particular temperature at which it will boil. The "boiling points" of the hydrocarbons in crude oil form a series of temperature ranges from about 260°F. below zero for Methane, a hydrocarbon gas, to temperatures so high that the compounds break down or "crack" before they get a chance to boil. Many of the boiling point temperatures are so close together that it is impossible, except in the case of a few of the very lightest compounds, to separate the hydrocarbons as pure substances. Consequently, the refiner separates from the crude oil groups of hydrocarbons which boil within a limited temperature range. These groups he calls "fractions"—such as the gasoline fraction, kerosene fraction, etc.

Furthermore, there are different types of crude oil, depending on the number and composition of the hydrocarbons that happen to be present. To analyze each crude for all the hundreds of hydrocarbons in it is an impossible task. Yet the refiner must know what is in his raw material. This he learns by separating the crude into fractions and determining what hydrocarbon "families" are represented in each. The groupings of hydrocarbons with similar characteristics into families (the Paraffin Family, the Aromatic Family, the Naphthenic Family, etc.) and the relatively easy chemical determination of those families gives the refiner a chemical picture of his raw material. It also permits him to classify the various crude oils that enter his refinery.

Among the confusion of compounds in crude oil, some make a gasoline engine start easily, while others have just the opposite effect; some make the engine a giant of power while others turn it into a noisy wheezing; some make good lubricants while others corrode bearings; a few simply smell badly. These and many more gaseous, liquid and solid, good, bad and indifferent compounds make up the refiner's complex raw material.

It is the refinery's task to bring order out of the confusion—to retain the good, eliminate the bad and convert the indifferent compounds into useful products. The processes used by the refiner to convert all parts of the crude into useful products are:

**Distillation**

**Treating**

**Cracking**

**Synthesis**

**Compounding**

**Bleeding**

By "Distillation" the refiner lines up the members of the chemical families in their order of size (really boiling point and marches them off for their various duties (gasoline, kerosene, etc.).

As the selected groups or "fractions" leave the still, other compounds tag along which, in the

**Editor's Note:**

The work of a modern oil refinery is a fascinating story, but one which is too long to be contained in a single issue of "The Imperial Oil Review." However, your editors have had so many requests for the story of oil refining that they have decided to present it as a series of articles.

These articles were prepared by Gordon Purdy of Imperial Oil's Technical and Research Department at Sarnia in collaboration with the Advertising Department. This is the first of the series, and deals with the general purpose of refining, and with the first step—distillation. In future issues, the complete refining of various products such as gasoline, lubricating oil, etc., will be discussed.
THE BUBBLE TOWER... Heart of a Modern Refinery

BUBBLE TRAY IN OPERATION

There may be from 4 to 60 trays in the tower. The trays are numbered in order from the bottom up. Each tray is separated by a tray plate or tray. The hot crude rises through the trays, and the lighter vapors are condensed in the liquid. The heavier vapors pass on to the tray above, and so on to the top of the tower. As the level of the liquid of tray A rises, it flows down through the overflow pipe to tray B, where most of it is re-adiabatized to pass up to tray C, and so on to the bottom of the tower. The liquid "fractions" are drawn off at various heights on the tower, through side outlets, for further processing.

PIPE STILL

Oil or gas burners heat the temperature of the pipe still to approximately 755°F, before it is run into the Bubble Tower. The hot product from the tower is used to raise the temperature of crude in order to the Pipe Still. The hot product in turn is cooled by the crude.

Crude from refinery storage tanks is preheated on its way to the Pipe Still by passing it through Heat Exchangers.

Gas for domestic use or for refinery fuel.

RERUN TOWER

The Ranor Tower may be considered as a continuance of the main Bubble Tower. Its purpose is to make the crude fractionate sharply between the gasoline and heavy naphtha fractions.

DEPROPA NIZER

The fraction leaving the top of the Reburn Tower is suitable for gasoline, except for the high-propane ethanol and other higher gases in it. By further fractionation, the Depropanizer separates these light gases from the liquid.

STRIPPER

The Stripper is a short Bubble Tower. The desired product enters at the top and as it condenses down the tower, it is scrubbed or stripped of undesired light components by stripping steam. In this way, traces of gasoline are recovered from kerosene, making the latter safer for use in lamps and stoves.

CONDENSERS AND COOLERS

These are a continuous series of pipes, usually submerged in water. Their purpose is to condense the vapors to liquids and to cool the liquids to safe temperature.

HEAT EXCHANGERS

These operate much like coolers. A typical use is to pass hot product from a tower through a Heat Exchanger to raise the temperature of the crude in order to the Pipe Still. The hot product, in turn, is cooled by the crude.

REFLUX

This is the term given to the cooling liquid pumped into the top of the tower which causes the temperature of the tower to be reduced. Some of the liquid (in this case gasoline) is pumped from a plate at the top of the Bubble Tower, cooled and flowed back into the tower on the top plate. Other vapor leaving the top of the tower is condensed in a liquid and part of the liquid product is pumped back into the tower on the top plate, as shown on the Reburn Tower. Sometimes a large Reflux system is installed to lower the temperature of the tower to a better temperature gradient.
Pipe Still

In any distillation process, heat must be supplied to the crude oil. In modern equipment this is usually done with a pipe still. The pipe still often looks like a squat windless brick building about the size of a small cottage. Within it are many hundreds of feet of seamless steel alloy pipe which absorb intense heat from a row of oil or gas burners inserted through one wall. The crude oil is forced by pump through the pipe where it is heated to a temperature of about 275° F. At this temperature it enters what is known as a "bubble tower".

Bubble Tower

In any modern refinery the bubble towers, tall silver castles, dominate the scene. Their job is to separate the various fractions of the crude oil one from another by fractional distillation. If the crude were a well-mixed deck of cards, the bubble tower is the master dealer that shuffles them continuously into order and deals them out such suit almost instantly. This shuffling and dealing operation is the same in all modern distillation towers regardless of their size.

Let’s take a look inside the bubble tower. Every two feet or so up the tower there is a steel tray which, like a tremendous pie plate, extends completely across it. Each tray has several hundred holes in it and from each hole rises a pipe surrounded by a cap. These caps, like inverted teacups with a notched edge, are so designed that vapors passing up the tower are forced to bubble through the liquid that covers each tray. Hence the name “bubble tower”.

To take care of the accumulation of liquid on a tray, a pipe carries the overflow to the tray below. Thus liquids can work their way down the tower while the hot vapours travel upward.

What is the liquid on the trays and how does it get there? The liquid is a sort of condensation of some of the crude oil vapours, for example the kerosene vapours. The condensation has occurred because the trays as they approach the top of the tower are cooler. This cooling is caused by drawing off to a place outside the tower some of the hot vapours, condensing them and then pumping the resulting cool liquid back into the tower. The liquid flowing from tray to tray down the tower causes the trays to be cooled. The petroleum engineer calls this cooling liquid the "reflux". It accounts for the gradual change in temperature down the tower necessary for the operation of fractional distillation.

How Fractional Distillation Works

Now that we have an idea as to what the fractional distillation equipment is, let’s see how it separates crude oil into gasoline, kerosene, gas oil fractions, etc. The first thing to note is that the crude oil is heated in the pipe still to a temperature at which the various fractions the refineries wish to obtain at the same time are turned into vapour. In the shell still, you will remember, the crude was heated only hot enough to vaporize one fraction. In bubble tower operation the highly heated crude (275°F) leaves the pipe still and enters the tower about six trays from the bottom of the tower where it divides into a vapour portion and a liquid portion. The liquid portion collects in the bottom of the tower where it is continuously withdrawn as "reduced crude". The vapour portions consisting of gasoline, kerosene, gas oils, etc., rush up the tower where they are separated once from another by the action of fractional distillation.

(Continued on Next Page)
The higher the vapours rise in the tower, the cooler the tray encountered, as explained before. The liquids on these trays form a series of gradually cooler baths through which the rising vapours must bubble their way. A more easily condensable fraction, such as gas oil, changes from vapour to liquid as it bubbles through the liquid baths in the lower part of the tower. However, the liquid on the lower trays is not cool enough to condense the kerosene and gasoline so they go on to higher and cooler regions. Eventually all the fractions are condensed except most of the gasoline—the least condensable fraction—which passes out at the top of the tower as a vapour to an external condenser.

Since in the larger towers 500 or more gallons of liquid fractions are produced each minute, the vapours travelling up the tower form a vertical hurricane. Consequently bits of gas oil, for example, can be carried in the rush well beyond the tray where they should condense. Eventually these stray bits are caught in the liquid on one of the upper trays containing mainly kerosene. Here the bits of gas oil contaminate the kerosene. When this plate overflows and the liquid spills down to the trays below, the kerosene revapourises and again rushes upward while the gas oil remains behind where it belongs. The shuffling caused by revapourisation and recondensation—repeated many times from tray to tray—sets one fraction from another. This is the fractional distillation. The net result is that one tray collects gas oil substantially free of heavier fractions, another tray ten plates or so up the tower collects kerosene, substantially free of gas oil and so on. These trays are tapped and the liquid drawn off—aided by “side streams”—is pumped into separate smaller hubble towers known as “stripplers” which remove by more fractional distillation the last traces of any undesired lighter fraction that is present. Steam is usually introduced into the stripplers to aid the stripping action.

**How the Liquid Fractions Are Cooled**

The vapour fractions leaving the top of the bubble tower are first condensed in “condensers” to a liquid and then cooled to a safe temperature in “coolers” for storage. The liquid “side streams” are also passed through coolers to reach safe temperature levels. Coolers and condensers usually consist of a bundle of pipes enclosed in a steel shell. The hot product flowing through the bundle of pipes is cooled by water flowing through the shell. If the product is hot enough to make it worth while, cold crude oil replaces the water in the shell as a cooling medium. In this case the cooler is called a “heat exchanger” because the hot fraction loses its heat to the crude, which is thus preheated before entering the pipe still. This is one example of the way the refinder makes use of every possible degree of heat to keep costs down.

As explained earlier, distillation is only one of the many processes, all of which play their part in modern refining. Because it is the first process to which the crude oil is subjected—no matter what product is to be made—it has been described rather fully in this general article on refining. In future articles in this series, when the complete refining of various products such as gasoline, lubricating oil, etc. is discussed, the remaining processes will be described. Each of the other processes requires a plant of its own. Thus the modern refinery is really a collection of manufacturing plants, each a separate unit, where the “raw fractions” after they leave the bubble tower become precision products.

**George H. Dickinson Receives 50-Year Button**

Mr. Geo. H. Dickinson, employee of Imperial Oil Limited in Montreal, is to be presented with a 50-year service button. Mr. Dickinson entered the oil business as a general clerk with the Vacuum Oil Company in 1892. He was employed in their office at St. Paul Street, Montreal, until the Imperial Oil Company took over the business in 1899, when he moved to the Imperial Oil offices in the Board of Trade Building. Mr. Dickinson has worked under ten different divisional managers since he started with the Company.

Although many Imperial Oil employees have long years of service with the Company—some having received 40 year buttons—this is the second time in the history of the Company that an employee will receive a button for 50 years of service. The late Mr. C. G. Stillwagon was the first to receive one of these.

The *Imperial Oil Review* joins with Mr. Dickinson’s friends of Montreal office in extending congratulations on his fine record of service.

**New Transatlantic Airline Flies with Nata**

To the long list of transatlantic flights which have been fuelled by Imperial Oil Limited is now added American Export Airlines’ important new service to Europe with a fleet of giant, long-range four-engined “Flying Aces.”

American Export Airlines, newest name in the air transport field, inaugurates transatlantic air service at a time when additional, dependable lines of communication and transport are urgently needed between the United States, the United Kingdom, and Ireland. In February the Civil Aeronautics Board granted the company a certificate to operate between New York and Fowey, Ireland. Under the terms of this certificate, American Export Airlines is permitted to land for refuelling purposes at Bermuda, the Azores, and Lisbon.

Early in May the governments of Canada and Newfoundland granted American Export Airlines the courtesy of landing within their borders, and a proving flight was made covering these countries.

When the United States of America entered the war, American Export Airlines offered its equipment and personnel specifically to operate a short cut service to the United Kingdom and Ireland. This offer was accepted.

A new fleet of giant, long-range four-engined Flying Aces, built by Vought-Sikorsky, will maintain regular transatlantic service, and will be refuelled at Botwood, Newfoundland, with Intara Aviation Gasoline 100 and Intara Aviation Oil. The Flying Aces were designed to cross the Atlantic on a non-stop schedule, carrying 12 sleeping passengers, plus a crew of 11, and a substantial amount of mail and cargo. The Flying Ace EXCALIBUR, first of the fleet, was christened in January by Mrs. Henry Agard Wallace, wife of the Vice-President of the United States.

In addition to this fleet of large, fast ships, the Company has a Consolidated PB2 flying boat, originally acquired to make a series of transatlantic survey flights between the United States and Europe, and which is currently used as a training ship. This aircraft is similar to the long-range “Catalina” type aircraft which are used so effectively by British and American air forces in long-range patrol work.

The American Export Airlines service is staffed with a full complement of executive, ground, and flight personnel. The crews are composed of veteran specialists.

The Company’s operations base is at La Guardia Field, New York. The hangar, which comprises the first unit of this base, will take three of these large Flying Aces at a time. A two-storey office building is attached to the hangar which houses the offices of the various operations department. The base is provided with all necessary mechanical equipment to facilitate continuous maintenance and complete overhaul of this aircraft. Transatlantic passengers will be embarked and debarked at the La Guardia Field Marine Terminal, which has been altered to house personnel and equipment.
...of security and efficiency

By F. J. CAMERON, Royalle Oil Co., Ltd.

WAR to the contrary notwithstanding, the development of civilization has been marked by an increasing regard for the value of human life and happiness. This is exemplified in industry which although once, like its domotic contemporaries of ancient times, disdainful of human rights and values, has in recent years kept pace with and often led the way in the social development of a human consciousness of responsibility.

Avoidance of the needless hazards of disaster that existed in the past has brought long years of industrial peace to many industries. Fair wages, good working conditions and, above all, a sense of security for the worker in his employment and for the latter years of his life have played a large part in this.

Accident prevention obviously is important to all business but it is not intended for that purpose alone, laudable as it may be; it is a phase also of modern industrial efficiency. An industry with a high accident ratio cannot be efficient because accidents result in loss of manpower, loss of materials and curtailment of production, all of which add to the costs of both the worker and his employer.

Safety and efficiency go hand in hand. Unsafe working conditions, fatigue and mental strain cannot work at maximum efficiency; further, men trained to work safely consciously cooperate with each other and with the management.

Large companies have been quick to realize the benefits to be derived from a well-organized, active safety campaign, and have instituted safety departments and have added personnel to their organizations. Such a department must have the whole-hearted and enthusiastic support of the management, and if violated, the support must be born of a sincere, humane interest in the well-being of employees.

A false assumption on which safety departments are sometimes built is the purely monetary one. Many of the discussions and articles on accident prevention remind us that we can save money by improving safety. When the saving of money was the only factor in consideration, if the department run only in the interests of the company, with a primary concern of money saving, it will achieve results in only half measure because employees will be quick to recognize its motives and treat it accordingly. Without their cooperation there is no real success in such work.

One hesitates to introduce the word humane as a motive for business, yet our relations one with another and our position in business is founded on the principle to make them all-embracing. Human values are the ones that finally count. The natural incentive and prime motive for the operation of an accident prevention department will only succeed fully when all such factors are laid down. When we speak of humane motives in accident prevention everyone understands, and we can obtain cooperation from department heads, foremen, straw bosses and the worker. Let this be the motivating principle, and the results are assured. There can be no greater motive than the humane one, and the organization built on such must be successful.

Having laid this foundation let us now turn to the Accident Prevention practices employed by the company which I serve. We have and are attempting to carry out a program on the basis of the above principles. Any success we have attained may be attributed and is entirely due to keeping this in mind.

There are two aspects to practical accident prevention work, the psychological and the physical, or, if you prefer, the mental and the mechanical. Statisticians tell us that more than ninety per cent of accidents are due to human failure, and the balance of ten per cent to improperly guarded and faulty equipment. To provide proper machinery, tools, etc. and to maintain them in safe working conditions is wholly the responsibility of any company. Some companies have a tendency to think their responsibility ends there, but facts quite clearly show that providing safe and properly guarded equipment is but ten per cent of the cure. An employer's obligation goes much further. He must educate his employees to safety consciousness. And so we approach the psychological aspect.

In our company the campaign to make each man safely conscious begins when he is taken on the payroll. We impress him with the value and necessity of working safely, and tell him what we expect of him and what his responsibilities are in this matter. He is told that Safety First means exactly what it says; and that this principle is to be followed in all his actions. A pamphlet containing the company's safety rules is given him.

Care is taken at this time, and on all other occasions not to give the impression that he will be surprised or reprimanded if he is unfortunate enough to have an accident. Intimidation is a poor teacher; and men fearing criticism become an easy prey to accidents.

When the employee is sent out on the job his foreman further impresses him with the importance of working safely. By this time the man begins to realize that accident prevention is no mere talk but is an important part of his daily routine. He is instructed in the details of how best to do his work, and to do it without accident to himself or others. He is often to be found walking the old employees to give new men all the assistance in their power. A new man, being unfamiliar with his work, surroundings and fellow workmen is not at ease, and is therefore more liable to accident. The new man thus becomes one of a crew and his education continues in various ways within the group. Safety bulletins are continuously circulated throughout all departments; Safetyograms on pertinent subjects are prepared and posted. An inter-departmental competition with annual awards to the personnel of the department having the best accident history if held. The rivalry this creates is another means of stimulating interest in accident prevention.

The most far-reaching education is, however, derived from monthly safety meetings which are held in all departments on regularly established days. These meetings last from 30 minutes to an hour, and are held on company time, with the exception of the drilling department where it is impractical to the nature of the work. To encourage cooperation by employees these meetings are made as informal as possible. Here all last time accidents occurring since the previous meeting are reviewed, the object being to bring to the attention of the employee ways and means of preventing a recurrence of similar accidents. Employees are urged to submit safety suggestions, and those found practical are acted upon with dispatch. It is encouraging to the employees to have their recommendations acknowledged by prompt action.

Employees are also urged to take an active part in the discussions, and to prepare safety papers on any phase of their work they choose. Some excellent papers on safety practice in welding, machine shop work, care of tools, etc., are written and published, and posted in the departments affected.

The monetary and physical costs from the company's and employees' standpoint are good material for discussion, but must be used at long intervals. We constantly repeat the need for every man to assume his responsibilities in reporting all accidents regardles- s of how trivial they may be. This is a process of educating men not to think lightly of small cuts and scratches, and injuries of apparently no consequence, but which might assume serious proportions at a later date.

The majority of employees learn in time to work safely, but there are always individuals who require special instructions. It has been found that a few minutes quiet talk with such men is usually sufficient to make them understand the importance of working safely. However, there are some who either will not or cannot learn to work safely at some occupations. In such cases it has been found necessary to transfer them to another kind of work which is less hazardous.

It will be of interest to state here our methods of handling accidents. There are three types of accidents, namely the trivial, the minor, and the last time accident.

First, trivial cases are cuts, bruises, etc., which are treated and recorded by the injured man or by a qualified first-aid man, of whom we have had as many as fifteen employed at different locations. Under the second is classed the accident that requires medical attention but does not result in loss of time. If the cause of the accident points to carelessness the injured is given special instruction on working safely. All last time accidents are investigated by a committee of three. To determine the cause of the accident it is reconstructed at the scene and witnesses examined. The Committee then completes a report and makes recommendations, which must be put into effect and tested in the future. Lost time accidents are the only ones on which statistics are kept, and these form the

(Continued on Next Page)
WAR SERVICES GROUP OUTFITS CREW OF A CORVETTE

LATE ONE NIGHT last Spring, H.M.C.S. "Port Arthur" slipped into her berth in Toronto Bay. Early the next day an Imperial Oil truck drove onto the dock beside the ship, and while the crew looked on with interest and anticipation, the driver loaded more than a dozen cartons onto the ship.

The cartons contained knitted garments—enough to outfit the entire crew. Included were turtle-neck and sleeveless sweaters, turtle-neck tuck-ins, scarfs, sea boot and day socks, helmets and mitts. All were knitted by the group of the Imperial Oil War Services Group in Toronto.

The work was planned to be ready by the first of June, when it was expected that the ship would visit the city. However, the chairman of the group had to send out an emergency call when it was discovered that the ship was due to reach the dock before that time. All the ladies plunged in—to such an extent that the quota on some of the items was exceeded. In all, 350 complete articles were prepared.

Previously the group "adopted" the crews of two "Q" boats of the 1st Motor Launch Flotilla, outfitting them with approximately 100 knitted articles. At present they are at work on outfits for the crew of another Corvette.

In addition, at the request of the R.C.N. Acceptance officer of the Great Lakes Area, the group has undertaken to assist in outfitting the crews of smaller naval craft, such as the Fairmiles. If the commander of a ship finds that his crew is short of material such as knitted garments, books and games, the group has taken upon itself the task of supplying these. It is the group's intention always to have on hand a complete outfit for a "Fairmile", and to be able to supply the articles required at a moment's notice. Also, they are gathering sufficient books for a complete ship's library, as well as playing cards, games and magazines.

ACCIDENTS ARE ENEMIES (Continued from Page 19)

basis of computing our accident frequency rate.

Because we are primarily concerned with safeguarding men from serious injury we include in our statistics accidents that prevent men from returning to work for one day, even though that may be his normal day off.

All the benefits derived from an accident prevention policy cannot be fully measured. Possibly the greatest, and certainly one that cannot be overemphasized is that employers, knowing the company has their well-being at heart, appreciate this fact and thus a better relationship between the employer and the employee is created. The reduction of accidents has curtailed waste of time and material, and has resulted in a smoother running of plants, with less interruption. To the men it has brought fewer injuries, safer pay cheques—more contentment. Such benefits are of inestimable value to all concerned. In these critical times when the last ounce of effort is required of us all, an accident prevention department makes its contribution.

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IMPERIAL OIL REVIEW

FALL '1942
MARINE DEPARTMENT

ANDREW, Captain

ARMSTRONG, Warrant, C. G.

BROWNING, A. J.

CLARKE, A. T.

CLAYTON, A. C.

CLAYTON, A. D.

CRAIG, W. M.

DADSON, A. B.

DADDY, A. C.

DADDY, A. F.

DEACON, A. B.

DISNEY, A. V.

DUGGAN, A. H.

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As Imperial Oil technicians volunteer for service with His Majesty’s Forces, women are stepping in to help out in the Laboratories. The young lady shown here is one of a group at Imperial Oil Limited in Sarnia.

Front Cover: A British battleship is fuelled by an Imperial Oil Tanker.