

THE PRESERVATION OF TIMBER.*

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INTRODUCTION.

DURING 1940 approximately 1,000,000 cubic feet of local timber (excluding corduroy and firewood), and a further 1,829,000 cubic feet of imported timber, were utilized in Trinidad, whilst a further estimated 1,400,000 cubic feet of local wood were cut by petroleum companies and not used. There is every reason to believe that the consumption for 1941 will be even greater, especially in view of the restrictions on steel.

Such a large consumption of local wood, which is nearly double that of normal years, constitutes a considerable drain on available supplies, especially of the more popular species. The even larger consumption of imported wood represents a considerable expenditure of dollar currency and the use of a considerable amount of shipping. By no means all of this consumption is represented by new works: a large portion of it goes to replacements and repairs, although figures of the relative proportions are not available.

No one can foresee how long the present crisis will last, nor whether throughout the crisis there will be available ample supplies of timber from the U.S.A. and Canada and ships in which to carry them. It is our bounden duty, therefore, to avoid waste of timber from whatever source, and we can do this only by the adoption of appropriate measures, at present almost non-existent in the Colony, to prolong to the utmost the life of all the timber that we use, and to enable the use in one form or another of species of timber which we have despised in the past and allowed to rot unused on the ground.

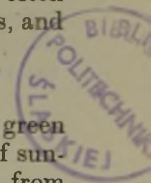
The decay and destruction of timber can, even in the tropics, be very considerably retarded by the adoption of certain practical constructional methods and by the use, where indicated, of timber treated with preservatives. The former measures involve little, if any, increase in expenditure; the latter must inevitably increase the first cost of the timber, but if intelligent methods are used according to the relative dangers to which timbers of various types are to be exposed, the increased cost is more than offset by the increased life of the timber.

Before considering remedial measures, however, it is of the utmost importance to have a basic knowledge of the kinds and habits of the pests which cause decay and destruction in timber, since remedial measures ignorantly and unintelligently applied cause waste of money and often complete failure. The enemies of timber on land are fungi and insects, and in the sea marine borers.

FUNGI.

Fungi represent a low form of plant life, which does not possess the green colouring-matter (chlorophyll) by which other plants, with the help of sunlight, are able to build up the greater part of their food materials from

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the carbon dioxide in the air ; consequently fungi are forced to obtain their organic food from supplies in dead or living plants and animals.

The main body of the fungus, known as the mycelium, is built up of a mass of fine threads or hyphæ : these hyphæ, in the case of wood-destroying fungi, permeate the wood cells and are able to digest the wood substances, which are mainly composed of material easily converted to sugar.

The fruiting body of the fungus, which is in most cases the conspicuous part, is usually formed only after a large amount of mycelium has been formed. These fruiting bodies, which are formed in the open, produce enormous numbers of microscopic spores : it has been estimated that the fruiting body of a dry-rot fungus a foot square can throw off some 5 million spores per minute for a period of several days. These spores, of course, function as seeds, and as a result of their immense numbers it is clearly impossible for any piece of wood in the open not to come into contact with spores sooner or later.

Fortunately, however, for timber generally fungi require certain conditions for their growth : these are as follows :—

(a) *Suitable Food Material*.—Not all timbers provide a suitable food material for fungi : for example, such well-known local woods as balata and poui prove resistant to fungi. Again, the heart-wood of all species of timber provides a less suitable food material than the sapwood, and is consequently more resistant. Certain fungi are so highly specialized that they will attack only one species of wood ; other destructive fungi are unable to attack absolutely sound wood, but will readily attack wood already infected by some other fungus.

(b) *Adequate Supply of Air*.—Fungi require oxygen for their respiration, and are unable to grow in the absence of air : that is why timber which is permanently submerged under water cannot be attacked by fungi.

(c) *Adequate Supply of Moisture*.—Fungi require moisture for their growth, and grow most vigorously under very damp conditions. It is a most heartening fact that fungi cannot grow in timber which contains less than 20 per cent. moisture, based on its oven-dry weight. This is a most important fact to remember in connection with the use of timber in buildings.

(d) *Satisfactory Temperature*.—The optimum temperature for fungi is about 80–90° F. : high temperatures are lethal to fungi, whilst growth stops entirely at low temperatures a little above freezing point.

Especially ideal conditions for the development of wood-destroying fungi, in the shape of an abundant supply of moisture and stagnant air, are present in the case of wood in contact with the ground. Similarly, cracks developing in wood in the open collect and harbour moisture and form a satisfactory starting-point of attack by fungi.

INSECTS.

1. *Termites*.

Termites are the insects most destructive to timber in Trinidad, although their attacks are not so severe as in many other countries, and they are not

responsible for so much damage to timber in contact with the ground as are fungi.

Termites, commonly called white ants or, locally, wood-lice, are social insects living in colonies and dividing their work among specialized castes : each colony lives shut off from the outside world and with no interconnection with other colonies. They feed on cellulose materials and attack many other kinds of material ; their intestines contain large numbers of Protozoa, which presumably aid in digesting the food, and without which the termite cannot live. An important habit with reference to their control is the constant licking of their own bodies and of the bodies of other members of the community.

Wood-destroying termites in Trinidad may be divided into two main classes : dry-wood termites and subterranean termites.

(1) *Dry-wood Termites*.—These are confined entirely to wood, living in dry, sound wood of trees, poles, posts, buildings, furniture, etc. ; they do not enter the ground, and the common species require no water supply. There are only two forms—soldiers and reproductives ; the latter periodically develop wings and emerge into the open. These alates (locally known as rain-flies) find themselves mates and, after dropping their wings, eat their way into some piece of wood, plugging up their entrance hole after them, and found a new colony. Dry-wood termites attack the woodwork of buildings and furniture : their presence can be detected by the extruded small faecal pellets, of uniform size and shape and about the size of pins' heads. The commonest and most destructive species in Trinidad is *Cryptotermes brevis*.

(2) *Subterranean Termites*.—These termites live partly or almost entirely in the ground, and it is essential for them always to maintain a connection with the ground, as it is from this source that they derive their moisture. All termites working in a structure above ground will die if their connection with the ground is permanently severed. They attack wood in or on the ground, or build covered runways to reach wood above the ground ; these runways are composed of particles of earth and partly digested wood, and form the essential link with the soil. Subterranean termites have three forms—reproductives, soldiers, and workers ; the reproductives develop wings, as in the case of the dry-wood termites, mate, and found new colonies. Subterranean termites never produce the faecal pellets characteristic of the dry-wood termites : their work can be recognized by the presence of a " frass " composed of earth particles, wood fragments, debris, etc., cemented together by saliva and faecal deposits, which is used to plug up unused galleries or openings. External attack can also, of course, be recognized by the characteristic tubes. The two commonest genera of subterranean termites are *Heterotermes* and *Coptotermes*, of which the former is by far the most destructive to houses.

2. Powder-Post Beetles (*Lyctidæ*).

The larvæ of the powder-post beetles do a considerable amount of damage to timber in houses and furniture. The adult beetle is small,

about $\frac{1}{16}$ inch in length; it lays its eggs in the wood, and the burrowing larvæ are capable of reducing the wood to a fine powder. The extrusion of this fine powder—quite distinctive from the pellets of the dry-wood termite or the “frass” of the subterranean termite—indicates the presence of attack. Sapwood is far more susceptible to attack than heartwood.

3. *Other Insects.*

There are other insects, such as the Bostrychidæ (another form of powder-post beetle) and Cerambycidæ or Longhorns, which are responsible for the destruction of timber, mainly sapwood, but these are of relatively minor importance, and preventive measures are the same as those for dry-wood termites.

PREVENTIVE MEASURES.

From the foregoing very brief outline of the types and habits of the principal agents of destruction and decay of timber, it is clear that their varying habits and mode of life mean the adoption of a variety of common-sense preventive measures; certain measures, for example, designed to ward off the subterranean termites are quite useless as a protection against the dry-wood termite.

Preventive Measures against Fungus Attack.

In considering adequate measures for the prevention of fungus attack, the following material facts must be borne in mind :—

- (a) That heat, air, and moisture are necessary for the development of fungi.
- (b) That a great excess of any of these is deleterious to fungi.
- (c) That, generally speaking, softwoods are more liable to attack than hardwoods, and sapwood than heartwood.

The following are the main preventive measures which should be generally adopted :—

1. *Timbers in Contact with the Ground : e.g., Posts, Poles and Wooden Foundations of Buildings.*

- (a) Use only all-heart timbers of proved resistance to fungus attack (*vide* table in Appendix I).
- (b) Use timber which has been properly treated with an effective preservative.

2. *Timbers not in Contact with the Ground : e.g., House Timbers.*

(1) *Selection of Timber.*

- (a) Use only seasoned timber, and protect such timber against subsequent dampness prior to use : fungus cannot grow on timber with a moisture content of 20 per cent. or less.
- (b) If the timber is to be exposed, and at all danger points where there may be access to moisture or poor air circulation, use only heartwood of timber of proved resistance, or treated wood.
- (c) Do not use timber which already shows any signs of fungus attack.

(2) *Construction Measures.*

(a) Take every precaution to avoid access of moisture to the timber. In other than timber-frame houses adequate damp-proofing is essential where timber comes into contact with other materials of construction, which are introduced in a wet state or which themselves are not damp-proof.

(b) Avoid any danger of condensation of moisture on the internal surfaces of walls, which may start fungus growth behind skirting-boards, etc.

(c) Ensure, so far as is possible—*e.g.*, in the case of wood floors—adequate air circulation.

(d) In the case of wood floors laid on concrete, construct an upper thin layer of impermeable concrete, and cover the concrete after it has dried with a thick, damp-proof, bituminous coat.

(e) Do not allow the use of linoleum over wood flooring which is laid direct to concrete, until the house has had time to dry out. At any time the use of a covering over the *whole* floor area, which prevents the access of air and, when washed, allows water to accumulate below, is dangerous.

(f) When using treated wood, pre-fabrication is desirable before the application of treatment; *if possible, all surfaces subsequently exposed by cutting or puncturing must be brush treated with preservative.*

(g) Always remove shavings, soil, and debris from surface concrete, together with pieces of wood employed during excavation and shuttering used for concrete work.

Preventive Measures against Dry-Wood Termites, Powder-Post and Other Beetles.

The dry-wood termite cannot be controlled by construction measures, as it does not need contact with the ground. The best preventive measures are :—

(a) Use only all-heart timbers of proved resistance to termite attack (*vide* table in Appendix I).

(b) Use timber which has been properly treated with an effective preservative.

Preventive Measures against Subterranean Termites.

1. *Timbers in Contact with the Ground.*

(a) Use only timber of proved resistance to termite attack (*vide* table in Appendix I).

(b) Use timber which has been properly treated with an effective preservative.

2. *Timbers not in Contact with the Ground.*

It is important to remember that subterranean termites enter buildings by means of cracks in concrete or masonry walls, through timbers, or by means of their tubes built over these materials. They may also build their

tubes along the surface of pipes, fence-posts, trellises, etc., and thereby gain entrance. Proper methods of construction can in the case of simple buildings prohibit entirely the entrance of subterranean termites.

The following is a summary of some of the measures recommended in the U.S.A. :—

(1) Build in a manner which will prevent the entry of termites from the soil.

(2) The foundations of buildings should be of concrete, masonry laid in cement, or of properly treated timber, or of timber of proved resistance to termites.

(3) Provide all foundation walls, posts, or piers with metal termite shields below the wood to be protected, consisting of a non-corroding sheet of metal projecting horizontally at least 2 inches, and then turned downwards for an additional 2 inches at an angle of 45°; all joints should be locked, and preferably soldered with corners made tight. Bed all wood posts, plates, etc., on a newly laid mortar cap above the foundation.

(4) Where pipes extend through concrete floors or masonry walls, a tight joint must be secured about them with cement mortar. Pipes extending into the ground should be protected by a downward-sloping collar soldered to the pipes about 18 inches above ground with a horizontal projection of at least 3 inches at their lower edge.

(5) The soil beneath and around the building should be provided with adequate drainage.

(6) Debris and shuttering should be cleared from under floors, porches, and around foundation walls, and not used as fill in place of earth. Remove all tree-stumps and roots under and around the building.

(7) Fences, trellises, etc., should be kept at least 2 inches away from the building.

In the case of buildings raised off the ground, it is a sound practice not to join the steps to the building, but to separate the two by a gap of 2 inches. Regular inspections to look for runways are desirable.

METHODS OF REPAIR.

Attack by Fungus.

(1) Remove and burn all infected material, and replace with properly treated timber.

(2) If not too costly, eliminate the conditions of damp causing the fungal attack.

Attack by Dry-Wood Termites.

(1) All structurally unsafe materials should be removed and burnt.

(2) In the case of wood left *in situ*, poison dusts, such as Paris Green, may be blown into openings made into the galleries of the termites, and the openings then plugged. As the termites lick each other and also consume dead members of the colony, the whole colony may be eventually destroyed.

(3) Alternatively, the wood may be fumigated by placing a wad of cotton soaked in carbon bisulphide over an opening to the galleries and covered by a double sheet of wet newspaper made to adhere closely to the wood.

(4) Infected furniture may be exposed to lethal temperatures (120–150° F.), or fumigated in an air-tight container with some fumigant such as carbon bisulphide.

The use of arsenical-dust poisons in dwelling-houses is not recommended, owing to the ability of certain fungi, which may be present in the termite galleries, to absorb arsenic and later emit it in the form of diethylarsine, which is a highly toxic gas, dangerous to human beings.

Attack by Subterranean Termites.

(1) All avenues between the ground and the material to be protected must be closed by placing barriers of metal, concrete, or treated wood. All termites cut off from the ground will die.

(2) All structurally unsound wood must be removed and burnt.

(3) The ground may be poisoned at all points where runways emerge; poisons recommended by authorities are a 10 per cent. solution of sodium arsenite; lead arsenate at the rate of 5 lb. per 1000 sq. ft.; a mixture of 1 part creosote to 3 parts kerosine; and carbon bisulphide emulsion.

(4) Introduce poison dusts or fumigants, as in the case of dry-wood termites, into termite galleries in wood which must be left in contact with the ground.

WOOD PRESERVATION.

In the foregoing description of measures to be adopted for the prevention of fungus and termite attack frequent mention has been made of the use of wood properly treated with effective preservatives. The use of wood preservatives is, unfortunately, almost non-existent in Trinidad; when wood preservatives *are* used, they are often so unintelligently applied as completely to nullify their value and waste the money spent on them.

The first important point to remember in connection with wood preservation is that satisfactory results depend on the maintenance of an *unbroken* coating of preservative; as soon as the coating is broken at any point, untreated wood is exposed to insect or fungus attack and the remaining coating is rendered useless, since attack can progress behind it. Consequently timbers exposed to splitting from atmospheric conditions or to mechanical injury require a far deeper penetration of preservative than timbers which, after being placed in position, are not so exposed.

The second important point to remember is that the penetration of the preservative into seasoned timber is far greater than into green timber, and into sapwood than heartwood. Generally speaking, penetration is better with softwoods than hardwoods.

Thus the adoption of proper wood preservation enables the confident use of timber containing sapwood and of non-durable species of timber, which, untreated, are prone to rapid decay or destruction.

METHODS OF TREATMENT.

No preservative confers complete immunity indefinitely, and, provided that a preservative of proved efficacy is used, the method of treatment is, subject to certain considerations referred to later, more important than the choice of preservative.

There are five methods of treatment—viz., brushing, spraying, dipping, "open tank," and pressure, of which the first is the least efficacious and the last the most.

Brush Treatment has the advantage of extreme simplicity, but penetration is usually very superficial. At least two coats should be given, the second being applied after the first is dry. In the case of creosote type preservatives, better penetration is secured if the liquid is applied hot.

Spraying has much the same effectiveness as brushing.

Dipping in either hot or cold preservative is better than brushing, but again only light penetration is secured.

All the above methods should, if long life is aimed at, be confined to timbers which are to be protected from exposure to atmospheric conditions and to mechanical injury, and to repairing the damage done to treated timber by subsequent fabrication.

The Open-tank Treatment is far superior to brushing, spraying, or dipping ; provided the wood is seasoned, good penetration is secured, except in the case of timbers which are highly resistant to impregnation. Such timbers, however, may prove refractory even to pressure treatment.

The theory of the method is as follows : Air-dry wood contains minute air spaces, which may occupy up to nearly 50 per cent. of its volume. When air-dry wood is immersed in a liquid, which is then heated, the air expands, and some of it is driven out of the wood. When the liquid is allowed to cool, the air left in the wood contracts again, forming a partial vacuum, and the liquid is drawn into the wood. In the case of green wood, the spaces, which in air-dry wood are filled with air, contain water ; the expansion of this water under heat is relatively small, and consequently but little of the preservative will be drawn into the wood during the cooling period.

The plant required for this method is simple and inexpensive, and does not require technically skilled operators. It consists of a treating-tank made of iron or mild steel $\frac{1}{4}$ inch thick, of dimensions suitable for the types of timber to be treated ; a useful sized tank would be 20 feet \times 4 feet \times 4 feet. Treating-tanks should be deep and narrow, rather than wide and shallow, in order to minimize evaporation losses.

The treating-tank must be provided with some means of heating, such as a system of steam coils leading from a boiler, or a flue running the whole length beneath, in which a fire can be lit ; alternatively, it may be electrically heated.

The treating-tank should also be provided with steel girders at the bottom on which the timber can rest, and thus allow circulation of the creosote. It is desirable also to provide wooden covers with which to close the tank and minimize evaporation. A drain-plug should be provided in the bottom of the tank to allow emptying for cleaning or other purposes.

The tank is usually partly sunk in a pit with a space around the sides to

allow free circulation of air for cooling and access for inspection. It may be provided with a storage tank and pump, or merely a platform on which drums of the preservative can be placed, and from which the liquid can run direct into the tank.

At one end of the tank a draining-table should be constructed large enough to hold any load coming from the treating-tank. The table can drain back into the tank or into a drain leading to the storage tank.

A simple form of gantry and lifting-winch should run the entire length of the plant to facilitate the handling of the loads of timber. The laths are usually held in some form of cradle, which is lowered into the tank for treatment. The timber is stacked in the cradle with strips of wood $\frac{1}{2}$ inch thick between each layer to ensure free circulation of the liquid, and heavy weights of old iron are placed on the top to ensure complete submersion of the load. A thermometer completes the equipment.

The method of operation is as follows : the cradle containing the load of timber is lowered into the tank, and the preservative is then heated to a temperature of 180–220° F. This temperature is maintained for varying periods, according to the size of timber being treated and the amount of absorption desired. The preservative is then allowed to cool, *care being taken that the timber is completely submerged during the cooling period, which is also the absorption period*; the timber is then removed and allowed to drain. The heating period usually occupies about 4 hours, and thus the operator need only be in attendance for that period, as there is nothing further for him to do after turning off the heat. The absorption of the preservative can be regulated by lengthening the heating period.

The process can be speeded up by installing a battery of two tanks, one to contain the hot preservative, and the other the cold. With this plant the timber can be transferred, after a sufficient heating period, from the hot tank to the cold, whereupon a new load can be placed in the hot tank.

For the butt treatment of posts and poles—*i.e.*, the treatment only of that part which is in contact with and near the ground—a very simple plant can be constructed, consisting of an oil drum provided with a brick furnace and a flue.

It may be of interest to record that in the case of railway sleepers made from fourteen different species of local hardwoods, an average absorption of 4 lb. of creosote per cubic foot was obtained by this method; a longer seasoning period would have produced even better results.

Pressure Treatment is the most effective of all methods of applying preservatives : it is usually considered economical only where considerable quantities of lumber have to be treated, as it involves a somewhat elaborate and expensive plant combined with skilled operation. In brief, the plant consists of a storage tank, a treating-tank or cylinder, vacuum and pressure pumps, and a steam-raising plant.

In the “full-cell” process the timber is placed in the treating-tank, and a vacuum is applied to draw as much air as possible from the cells of the wood. The preservative is then run into the tank, and a pressure of 100–175 lb. per square inch is applied to force the preservative into the wood. As a result of the preliminary vacuum treatment the preservative flows into, and remains in, the wood cells.

In the “empty-cell” process the timber is subjected to a preliminary

pressure before the application of the preservative, and the latter is then forced into the wood under pressure. When the pressure is released, the expanding air in the cells forces the preservative out of the cells, leaving only the cell walls coated with the preservative. A final drying vacuum is then applied.

Pre-treatment.—In the case of timbers which are resistant to impregnation—*e.g.*, douglas fir—and where good penetration is essential, a pre-treatment by incision is often practised. The timber is passed under a revolving drum fitted with regularly spaced knives, which incise gashes into the timber of the required depth. This operation assists subsequent penetration.

WOOD PRESERVATIVES.

Preservatives can be broadly classed into three main groups : Oil preservatives, water-soluble salts, and solvent type preservatives.

Oil Preservatives.

The most important of these are coal-tar and creosote.

Coal-tar is not very satisfactory : it does not penetrate wood, but forms a surface coating which may eventually assist decay by sealing up the moisture in the wood.

By creosote as a wood preservative is understood a coal-tar creosote oil ; it is a distillate of coal-tar produced by high-temperature carbonization of bituminous coal. It should comply with the specification of the British Standards Institution (see Appendix II).

A half-and-half mixture of creosote with diesel oil is just as effective as pure creosote, from the preservation point of view, penetrates wood better, and is considerably cheaper in view of the low cost of the diesel oil.

The advantages of creosote are its extreme toxicity and its permanence in the wood even when exposed to rain ; its disadvantages are its smell, its dark colour, its liability to creep onto and stain adjoining material, the fact that it cannot be painted over, and, being in liquid form, its bulk.

Its excellence as a preservative is unrivalled, and where its disadvantages do not matter—*e.g.*, for exterior timbers in contact with the ground, such as posts, poles, sleepers, etc.—a better choice cannot be made.

There are various proprietary preservatives prepared from tar oil, which are efficient, cleaner, and of less pungent smell than ordinary creosote ; they are, however, more costly.

Water-Soluble Salts.

The salts chiefly concerned are copper chromate, copper sulphate, sodium fluoride, mercuric chloride, zinc chloride, zinc sulphate, and zinc meta-arsenite. Several proprietary brands of preservatives employ one or more of these salts, and in some an attempt has been made to fix the preservative principles in the wood so that they cannot be leached out.

The advantages of water-soluble salts, particularly for buildings, are : their relatively small bulk in solid form, their lack of smell and (usually) colour, and the facts that they do not creep and stain adjoining material, and can be painted over. In addition, zinc chloride to some extent increases the fire-resistance of wood. Their disadvantage lies in their

liability to be leached out by rain and that some of them have a corrosive effect on metals, necessitating a wooden tank for treatment. This does not apply to zinc chloride, which, incidentally, has a good record in Panama.

Solvent-Type Preservatives.

The solvent-type preservative consists of a toxic chemical dissolved in a volatile oil or spirit solvent, which, after treatment, evaporates and leaves the toxic chemical in the wood. The toxic chemicals used include metallic salts of organic acids such as naphthenic and oleic acids; phenols such as β -naphthol, chlorinated phenols and chlorinated hydrocarbons, such as chlorinated naphthalene. It may be of interest to record that local tests are now being conducted on timber treated locally by the open-tank method with copper and mercuric naphthanates produced by Trinidad Leaseholds, Ltd., with, so far, most encouraging results.

The advantages of this type of preservative are their high toxicity and good penetration; the disadvantages are the high cost, and, in some cases, their inflammability prior to being applied to the wood. The open-tank treatment was, however, applied without danger in the case of the copper and mercuric naphthanates referred to above.

CHOICE OF PRESERVATIVE AND METHOD OF TREATMENT.

From the foregoing brief account of wood preservatives and the methods of their application, it is clear that the choice of preservative and method of treatment will vary according to a number of factors *e.g.* :—

(1) The species of timber—its natural durability and its resistance or otherwise to impregnation.

(2) The use to which the timber is to be put, and the consequent degree of danger to which it will be exposed. Clearly timbers in contact with the ground and exposed to the weather require a deeper and more thorough impregnation than interior timbers.

(3) The length of life which it is desired that the timber should have.

(4) The cost of the method of treatment and of the preservative relative to the value of the increase of life obtained.

(5) The annual amount of timber utilized for new works.

(6) The amount of capital available for the erection of plant.

In view of these varying factors, it is not possible to lay down hard-and-fast rules to govern the choice of preservative and method of treatment for all local timber-consuming industries, but the following recommendations are put forward as a guide, which may be altered to suit individual circumstances :—

1. *Timbers other than for Dwelling-houses, Offices, etc.*

Type of timber.	Preservative.	Method of treatment.
(a) Timbers in contact with the ground and/or exposed to the weather and/or abrasion— <i>e.g.</i> , posts, poles, bridge-timbers, etc.	Half-and-half mixture of creosote and diesel oil.	Pressure or open tank.
(b) Other timbers.	Half-and-half mixture of creosote and diesel oil.	Open tank, dipping, spraying, or brushing.

2. *Timbers for Dwelling-houses, Offices, etc.*

- | | | |
|---|---|---|
| (a) Timbers in contact with the ground and/or exposed to the weather and/or abrasion. | Water-soluble salts—
e.g., zinc chloride or reliable proprietary preservative. | Pressure or open tank, followed by applications of paint. |
| (b) Interior timbers. | Water-soluble salts—
e.g., zinc chloride or reliable proprietary preservative. | Open tank, dipping, spraying, or brushing, followed by applications of paint where indicated. |

CONCLUSION.

The adoption of the simple preventive methods of construction described in this paper, combined with the use of wood which has been properly treated with a reliable preservative, would unquestionably result in the minimization of the decay and destruction of timber, in a considerable reduction of expense incurred in repairs and replacements, and in a much-needed economy of timber consumption.

SUMMARY.

The need for economizing the use of timber by the prolongation of its life is stressed; a brief account of fungi, termites, and other insect pests is given; preventive and control measures against these agents of decay and destruction are described, and information as to wood preservatives and the methods of their application is presented.

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APPENDIX I.

Resistance of Local and Imported Timbers to Fungi and Termites.

Species.	To fungi.	To termites.
Acurel.	Very susceptible.	Fairly resistant.
Balata.	Very resistant.	Very resistant.
Blackheart.	Fairly resistant.	Susceptible.
Bois lisette.	Very susceptible.	Fairly resistant.
Bois mulatre.	Resistant.	Very resistant.
Cajuca.	Very susceptible.	Very susceptible.
Douglas fir.	Fairly resistant.	Very susceptible.
Fiddlewood, black.	Susceptible.	Fairly resistant.
Fiddlewood, white.	Fairly resistant.	Fairly resistant.
Figuier.	Very susceptible.	Very susceptible.
Galba.	Susceptible.	Fairly resistant.
Gommier viande biche.	Susceptible.	Very susceptible.
Guatcare.	Resistant.	Very resistant.
Hogplum.	Very susceptible.	Very susceptible.
Laylay.	Very susceptible.	Very susceptible.
Mahoe.	Very susceptible.	Very susceptible.
Mangrove, red.	Fairly resistant.	Susceptible.
Mangue, yellow.	Resistant.	Susceptible.
Mora.	Susceptible.	Resistant.
Milkwood.	Very susceptible.	Very susceptible.
Olivier, white.	Fairly resistant.	Fairly resistant.
Olivier, yellow.	Fairly resistant.	Fairly resistant.
Pitch pine (all heart, unbled).	Very resistant.	Resistant.
Poui.	Very resistant.	Very resistant.
Redwood.	Resistant.	Very resistant.
Sandbox.	Fairly resistant.	Susceptible.
Sardine.	Very susceptible.	Very susceptible.
Serrette.	Susceptible.	Resistant.
Tapana.	Susceptible.	Resistant.
Toporite.	Very susceptible.	Very susceptible.
Wild coffee.	Very susceptible.	Susceptible.
Wild chataigne.	Very susceptible.	Very susceptible.

N.B.—(1) In the above table five classes of description are used—viz., resistant, very resistant, fairly resistant, susceptible, very susceptible.

(2) The table was compiled from durability tests on untreated timber specimens conducted by the Forest Department in collaboration with the Imperial College of Tropical Agriculture from 1937 onwards.

APPENDIX II.

Very large quantities of timbers are cut each year by petroleum companies in the course of oil exploitation, of which no use is made whatsoever. Attention is, therefore, directed to the following suggestions :—

Suggestions for the Increased Use of Local Timber Cut for Clearing Purposes by Petroleum Companies.

(1) Non-durable softwoods, such as mahoe, cajuca, wild chataigne, etc., could provide useful boards and planks, if the latter were seasoned and then given a preservative treatment.

(2) Unseasoned boards of local woods could be used for such purposes as shuttering for concrete, boxing for slush-pits, etc., instead of imported timber.

(3) Scantlings of local woods can be used after a short period of case-hardening, provided they are not re-cut into smaller dimensions. Scantling which is not quite straight can usually be keyed into position.

(4) The air-seasoning of boards and planks is a shorter and simpler process than appears to be generally understood; full particulars of the correct method can be obtained from the Forest Department.

APPENDIX III.

*Summary of Tests on Timber Treated with Preservatives,
to date September 1941.**(a) General Durability Trials.*

Species.	Date put in ground.	Treat- ment.	Remarks.
1. Acurel	March April 1937	50-50 Creosote and diesel oil mixture, open tank.	Still sound after 4 years. Untreated, all destroyed in 2 years.
2. Blackheart			Still sound after 4 years. Untreated, 50% destroyed in 3 years.
3. Bois lisette			Still sound after 4 years. Untreated, all destroyed in 2 years.
4. Bois mulatre			Still sound after 4 years. Untreated, 30% destroyed in 3 years.
5. Cajuca			Still sound after 4 years. Untreated, all destroyed in under 1 year.
6. Figuier			One destroyed by fungus, rest sound. Untreated, mostly destroyed in 2 years.
7. Black fiddlewood			Slight fungus attack, 1 destroyed. Untreated, 80% destroyed in 3 years.
8. White fiddlewood			Slight fungus attack, 3 destroyed. Untreated, 80% destroyed in 3 years.
9. Galba			Sound. Untreated, 90% destroyed in 3 years.
10. Gommier viande biche			All heavily attacked by termites. 19 destroyed. Untreated, 80% destroyed in 2 years.
11. Guatecare			Fungus on a few. Untreated, wood is resistant.
12. Red mangrove			All heavily attacked by termites, 3 destroyed. Untreated, 60% destroyed in 3 years.
13. Laylay			Sound. Untreated, all destroyed in under 1 year.
14. Mahoe			Some attacked, 8 destroyed. Untreated, all destroyed after 1 year.
15. Hogplum			Sound. Untreated, all destroyed in under 1 year.
16. Yellow mangue			Majority attacked by termites, only 1 destroyed. Untreated, 30% destroyed in 3 years.
17. Milkwood			Sound. Untreated, all destroyed in 1 year.
18. White olivier			Fungus on a few. Untreated, nearly 50% destroyed after 3 years.
19. Yellow olivier			Sound. Untreated, nearly 50% destroyed after 3 years.
20. Sandbox			Sound. Untreated, 75% destroyed in 3 years.
21. Sardine			Majority attacked, 2 destroyed. Untreated, all destroyed after 1 year.
22. Sorrette			Slightly damaged. Untreated, all destroyed in 2 years.
23. Tapana			Sound. Untreated, all destroyed in 3 years.
24. Teak (10 years old)			Sound after 2 years. Untreated, susceptible to damage.

APPENDIX III.—*Continued.*

Species.	Date put in ground.	Treat-ment.	Remarks.
25. Toporite	March April 1937	50-50 Creosote and diesel oil mixture, open tank.	Slight damage. Untreated, all destroyed in 1 year.
26. Wild coffee			Slight damage. Untreated, 90% destroyed in 3 years.
27. Wild chataigne			Sound. Untreated, all destroyed in 1 year.
28. Balata			Sound. Untreated, few destroyed in 4 years, but all attacked.
29. Poui			Sound. Untreated, few destroyed in 4 years, but all attacked.
30. Pitch pine			Sound. Untreated, fairly resistant, 20% destroyed in 3 years.
31. Douglas fir			Sound. Untreated, all destroyed in 3 years.
32. Calif. redwood	Oct. 1939		Sound. Untreated, 50% destroyed in 3 years.
33. Mora			Still sound after 2 years. 60% untreated pieces destroyed after 3 years.
34. W/red cedar	Oct. 1939		Still sound after 2 years. 30% untreated pieces destroyed after 2 years.

N.B.—The few treated pieces which have been badly attacked, had resisted impregnation; penetration of the creosote was poor.

(b) *Special Trials.*

Species.	No. of samples.	Date put in ground.	Treatment.	Remarks.
Laylay	20	June 1939	Copnap 15%, open tank.	Still sound.
White pine	10	Sept. 1939	21% } 5% } 7% } 10% } 15% } 20% }	
	10		Copper naphthenate, open tank.	
	10		NoRot, open tank, 9-41 lb. per cu. ft.	
	10		NoRot, soaked 24 hours, 3-13 lb. per cu. ft.	
	10		Seekay soaked 24 hours, 3-7 lb. per cu. ft.	
	10		Gas oil, open tank.	
	10		0.43% } 0.875% } 1.3% } 1.75% } 3.5% }	
	10		Mercuric naphthenate, open tank.	
	10			
	12			
Chir pine	12	Apr. 1937	Treated with "Ascu" in India.	Still sound after 4½ years. 12 untreated pieces destroyed in under 1 year.
Teak fence-posts	7	Oct. 1939	Creosote/diesel oil, open tank.	Still sound after 2 years.

DISCUSSION.

MR. L. A. BUSHE (A.T.O.L.) congratulated the author, and said he did not think they were in a position to question the results of research carried out by the Forest Department, or the principles of wood preservation. They might, however, argue that, whereas Mr. Brooks was interested in preservation, perhaps at any cost, they in the Oil Industry had to consider the cost. The author, as a forestry-trained man, took a long view, and it seemed to him that they also had to take a similar view with regard to the use of timber, and the author had made some very pointed remarks on the unintelligent way in which preservatives had been used in Trinidad. He expected every one would find it difficult to extract costs of replacement of timber in buildings, but they could accept the fact, which was given in many textbooks, that preservation of timbers (railway sleepers, for example) did multiply the life by something like three or four times, using creosote or tar oil.

There was a very appropriate mention made in the paper about the greater use of local timber in war-time, and he was sure they could use a great many of the trees which were felled in the course of their operations and which at present were simply allowed to rot.

Mr. Bushe then declared the paper open for discussion.

MR. G. MARDALL (T.L.L.) said it would be interesting to know what percentage of the 1,400,000 feet of timber mentioned in the paper as being cut out in the course of oilfield development during 1940 was usable for building and other purposes.

There was also a point which Mr. Brooks had not mentioned in his paper, and which had come to their notice recently with the curtailment of the use of galvanized iron—namely, the question of using shingles for roofing—and he wished to know what were the author's recommendations for the best type of timber for the purpose of shingles, and also whether treatment was essential to make it resistant to fungus attack, if it was liable to such attack.

On the question of solid floors, instead of the standard and somewhat elaborate form of protection when putting wooden flooring on the top of concrete on the ground, about 5 or 6 years ago T.L.L. had laid down a number of concrete floors which they had covered with wood, and had found it perfectly satisfactory to cover the concrete with a layer of pitch before putting the timber on, and so far experienced no trouble with these floors.

He was also interested to know the rate of penetration of termites once they started in timber such as posts or flooring.

MR. J. D. FULLERTON (A.T.O.L.) referred to the pressure treatment described on page 71 of the paper, in which mention was made of pressures of 100–175 lb. per square inch, and enquired whether that limit was imposed by economic reasons, and if such pressure was considered advisable for all types of wood. In other words, would 500 lb. pressure be advantageous or not, supposing that such pressure could be as readily applied.

MR. G. H. SCOTT (A.T.O.L.) asked if the author could say anything about the theories advanced by Dr. Rudger of Cardiff, who attacked the idea of fungus rot and believed in the idea of inorganic infiltration as the cause of primary decay. His writings had led to a great amount of controversy, but his latest paper, he believed, vindicated the theory that the effect of such inorganic substances as calcium bicarbonate was fully as important as the extent of attack by fungus.

For instance, in the example given by Mr. Mardall where they had actually placed residuum or pitch on concrete and applied their wood floor to it, they had not had any appreciable decay. This may have been the result of the wood being removed from the infiltration of calcium bicarbonate. A source of inorganic attack could be where wood penetrated into the concrete on which a structure was built. He believed that woods contain a certain amount of iron and calcium, and that ionization in the wood could set up wood decay. It was arguable whether dry rot was primarily due to inorganic infiltration, but, judging from examples cited by Dr. Rudger, it did, in many instances, play an important rôle.

MR. L. K. WHITE (T.P.D.) remarked that on page 65 of the paper it was stated that subterranean termites, if cut off from the ground, would die, but did that mean they would actually die if cut off from the ground, or would they be able perhaps to get the necessary moisture from household water supplies? If so, it would seem that cutting off of an infected house would not guarantee death to the termites.

He seemed to remember having seen or heard that people used to burn the ends of posts before putting them into the ground, in order to prevent rot or decay, and would like to know if that was a sound practice and, if so, what was the principle involved.

MR. BUSHE observed that quite recently a pamphlet had come into his possession advertising a proprietary preservative, and putting forward a theory which the author had not touched on, and which was called the "Osmotic Pressure Treatment." This meant that the preservative, which was applied cold in a liquid state and before the timber was seasoned, was absorbed by the moisture in the wood, and it was claimed that very deep penetration was obtained. The cost of the treatment was given as something between $\frac{1}{2}$ c. and 1 c. per square foot of cover, but he did not know if the author would consider that cheap or expensive.

MR. BROOKS remarked that he had had an uneasy feeling before he came to the meeting that he would be faced with some rather difficult questions! Firstly, as to the question of cost, he definitely had not run away from it, but at the present time it was extremely difficult to give any accurate costs, owing to rising prices. Creosote treatment before the war was extremely cheap, particularly when the creosote was mixed with local diesel oil, as even an absorption of 6 or 7 lb. to the cubic foot added on a very small cost to the article concerned. The cost of creosote was now, however, higher than pre-war.

There was also the question of the different sites in which the timber was going to be used and the relative cost of the structure itself. If, for example, one was going to the trouble of building a fairly large and heavy pitch-pine bridge, much of the pitch-pine coming to Trinidad to-day being about 50 per cent. sapwood, the normal life would be about 5 years, and to double the life by treatment of the timber would be an economic proposition. On the other hand, to impregnate roof-timbers under pressure treatment would be a waste of money. The question of the economic cost was a question of the relative life of the untreated and treated timber coupled with the length of life desired.

Roughly speaking, buildings could be termite-proofed at a relatively small cost, say 1-2 per cent. of the initial cost in the case of subterranean termites, which meant mainly structural measures, and about 10 per cent. of such cost in the case of dry-wood termites, which necessitated impregnation of the timber.

The cost of replacement had also to be considered in the case of railway sleepers; an original untreated sleeper other than balata or poui might cost about \$2.40, and would last about 3 years. If treated with hot and cold treatment it might last 12 years, and this would save the re-laying of three sets of sleepers during that period. Such treatment would cost perhaps \$1 extra per sleeper, and was thus clearly economic.

What the actual cost was to-day of going in for preservative treatment was very difficult to say, as it would depend on what method of treatment and what preservative was used and how much capital was sunk in the plant.

He thought there was very little doubt that the ordinary cheap processes that did not involve much capital expense, the use of water-soluble salt preservatives for timbers that were not going to be exposed, and a mixture of creosote and diesel oil (which before the war could be prepared for something like 15 c. per gallon) for exposed timbers, was economic, provided a certain length of life was wanted out of the timber.

The initial outlay in the case of hot and cold treatment was very small, and if the life of the timber by this treatment was going to be multiplied several times, and as most other countries, even before the war, never dreamed of putting in outdoor timbers without treatment, the question of economics for that type of work surely answered itself.

With regard to Mr. Maddall's questions, the figure of 1,400,000 feet mentioned represented inevitable clearing by oil companies for their well locations, roads, etc., and the bulk of the trees were just left to rot on the ground, although some of the better-class trees might be removed by oilfield contractors. He had ventured to suggest in the Appendix to his paper that, in a time of crisis like the present, when pitch-

pine might not go on being *ad lib.* for the rest of the war, some of these woods that they despised to-day might be used, even untreated, where the question of durability did not arise.

As for shingles, for long life they certainly required some form of treatment. With the hot and cold method of treatment they could be saturated with creosote, but at least they required some form of treatment as used in British Guiana in the case of wallaba shingles.

On the question of the solid floor with a layer of pitch, the results might have been due to luck, but 5 years was not a particularly long period. Good pitch-pine, even under bad conditions, might well last that period. With reference to the illustrations he had shown of this kind of floor, the note in the textbook was that none of these forms was completely satisfactory, and the author advised against any form of solid floor. The generally accepted principle, so far as fungus prevention was concerned, was that it was difficult completely to exclude air, and it was therefore preferable to provide free air circulation.

As to the rate of destruction by termites, this entirely depended on the species of termite and the type of wood. For example, in India there were termites which people asserted would eat out the legs of a bed in the course of a night, provided the legs were made of a non-resistant species of wood.

In Trinidad the dry-wood termites were a comparatively slow-working species, but with certain non-resistant woods, such as douglas fir, a piece of 2 inch \times 2 inch could be reduced completely unsound in 6 months by subterranean termites. On the other hand, termites appeared to be cunning engineers, and he did not think they had ever been known of themselves to cause a structure to fall down, but they would weaken it so much that a high wind or earthquake could bring it down. A good example of this was the cottage in the Government House grounds, the frame of which was so termite-riddled that in places one could poke one's finger right through, yet it has been up for 50 or 60 years, and appeared to be kept together only by the paint and the termites themselves holding hands! The rate of damage would entirely depend on the species of termite and on the species of wood, and whether it was all heart or contained a lot of sapwood.

With regard to Mr. Fullerton's question about pressure, he thought the pressures given were just the result of experience. Obviously one did not want to put more creosote into the wood than would be effective, and excessive pressure might injure the cellular structure of the wood. The "full-cell" pressure method left unnecessary creosote in the wood, while the "empty-cell" pressure just left a coating of creosote on the cell walls. If an absorption of 12 lb. per cubic foot was enough to give satisfactory results for extreme conditions, it would be a waste of creosote and money to put 24 lb.

Mr. G. H. Scott had, he feared, gone further into the subject of the possibilities of damage to wood by inorganic attack than he himself had. There had been a great deal of research recently as to exactly how fungus did attack wood and what were the effects of concrete and other materials on wood, but the fact remained that there were certain basic laws with regard to fungus, which at any rate did the main damage, and the principle remained that fungus must have certain conditions in which to grow. If conditions were suitable the fungus was going to do the damage.

With regard to Mr. White's question on sources of moisture for termites, he had, when reading the paper, added to the statement that subterranean termites would die if their connection with the ground was permanently severed, the proviso that they found no other source of moisture.

The charring of wood posts was effective through changing the material nature of the wood and turning it into charcoal, thus destroying the food material for fungi. It was a good method of prolonging the life of poles, but did not last very long generally, owing to insufficient depth of charred surface.

Mr. Bushe had mentioned the "osmotic-pressure" method, and he would like to know the source of this. There were many different proprietary preservatives and, some of them made very optimistic claims. For example, he had received an advertisement for a process whereby one just cut a ring round the living tree and poured the preservative in, which then not only stopped all insect attack and preserved the wood for ever, but even seasoned the wood! Any new method of treatment or type of preservative which was both cheap and efficacious would soon be generally adopted.

In the meantime it was safer to rely on standardized methods and preservatives, and to take with a grain of salt any over-optimistic claims of new methods and preservatives which had not yet been adopted as standard general practice.

In Trinidad to-day there was an enormous amount of damage done by termites that could be avoided by simple construction methods. House after house was just being riddled by termites for want of simple precautions.

He was not trying to push local wood, but was talking about imported wood, which arrived in Trinidad already seasoned. By intelligent application of preservatives one could lengthen the life of that wood, whether for outside or indoor use, and as it was war-time, he thought it should be introduced now, and if that were done he believed the practice would never be abandoned afterwards.

MR. BUSHE, thanking the author for his paper, said it seemed to him that this was possibly one of the comparatively few subjects upon which the views of Government and of the oil industry might well coincide. The Conservator of Forests thought they ought to use wood preservatives, and it was left to them to see that they did so in an intelligent manner.

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Geology and Development.

280.* Hombre Pintado, Venezuela. G. W. Halse. *J. Inst. Petrol.*, February 1942, 28 (218), 36-40.—The topography and geology of this field are discussed after a brief *résumé* of its development. The country contains precipitous and impassable hills. Surface geology had been mapped as a fairly simple anticline in the form of a crown of a structure sheared off its flanks. Difficulties met in certain localities are discussed.

A. H. N.

281.* Exploitation of Deep Pays Offers Rich Possibilities. W. V. Howard. *Oil Gas J.*, 5.6.41, 40 (4), 24.—Experience has shown that if oil is found at relatively shallow depths on a structure, there is more than an average chance that lower pays will also be found on that structure. Although some argue that this is due to the upward movement of oil from one pay to another, marked differences in the composition of the oils seem to deny this, and point to the recurrence of oil-forming conditions in the locality.

In California the finding of oil in a lower pay on one structure almost invariably leads to deeper drilling on neighbouring structures, while no salt-dome structure on the Gulf Coast can be considered barren until its flanks have been tested to the level of the lowest pay in the district.

In West Texas 1,000,000 bbl. of oil have been produced and the Permian has reserves of 2,500,000,000 bbl., but it is clear that beneath the Permian there is an Ordovician basin which may be equally important, and possibly more extensive. A Silurian pay has been found on the western rim of the basin, and a Mississippian lime pay in Young and Archer counties.

Improvements in equipment and technique have rendered this deep testing possible, and made the drilling of a 20,000-ft. well a distinct possibility. There have been comparable advances in production technique.

The Los Angeles and neighbouring basins, the San Joaquin Valley, the Gulf Coast, and the Anadarko basin of Oklahoma are areas with producing or potentially producing beds below 10,000 ft. Other areas, such as the Rocky Mountain States and the Northern Great Plains, have over 10,000 ft. of sediment, but little is known about conditions at depth upon which to assess the potentialities.

The results of deep drilling in various regions and the prospects are briefly discussed.

G. D. H.

282.* Well Logs and Field Data of Prospective Oil Areas—North-west Kansas. Anon. *Oil Gas J.*, 5.6.41, 40 (4), 96B.—The area south and south-west of the Central Kansas uplift is little developed at present. On this feature producing trends have been drilled on the high, with more or less scattered wild-cattling down the flanks later. West of the Burnett pool in Ellis County there are only a few isolated producing areas, for lack of pipe-lines and low allowables have kept down developments in the more remote districts.

The Central Kansas uplift rose fairly continuously during the Palæozoic, with greatest uplift following the deposition of the Mississippian lime, and leading to exposure of the granite. The uplift was later covered by Pennsylvanian and Permian beds. Mesozoic and some Tertiary beds were also deposited.

Oil has been produced from the Arbuckle, Lansing-Kansas City, Mississippi lime, and granite wash. It seems possible that the Sundance, Morrison, and Cretaceous may be productive in Western Nebraska, and even in Western Kansas. Some fields appear to be associated with cross-trends over the uplift, but the structural relationships of others are not clear.

A map and a series of well sections are appended.

G. D. H.

283.* Unconformities Complicate Exploration for Deep Pays. W. V. Howard. *Oil Gas J.*, 5.6.41, 40 (4), 109.—Slight unconformities give rise to wedging beds, and major unconformities give buried structures which have an indirect or no relation to the surface structures.

Two of the deepest basin areas in U.S.A. have thick sedimentary sections without major unconformities—California and the Gulf Coast, but there are many minor unconformities, and the marine oil-bearing formations commonly do not outcrop. Prospecting for deeper horizons in these two areas is a matter of finding gentle anticlines,

wedge-edges due to (1) pinching out of formations along old shore-lines, (2) facies changes, (3) erosion of a porous horizon and later burial beneath an impervious cap, steep structures due to pronounced folding or salt intrusions, and structures of any of the above types under an overthrust fault.

In the Mid-Continent area there is a great regional unconformity, but there is a reflection of the structure of the old beds in the younger beds, causing Ordovician pays to underlie Permian or Pennsylvanian production.

When erosion of an old land surface destroys all evidence of structure, and later movements take place along other axes the search for oil-pools is very difficult. Such a condition may possibly obtain in parts of the Appalachian basin. G. D. H.

284.* Northern West Texas Play Finds Production in New Pays. D. H. Stormont. *Oil Gas J.*, 1.1.42, **40** (34), 60.—Fourteen wildcats are drilling or preparing to drill in the north basin, and ten were completed in the past month, one of them finding commercial production, and thus extending the area's productive limits 40 ml. to the north and east. A wildcat now drilling shows signs of commercial production at a point 30 ml. east of the recent Lubbock discovery. In North-western Dawson County a small pumper seems assured, and in Gaines and Hockley Counties two wildcats are showing possibilities.

In the north basin the Permian pays were believed to lack porosity for giving commercial production, but the development of Wasson, Slaughter, and Seminole, fields of considerable size and with high well potentials, shows that the area was under-rated. The massive limestones of the south appear to be absent in this region, and there seems little likelihood of pre-Permian (mostly Ordovician) production. The frequent alternations of marine and evaporite deposits in the Permian adds to the number of possible pays in the north basin. Production has been found in San Andres and Clear Fork beds.

The Wasson field covers 58,000 acres, and Slaughter's productive area is even larger. G. D. H.

285.* Proven Reserves. W. V. Howard. *Oil Gas J.*, 29.1.42, **40** (38), 60.—Estimated proven oil reserves in the U.S.A. are 20,299,542,000 bbl., 200,285,000 bbl. more than on 1st Jan., 1941. There were 341 discoveries, new fields, or new pays in 1941, representing 486,935,000 bbl. of proven reserves, 135,046,000 bbl. more than in 1940. Extensions to old fields added 1,009,175,000 bbl. to the reserves. Revision of old estimates added only 95,719,000 bbl. of oil. Of the thirty-three districts into which the oil production can be divided, seventeen showed reduction in reserves in 1941, and changes in production rates gave eighteen districts a smaller reserve in terms of years' supply.

Texas leads with 669,290,000 bbl. of new oil, although four districts in Texas show a decline in reserves. California's reserves declined slightly as compared with 1940, and in some of the San Joaquin Valley fields suffered a sharp downward revision. Oklahoma's reserves also declined. There was a big addition to Illinois reserves as a result of the discovery and extension of prolific Chester and McClosky pools. Michigan, after a poor showing in the first half of 1941, had a good second half, in which most of the new fields discovered were north of the old producing belt.

There was considerable development of the Smackover lime, in Arkansas.

A table gives by States or districts the estimated reserves on 1st Jan., 1941, and 1st Jan., 1942, the amounts attributable to discoveries and extensions in 1941, the production during 1941, and the change in the reserve position, as well as the reserves in terms of years' supply.

A series of maps show the location of new fields and extensions, while the proven acreage, formation thickness, and estimated reserves are tabulated.

G. D. H.

286.* Production Record Reached in 1941 with Trend Still Up. W. V. Howard, *Oil Gas J.*, 29.1.42, **40** (38), 74.—1941's oil output in U.S.A. was 1,391,544,457 bbl., 4% above the 1940 figure, and averaged over 4,000,000 bbl./day during the last three months of the year. The leading State, Texas, had a production rise of only 1.5%, California's output rose 3%, and that of Oklahoma 1.5%, while Illinois declined by 13%. Rises of 12%, 18%, 25%, and 16% were shown by Louisiana, Kansas, Arkansas, and Wyoming, respectively. The production records of the seventy-five largest fields show an overall

fall of 44,500,000 bbl. as compared with 1940, although practically the whole of the decline can be accounted for by Salem's fall from 70,734,313 bbl. to 29,538,803 bbl. Forty-one of the leading pools are over ten years old, and the indications are that the leading pools are not able to take care of any increased demand, except in the case of East Texas if sound practice is ignored.

Tables give the annual production by States for the period 1932-41, and the production of the seventy-five largest fields in 1940 and 1941. The trends and future prospects of these fields are noted.

G. D. H.

287.* Record Demand in 1941 Met by Increase in Completions. W. V. Howard. *Oil Gas J.*, 29.1.42, 40 (38), 76.—32,140 wells were completed in U.S.A. in 1941; 22,005 were oil-wells, 3014 gas-wells, and 7,121 dry holes. Industrial demands led to the drilling of 30% more gas-wells than in 1940. The rise in dry holes was 8%. Average drilling depths were 22 ft. greater than in 1940, although in the parts of the Eastern fields the additional output was obtained from shallower depths involving, however, the drilling of nearly 3000 water input wells. In coastal Louisiana the average increase in depth was 857 ft. To provide 1942 supplies requires the drilling of over 32,500 wells, but steel is unlikely to be sufficient for this number, which will lead to the over-production of reservoirs.

East of the Mississippi, except in Michigan, drilling increased in all the States. In Kansas many pools were linked on the Barton Arch and new areas were opened in the Anadarko basin. Most of Oklahoma's discoveries were only small fields. In North Louisiana there was intensive development of the Wilcox trend, and in Arkansas there was renewed activity in the Smackover lime producing area. Hawkins, in East Texas, gave rise to much wildcatting, which had little success, and there was a revival of drilling in the East Texas field. A campaign to extend the play westward in West Texas increased drilling by about 25%, and large producing areas have been blocked on both sides of the Pecos River. A number of small discoveries were made in North Texas, and the potentialities of the deeper pays became apparent in 1941. Gas developments increased in the Rocky Mountain area.

A summary is given of all wells completed in 1940 and 1941.

G. D. H.

288.* Western Hemisphere Gains in Production Offset Other Losses. Anon. *Oil Gas J.*, 29.1.42, 40 (38), 87.—World production in 1941 is estimated at 2,209,761,000 bbl., an increase of 3% over 1940, the increase being due to U.S.A.'s and Venezuela's rise of 95,298,000 bbl. more than offsetting declines elsewhere. At the end of the year Venezuela's daily production of 750,000 bbl. exceeded that of Russia, and if it is maintained in 1942 the total will exceed that of Russia by a considerable amount. Much of the increase was due to Oficina, San Joaquin, and El Roble. U.S.A.'s output rose by 4%. 60% of Mexico's production came from Poza Rica. In Canada there was a further extension of Turner Valley, where the production rose by 1,516,000 bbl.

Russia's production slightly declined, and there are indications that Roumania's output was down by 20%. In Hungary the production rose by 75%, to exceed 10,000 bbl./day at the end of 1941. Germany raised the oil output in Austria, Czechoslovakia, Poland, and France. There was a severe fall in Iraq's production, and the outputs of Iran, Saudi Arabia, and Bahrein also suffered.

The production in 1940 and 1941 is tabulated by countries.

G. D. H.

289.* Texas Gulf Coast—Wilcox Trend and Jackson County Plays Yield Good Results. N. Williams. *Oil Gas J.*, 29.1.42, 40 (38), 111.—Twenty new fields, as well as new sands and extensions, were discovered on the Gulf Coast in 1941, in spite of a slight decline in drilling. Six new fields were found on the Wilcox trend, which appears extremely promising. For some time it had been thought that Wilcox production was limited to the zone between 6000 ft. up-dip and 9000 ft. down-dip, but early in 1941 oil was discovered 1100 ft. below the original Wilcox play, although prior to that many wells had been abandoned 500-600 ft. below the Wilcox section. At the end of the year there was prolific Wilcox production at 10,000-11,000 ft. In Jackson County there has been a Marginula-Frio play, leading to the discovery of Maubro, followed by North La Ward. Ganado and West Ganado have proved to be important reserves

as a consequence of new sand discoveries. Other Frio sand strikes were at Oyster Bayou, Stowell, Chenango, and Lucky. Cockfield production was opened in the Garwood area.

Tables give the discoveries on the Gulf Coast during 1941, the monthly production of the major fields, the yearly output since 1936, and a summary of the wells completed in 1941. G. D. H.

290.* California—Northern San Joaquin Valley to Govern 1942 Prospecting. L. P. Stockman. *Oil Gas J.*, 29.1.42, 40 (38), 118.—For many years Californian prospectors have searched for new fields along well-defined lines of folding, either visible or revealed by the location and trend of producing fields, but the urgent need for maintaining crude and gas reserves will cause them to move into other areas.

The Panoche discovery well was completed in the Cretaceous at 7200–7277 ft., giving much gas and 150 bbl. of condensate/day. Other Cretaceous wells in 1941 were unsuccessful, although, being intended initially to test the younger beds only, they were perhaps not very satisfactory Cretaceous tests. A number of commercial gas fields have been found in the Cretaceous in the central part of the State. The Raisin City field has opened up a considerable potentially productive area north of Coalinga, and fields have already been found at Helm and Riverdale.

The Cretaceous appears to have production possibilities which may later greatly affect California's reserves of crude oil and natural gas.

Ten oil-fields and one gas-field were discovered in 1941. Eight of the oil-fields and the gas-field were in the San Joaquin Valley.

Tables list the 1941 discoveries, the monthly production of the major fields, the annual production since 1936, and summarize the completions during 1941.

G. D. H.

291.* North Central Texas—Bend and Ellenburger Yield Best Discoveries of Year. D. H. Stormont. *Oil Gas J.*, 29.1.42, 40 (38), 125.—The majority of the many discoveries in North and West Central Texas were deeper pays in proven areas, but of the wells drilled, over half were less than 2500 ft. deep, and a quarter less than 1000 ft. There were nine Mississippian discoveries, six in the Ellenburger and twenty in the Bend, constituting over half the total. The K.M.A. Ellenburger production was extended to over 3000 acres, and was the greatest new oil reserve added in North Texas during 1941.

Thirty-one new pools or new producing horizons were opened in West Central Texas. Nearly all the new strikes were in the Cisco series, and many of them in Jones County. Deep tests to the Palo Pinto of the Canyon all failed. Two Strawn pools were added in Coleman County, and a deeper pay and two gas areas in Stephens County.

Tables show the North Texas production by fields and years for the period 1937–41, a summary of the wells completed in 1941, the 1941 discoveries, and the monthly production of the major fields in 1941. Similar data are presented for West Central Texas. G. D. H.

292.* North Louisiana, Arkansas, Mississippi—Central Louisiana Wilcox Sand Play Leads in Active Year. R. M. Sanford. *Oil Gas J.*, 29.1.42, 40 (38), 135.—There was extensive development of the Wilcox trend of fields throughout Central Louisiana, for there were ten new Wilcox sand discoveries in 1941. The wells are 100–200-bbl. wells, often making some water.

In the old Haynesville field a new Pettit lime level was opened at 5431–5440 ft. Smackover lime distillate production was found at 10,148–10,398 ft. in the Lisbon area.

Two new gas-fields and an oil-field were discovered in the Smackover lime of Arkansas

An apparently major discovery and one of small importance were made in Mississippi. In addition, several new deep zones of production were penetrated in the Tinsley field. The Pickens-Sharpsburg discovery yields oil from the Eutaw. Tinsley now has seven separate producing zones, and has been extended in area.

The discoveries, monthly production of the major fields, annual production for the period 1937-41, and a summary of the well completions are given for North Louisiana, Arkansas, Mississippi, and the East Texas border. G. D. H.

293.* Illinois—Intense Wildcatting Yields Many New Fields and Additional Pays. Anon. *Oil Gas J.*, 29.1.42, 40 (38), 140.—The Illinois production of 128,630,909 bbl. in 1941 was considerably below the 1940 figure, although more new productive areas and new pay horizons were found than in any other year. Most of the new pools in White County were small. The most prolific discovery was the Johnsonville pool of Wayne County, which yields oil from the McClosky mainly. The Aux Vases is also productive. Beds below the McClosky are untested, and the southern edge is still undefined. Woodland production is limited to the Benoist. The Tar Springs production at Benton is outstanding, and this has led to five additional Tar Springs discoveries in the basin. A Devonian test at Loudon did not come up to expectations, but the formation's possibilities cannot be said to have been determined fully.

The Aux Vases sand seems to have been under-estimated, and many "dry" sands have now given much oil. It appears that the Dale and Hoodville pools will be linked through Aux Vases production. Levias production was found at Rural Hill, followed by Aux Vases and McClosky production.

The 1941 discoveries in Illinois are listed, together with the monthly production by fields, the annual production in the period 1937-41, and the 1941 completions.

G. D. H.

294.* Louisiana Gulf Coast—New Fields and Flank Sands on Old Domes Share Interest. F. L. Singleton. *Oil Gas J.*, 29.1.42, 40 (38), 146.—Sixteen new fields were discovered in the Louisiana Gulf Coast area in 1941, at depths of 6700-10,990 ft., often with multiple sands. The most important fields seem to be Bayou Sale and St. Gabriel. The former is on a north-south structure, with production at 10,100-10,110 ft. and 10,310-10,342 ft. St. Gabriel has producing sands at 7700 ft. and 8880 ft.

Three fields were discovered in the Delta district, several sands being logged in the Miocene.

New sands were found on the supposed deep-seated salt structures of South Crowley, White Lake, Kenilworth, West Lake Verret, Erath, and West Bay. Exploration around many old salt domes fields opened important new production. A prolific Sparta producer was discovered on the east flank of the Pine Prairie dome at 8226-8233 ft. The early production was over the dome in the Miocene and in the cap-rock at depths of 1300-3200 ft., but was short-lived. Distillate production was found at 9830-9870 ft. on Belle Isle.

Production data are given by years for the period 1937-41, and by months for 1940, and the 1941 discoveries are listed, together with a summary of the 1941 well completion.

G. D. H.

295.* South-west Texas—Oil-Sands Flanking Gas-Distillate Fields have Large Reserves. F. L. Singleton. *Oil Gas J.*, 29.1.42, 40 (38), 153.—In 1941 important crude production continued to be found from down-structure sands flanking the huge gas-distillate structure of the Agua Dulce-Stratton field. All production was from sand lenses at 5500-7200 ft., which can usually be correlated with the gas-distillate sands of the gas-cap. The structure runs north-east-south-west for 16-18 ml. and is about 5 ml. wide. The La Gloria and La Reforma gas-distillate fields were also converted into oil-fields by flank development. Crude was found in new sands in the Odem gas-distillate field. New sand discoveries were made at Midway and Luby. Wilcox production was obtained in Quintana 1-B Washburn. A new discovery and several extensions were made along the lower Frio-Vicksburg trend in Starr County, and shallow fields were opened in the Laredo district.

Tables give the 1941 discoveries, the monthly production of the major fields in 1941, and the annual production in the period 1937-41, as well as a summary of the completions.

G. D. H.

296.* Eastern Texas—Drilling Localized in Hawkins and East Texas Fields. D. H. Stormont. *Oil Gas J.*, 29.1.42, 40 (38), 161.—The Hawkins field, discovered late in

1940, has proved the area's most important discovery for many years, and was the scene of much activity in 1941. Two new Woodbine oil-fields were found, and one with a pay in the Rodessa of the lower Glen Rose. Oil production was opened in the Pettit lime and Rodessa in the Willow Springs gas-condensate area, and a small oil-producer was drilled in the Pettit in the Groesbeck gas area.

The Pleasant Grove structure is erratically faulted, thereby slowing development, and the East Long Lake field seems to be on a separate structure from Long Lake, 2 ml. to the south-west.

The annual production by fields for the period 1937-41, the discoveries, the monthly production of the major fields in 1941 and a summary of the well completions are given.

G. D. H.

297.* Kansas—Three Regional Plays Added to Barton Arch Development. R. Ingram. *Oil Gas J.*, 29.1.42, 40 (38), 164.—Intensive development of pools along the Barton Arch led to the joining of many of them into large producing areas. The Patterson pool was opened in a stray Pennsylvanian sand at 4740-4782 ft., and its significance is its location well away from previous production, in the Dodge City basin. In Jefferson and Leavenworth Counties oil found near McLouth led to the drilling of thirty-three wells during 1941. The Zenith pool in Western Kansas is a stratigraphic Viola lime-trap with oil also in the overlying Misener. Efforts to locate an extension of the shoreline apparently succeeded in the discovery of Peace Creek to the north-east.

Tables show the 1941 discoveries, the monthly production of the major fields, the annual production in the period 1937-41, and a summary of the wells drilled in 1941.

G. D. H.

298.* Canada—North Turner Valley Raises Canadian Production Record. V. Lauriston. *Oil Gas J.*, 29.1.42, 40 (38), 172.—In 1941 Canada's oil production was 10,107,000 bbl., chiefly from Alberta. A large producer may indicate a possible extension of Turner Valley to the south-west, but in the north two dry holes appear further to define the limits, although there was considerable northerly extension of the producing area. The Steeveville-Princess field, 110 ml. east of Calgary, gave 19,337 bbl. of crude in 1941, and while several wells were unsuccessful, late in the year a 100-bbl. well was completed at 3190 ft. A large area of production at 1800-1900 ft. has been proved at Vermilion. A number of wildcats were drilled with little success, but the one on the Twin River structure yielded 30-50 bbl./day from the Madison at 3969 ft.

There was an active drilling campaign for gas in Ontario.

The gas and oil production of the various areas are tabulated.

G. D. H.

299.* Wildcatters Find Many Small Pools in Indiana. Anon. *Oil Gas J.*, 29.1.42, 40 (38), 172.—In 1941 some of the best pools were discovered since the opening of the Griffin pool, although most of the finds were small. The activity was chiefly in the Griffin pool. The Heusler and Bufkin pools, producing from Chester sands, were extended.

G. D. H.

300.* Permian Basin, Panhandle—Deep Pays and New Fields in North will Keep Basin Active. D. H. Stormont. *Oil Gas J.*, 29.1.42, 40 (38), 173.—In 1941 in the North Basin outside proven areas activity was directed towards extending the productive limits northward and eastward from Slaughter, the most northerly pool. Most of the wildcatting aimed at the San Andres and Clear Fork pays. In the south basin much of the wildcatting was associated with the trend of Lower Ordovician pools in Crane and north-eastern Pecos Counties. Thirteen new fields or possible major extensions were opened, and there were altogether twenty-seven new discoveries.

A deep-seated structural trend has been established on the platform between the two trends of Permian production on the rims of the platform. Simpson and Ellenburger production has been obtained. 20 ml. south-east of Big Lake Ellenburger production has been found at a depth of 9200 ft. The structure is apparently of large extent. Oil was obtained in the Strawn crinoidal lime 3½ ml. west of the Todd deep field in Crockett County.

Five miles east of Lubbock in the north oil was obtained in the Clear Fork lime, stratigraphically lower than the San Andres, which is productive at Wasson, Slaughter, and Cedar Lake. 2000 ft. below the regular pay oil has been found at Wasson.

The 1941 discoveries are listed, together with the monthly production of the major fields, the annual production during the period 1937-41, and a summary of the well completions in 1941.

G. D. H.

301.* Rocky Mountain Area—Gas Development in all Areas Shows Large Increase.

T. R. Ingram, *Oil Gas J.*, 29.1.42, 40 (38) 178.—The most important discovery in Colorado in 1941 was the finding of Sundance production at Wilson Creek. Gas was found in the Wasatch on the West Hiawatha structure in exploring sands which yield oil on the East Hiawatha structure. An extension was made to the Powder Wash oil- and gas-field by the completion of a large gas-well. Along the same line of folding gas was discovered on the Canyon Creek structure in Wyoming. This was also in the Wasatch, and the well had an oil showing 650 ft. above the gas-sand. A gas-well was completed in the Dakota in South Elk Basin. Extensions were made to the Wertz and Cole Creek fields.

In Montana oil was discovered west of Kevin-Sunburst. A gas discovery with favourable oil indications was made on the Twin Rivers or Reagan structure. Between the Kevin-Sunburst and Cutbank fields, and also 25 ml. east of Kevin-Sunburst, gas in quantity was found.

The Farmington sand has given oil in the Fulcher Basin district where the Picture Cliff sand yields gas. The Clay Basin gas-field of Utah now covers an area 4 ml. long and 1½ ml. wide.

Tables give the Rocky Mountain discoveries in 1941, the annual production since 1936, the monthly production of the major fields in 1941, and a summary of the wells completed.

G. D. H.

302.* Michigan—New Fields in Northern Sector Reverse Production decline.

O. Pressprich, *Oil Gas J.*, 29.1.42, 40 (38), 182.—During the first half of 1941 Michigan's oil production was slowly falling, but in June deepening of a small well to test the Dundee and Monroe at Reed City opened up a field in which both the Monroe and Traverse have proved prolific. The Headquarters field yields Traverse oil. A gas-pay was located in the Monitor area of Bay County, and Berea oil has been developed.

The annual production for the period 1937-41 is tabulated, as well as the monthly production of the major fields in 1941 and a summary of the well completions.

G. D. H.

303.* Oklahoma—Anadarko Basin Play Starts; Old Areas Reworked.

R. Ingram, *Oil Gas J.*, 29.1.42, 40 (38), 183.—During 1941 there was much reworking of old producing fields which failed materially to affect reserves in spite of many discoveries. In the south-west excellent production was found in Simpson sands at Apache and Velma. Some of the eight Apache wells have potentials as high as 15,000 brl./day. In the older areas, Guthrie, Tecumseh Lake, Hotulke, and West Hotulke are the outstanding new pools, although they do not appear to be of the Apache ranking. In addition to drilling on small structures, secondary recovery methods were introduced to maintain production.

The 1941 discoveries and extensions, monthly production of the major fields during 1941, the annual production during the 1937-41 period, and a summary of 1941 well completions are tabulated.

G. D. H.

304.* U.S. Crude Reserves Rise.

Anon. *Oil Wkly*, 26.1.42, 104 (5), 48.—In spite of the production of a record quantity of oil, the amount discovered but unproduced rose to a new peak during 1941. An estimated 1,903,344,000 brl. of new oil were discovered against production of 1,403,784,000 brl., and on 1st Jan. 1942, the crude oil reserves were estimated at 19,524,075,000 brl. Nevertheless, the additions to reserves were the smallest since 1935. The amount of oil found per dry hole fell by 11,354 brl. to 266,313 brl., again the lowest since 1935.

Most of the increase in crude reserves in 1941 was in the south-western group of States, where Texas was the chief gainer with 1,007,750,000 bbl. Louisiana, Arkansas, and Illinois increased their reserves, whereas California, Oklahoma, and Kansas failed to find as much oil as they produced.

Tables give the crude reserves by States at the beginning of each of the past six years, the oil discovered, that produced, the excess and accumulated reserves, as well as the number of dry holes for various years or periods; some details of the 1941 oil discovery rates.

G. D. H.

305.* Many Fields Found. Anon. *Oil Wkly*, 26.1.42, **104** (8), 65.—During 1941 the greatest number both of new fields and new horizons in old fields ever attained in a year were discovered in U.S.A. There were 346 new fields and 267 new horizons, considerably more than in 1940. The trend in discoveries has been almost continuously upwards during the past five years. The average depth of the 613 discovery wells in 1941 was 4355 ft., as compared with 3444 ft. in 1940 and 4253 ft. in 1939. The numbers of new fields, new zones, and the average depths of discoveries are tabulated by States for the years 1936–41. Other tables list by States the names, locations, discovery date, producing formation, depth, initial production and oil gravity of all the 1941 discoveries.

G. D. H.

306.* Production by Fields. Anon. *Oil Wkly*, 26.1.42, **104** (8), 75.—During 1942 three more American fields are due to qualify as "100,000,000 bbl." fields, a state achieved by only forty-two fields so far. The three fields are Chalk, Big Lake, and Hobbs. East Texas has produced 1,702,847,000 bbl. of oil.

The fields which have given over 100,000,000 bbl. of oil each are listed, and further tables give by States the discovery year, production in 1940 and 1941 and cumulative production of the various fields in U.S.A.

G. D. H.

307.* Wells Completed. Anon. *Oil Wkly*, 26.1.42, **104** (8), 101.—32,265 wells were completed in U.S.A. in 1941, not many fewer than in the record year of 1937. There were 20,113 oil-wells, including wells drilled deeper. 2656 gas-wells were drilled, and there were 7147 dry holes. 2184 water-intake wells were drilled, in addition to 117 gas-input wells and 48 salt-water-disposal wells.

Gas demand led to a rise of 60% in Ohio's completions, and there was a 22% rise in West Virginia. The rise in completions in Texas was 9%, while Michigan had a fall of 25% in the 1941 completions.

Tables show the number of wells completed, the types, total initial production, and average per well for the period 1859–1922 and by years from 1923 onwards; the total completions, types, and initial outputs by States for 1940 and 1941, with the same data broken up according to fields and states for 1941.

G. D. H.

Drilling.

308.* Record Number of Deep Tests Drilled During 1941. H. F. Simons. *Oil Gas J.*, 29.1.42, **40** (38), 193.—A statistical review of deep-well drilling for 1941 is presented dealing solely with U.S.A. activities.

A. H. N.

309.* Use of Hard-facing Material on Rotary Tool Joints. T. P. Sanders. *Oil Gas J.*, 5.2.42, **40** (39), 36.—Acceptance of tool-joint hard-facing in California has been accelerated by results made public from comprehensive tests conducted by a major West Coast oil company. These tests were carried out in the Ventura field, where drill-pipe wear is as severe as in any field west of the Rockies. The tool-joints were calipered after each run, and extensive tests showed that joints hard-faced with the electric-tube tungsten-carbide rod lasted two and a half to three times as long as the unfaced joints. Calculating that a saving of \$50/joint could be made with hard-facing, the company standardized on the tungsten-carbide rod, and laid down a definite procedure for its use, which is described. The process is used for hard-facing new, re-sleeved, or slightly worn joints. A discussion of face-hardening is given.

A few general rules apply to the hard-facing of all types of tool-joints: (1) Before the hard-facing is applied, the joint should be preheated to a temperature of approximately 300° F. to take the chill out of the steel. (2) It is good practice to weld the joints to the pipe with mild steel electrodes before applying the hard-facing. (3) A copper form should be used to help obtain a square elevator shoulder, but this cannot be done when the tungsten-carbide electrode is used. (4) In running a bead around a tool-joint lying in a horizontal position on a pipe-rack, a smoother application of hard-facing can be obtained if the welder works from the top of the joint down, rather than from the side nearest him towards the top. With the molten metal running downwards behind the electrode as the welding progresses, ridges or waves in the hard-facing are largely avoided and there is far less likelihood that the finished facing will be out of round. This recommended procedure also makes it natural for the welder to "drag" the electrode over the surface rather than push it, and this technique makes for faster progress. (5) It is unnecessary to hard-face both the pin and the box of a joint. On integral-joint drill-pipe the pins should be hard-faced, but the boxes of all other types of tool-joints should receive the application. Where the tool-joints are the type attached by the flash-welding process, the boxes are built up in a manner similar to that set out for worn joints except that the welding of the joint to the pipe with a mild steel electrode is unnecessary. (6) When self-hardening alloy is being applied, 25-50% more amperage should be used than is customary with the coated mild-steel rod. The additional heat is necessary for proper fusion of the alloying metals.

When new joints are to be hard-faced the work is carried out before the string is sent to the field. Each of the elevator shoulders is recessed $\frac{1}{8}$ in. deep in a band 1 in. wide, and the hard metal is deposited in this recess. This is done so that an application of sufficient thickness can be made without resulting in over-sized joints. These applications are to be avoided because they have a tendency to become undercut, thereby serving to nullify the effectiveness of the hard metal.

A. H. N.

310.* Reduction of Hole Size in Drilling as Affecting Costs, Completion, and Production Practice. Part I. I. W. Alcorn and J. U. Teague. *Oil Wkly*, 2.2.42, 104 (9), 15. *Paper Presented before American Petroleum Institute.*—This paper represents a joint effort of the south-western District Topical Committees on Drilling and Production Practice. The data submitted on some 2300 wells from all sections of the country indicate a trend towards the drilling of smaller-diameter holes, both exploratory and proven, and completing wells with smaller casing. Substantial savings are being effected in initial well costs by this practice.

No particular difficulty has been reported in drilling, completing, or producing the small-diameter wells. Nearly all the fields on which data were obtained are in the flowing stage; consequently little information is available on artificial-lift installation in the small-diameter wells. But the predictions are that no trouble will be experienced with artificial-lift equipment in the small-diameter wells, except when a large volume of fluid has to be produced with rod-pumps.

Small-diameter wells can be repaired by all commonly used methods as easily and cheaply as those of large diameter except when the well is to be deepened or sidetracked, in which case the small-diameter well is at a disadvantage. The majority of the small-diameter wells were completed with 5½-in. OD casing, which is considered by the majority of those who submitted data to be the smallest practical casing size to use. The popular size hole to drill for setting 5½-in. OD casing seems to be 8¾-in. A 9¾-in. hole was drilled for most of the large-diameter wells reported, and 7-in. OD casing was set as the final casing string.

The trend towards the drilling of smaller holes and setting smaller casing will probably continue, because of the lower initial well cost, long expected flowing life of most fields, and the low rates of production on individual wells under enforced curtailment of production.

The paper is well illustrated with tables and diagrams and references are appended.

A. H. N.

311.* Drilling Rig Designed for Ready Portability. W. A. Sawdon. *Petrol. Engr*, January 1942, 13 (4), 38.—The rig equipment consists of two main units mounted on semi-trailers and hauled by a semi-trailer tractor unit, all units being of road width and meeting legal requirements for load. All movement is made on pneumatic rubber,

tyred wheels. Of particular interest is the arrangement of the equipment when rigged up for drilling operations.

The drilling and pumping units are mounted permanently on the semi-trailers, which have three axles in the rear. During transportation the front of the semi-trailer is supported on the tractor unit, which hauls one unit to a new location and then returns for the other. Incidentally, the tractor also hauls a light semi-trailer used for general lease work while the other units are drilling.

One main unit consists of the hoist, its engine, the folding derrick, and auxiliary equipment used with these items. The other consists of two mud-pumps and their two engines, complete with manifold, large double tool-box, and lighting unit. The two units are mounted side by side with a walkway between. Before they are moved into place guide-tracks are laid at the location and the semi-trailers carrying the units are backed into position on these tracks. This provides for the alignment of the units in the desired position so that connections between the two units can be made rapidly and with minimum work. All water, mud, fuel, and electrical connections are built into the units. The forward ends of the trailers when rigged up are the ends away from the derrick floor and rest on tubular steel supports. Jacks placed near the wheels that are adjacent to the derrick floor relieve the load on the rubber tyres.

Each main part of the rig is described separately, giving capacities and other specifications. A. H. N.

312.* New Drilling Rig Embodies many Valuable Features. H. L. Flood. *Petrol. Engr.* January 1942, **13** (4), 42.—Many unusual features have been incorporated into the design and assembly of the drilling equipment, among the more important of which are:

1. The 122-ft. mast or derrick, by far the highest mast yet designed to be erected as a unit.
2. The all-wheel-drive truck-chassis supporting the drilling engines, draw-works, rotary table, etc. Noteworthy is the absence of a conventional truck engine; motive power for the truck when changing locations is supplied by the drilling engines.
3. The trailer that serves as a permanent base for the two 7½ by 12 mud-pumps. The fuel-tank and light-plant are also mounted on the trailer.
4. The compact design of the flanking substructure, walkways, and pipe-rack, representing virtually the only accessory equipment (other than the tool house) not permanently mounted on mobile equipment.

When on the road, or when making a move from one location to another within a given field, the "caravan" of trucks transporting the drilling equipment will comprise the following units: (1) The main truck, on which the engines, draw-works, table, bottom section of mast, etc., are mounted. (2) The pump trailer pulled by a medium- or large-sized oil-field truck. The trailer also carries the middle mast section during a move. (3) An oil-field truck on which the upper section of the mast is loaded, together with the substructure. (4) An oil-field truck on which the tool-house and pipe-rack are loaded.

Depending on the distance of the move, another truck or trucks may be used to haul the drill-pipe. Otherwise, on a short move, one of the above trucks may "shuttle" back and forth, making several trips to haul the various accessory equipment.

Although it was possible to describe only one operation at a time, it should be borne in mind that many of the operations involved in rigging-up proceed simultaneously. In this way the total time required to move and rig-up is reduced to a matter of hours.

Main items of the rig are described, and it is pointed out that it is found extremely easy for new crews to adapt themselves to the new rig. A. H. N.

313. Patents on Drilling. E. O. Roemhild. U.S.P. 2,270,604, 20.1.42. Appl. 23.6.39. Driving coupling for pipes forming hollow piling sections of different diameters.

W. L. Church. U.S.P. 2,270,647, 20.1.42. Appl. 15.6.39. Casing-plug for cementing the perforations in a well casing.

W. L. Church. U.S.P. 2,270,648, 20.1.42. Appl. 16.2.40. Cementing-plug having a packer arrangement.

P. H. Jones. U.S.P.2, 271,695; 3.2.42. Appl. 14.1.38. Conditioned well-drilling fluid having low gas-cutting tendencies and a fatty acid constituent.

P. H. Jones. U.S.P. 2,271,696, 3.2.42. Appl. 24.1.39. Conditioned well-drilling fluid having an ester of a fatty acid as a constituent.

O. J. McCullough. U.S.P. 2,271,742, 3.2.42. Appl. 18.8.39. Cable-measuring device, the cable being wound on a drum.

A. Hossfeld. U.S.P. 2,272,087, 3.2.42. Appl. 7.6.40. Drilling machine using a reciprocating hollow shaft at the end of which there is a bit, the shaft being simultaneously rotated.
A. H. N.

Production.

314.* Reserve Estimates Provide Important Danger Signals. W. V. Howard. *Oil Gas J.*, 1.1.42, 40 (34), 18.—The estimate of reserves as of a certain date, if presented alone, has very little significance. However, figures, say in terms of years' supply, for two dates do indicate tendencies. The complete definition of some fields is an extremely slow process, and improvements in technique may greatly increase recoverable reserves. Thus, prior to flooding, Bradford gave 203,000,000 bbl. Flooding has given 186,250,000 bbl., and it is estimated that 178,397,000 bbl. remain to be produced.

There is a definite reason for allocating oil reserves to the year of discovery of the field, and even of including lower sands, for a pool, once discovered, is unlikely to be abandoned until prospected to the limit, and hence all oil to be found in that field throughout its whole future history has become a routine development so far as prospecting is concerned.

Investments are not made on the basis of only 15 years' supply, especially when it is realized that some of that oil will still be in the ground 50 years hence, but on the basis of continued replenishment of reserves, so that oil may be produced at the current rate, or even at an increased rate, for many years.

It seems desirable to prepare estimates of reserves by the inventory method and by allocation to the year of discovery. When the two estimates approach each other, more exploration is needed to maintain the future position, and when the inventory method shows a decline below a certain level in years' supply of available oil, this also is a danger signal.
G. D. H.

315.* Increase in Oil Production by Application of Chemicals. P. E. Fitzgerald. *Oil Gas J.*, 29.1.42, 40 (38) 194.—A brief summary of different types of chemicals used to increase production is given. Inhibitors to prevent acid corrosion have been an important adjunct in well treatment, and are even more so now that well equipment is difficult to replace. Surface-tension reducing agents have been used for several years to facilitate uniform penetration of the acid into the formation and to assure easier, more complete and rapid removal of the spent-acid products. These agents have a definite application in formations of either low permeability, low pressure, or both.

Agents capable of changing rates of reaction of acids on different types of formations are available. Some of these increase the rate of reaction on dolomitic and siliceous formations, whilst others tend to reduce the reaction rate on fast reacting formations. The latter agents permit greater penetration of the acid before it becomes spent—an important factor in old wells where it is desirable to secure maximum penetration of the formation.

A large number of demulsifying compounds is available for use in wells where the acid or spent acid may form serious emulsions. The type of demulsifying agent used will depend on the type of oil and the emulsion formed as a result of the treatment. Blankets and organic gel compounds to prohibit or minimize the downward movement of the treating compounds into water or an otherwise undesirable portion of the exposed formation are available. All these are for temporary use, and can be removed by normal production methods, no special clean-out operations being required.

There are also chemically inert, fragmented, flakey substances that are useful in preventing mud losses in drilling walls, regaining circulation losses in drilling and

cementing operations. They also lend greater plugging properties to the organic gels used in temporary plugback operations and selective acidizing techniques.

Other chemicals often used are paraffin solvents of many types, gyp or scale solvents, and special acid compounds for the dispersion and disintegration of mud sheaths, infiltrated water, and similar deposits that may be causing a reduction of the flow of fluid through the critical area surrounding the well and the screen. The latter group includes the "mud acids" which have been especially beneficial in wells on the Gulf Coast of Texas and Louisiana.

More recently "formation cleaner" treatments have been found to be quite successful in certain types of wells where hydrocarbon deposits are thought to be causing production difficulties. The chemicals used in these treatments do not depend on an acid reaction, and are therefore applicable to all types of formations.

Another group of chemicals that have an interesting application in some types of wells is certain inorganic gels and special resins used for shutting off water and other undesirable fluids, to lower gas-oil ratios, water-oil ratios, and to save casing in some cable-tool drilling wells.

The methods adopted for injecting the chemicals are briefly reviewed.

A. H. N.

316.* New Liner-Cleaning Method Fills Need. T. P. Sanders. *Oil Gas J.*, 29.1.42, 40 (38), 206-207.—A new liner-cleaning method is reported. A string of fuse-like explosive was hung through the liner of an old California well that had ceased to produce. After it had been detonated and many barrels of silt had been bailed out of the liner, the well was put on production at the rate of about 200 bbls./day, of which only 10% was water.

The explosive fuse, known to its users as the "cleaner," closely resembles the Cordau-Bickford fuse long used in mining operations. It differs mainly in that it does not carry a lead-jacket and its explosive core is smaller. Being flexible, it is easily handled, and can be run over small pulleys at the well-head. Its tensile strength permits hanging a weight at the bottom so that the "cleaner" can be lowered to the desired position under fluid in the liner. The fuse diameter is slightly less than the thickness of a lead pencil.

A detonator is installed at the top of the explosive fuse where the connection is made with the shooter's line. This is a rather small cap, which is detonated by electricity from a switch at the surface. The detonator must be specially designed and manufactured to guard against premature discharge due to fluid pressures.

Experimentation was necessary to formulate general rules for the correct loading of wells. In most wells equipped with 5½- to 6½-in. liners, two strings of explosive fuse are detonated simultaneously side by side. In older wells, where liners are likely to be weak from corrosion, only one string of "cleaner" is used, in order to avoid any possibility of splitting the liner. Other conditions influencing determination of the proper number of "cleaner" strings to use include: (1) size of slots or perforations; (2) number of slots or perforations/unit of area, and (3) whether the liner is made of welded or seamless pipe.

Recommendations are given for the proper use of the method.

A. H. N.

317.* Gas Jetting Used to Lift Oil at Aransas Pass Field. N. Williams. *Oil Gas J.*, 5.2.42. 40 (39), 33-34.—The development and present conditions of the field are reviewed. The first stage of production is now over. Recovery of the remaining production by artificial methods presents various problems. Conditions in this field have not been regarded as suitable for conventional pumping. Not only are the main sands below 7000 ft. in depth, but wells have comparatively low fluid levels, and with increasing volumes of water to be lifted, costs of pumping might become prohibitive. This has led to consideration of other means of lifting the oil.

Plans of operators now call for the recovery of remaining production by gas-jetting, and within the past year this practice has been undertaken on a rather extensive scale in this field. By jetting, premature abandonment of many wells is being forestalled and increased recoveries made possible. Lack of adequate available gas supplies and pressures in the field for prolonged jetting operations presents a problem, but operators

generally are looking to the possibility of being able to lay a pipe-line to some nearby high-pressure gas-field by the time additional gas volumes are needed to carry on operations. Two corporations are now undertaking the jetting, and some details are given. A. H. N.

318.* World Production Outlook. Anon. *Oil Wkly*, 26.1.42, 104 (8), 40.—War has accelerated oil production in Venezuela and Canada, but in many other countries loss of markets and transport, and difficulties in obtaining drilling equipment, have had an adverse effect. Thus Mexico's output in 1941 fell 20% below the 44,000,000 bbl. of 1940. Turner Valley in Canada gave over 95% of the country's output of almost 10,000,000 bbl. of crude, which was about 9% above 1940. Venezuela gave 223,000,000 bbl. compared with 185,000,000 bbl. in 1940. Colombia's output fell 7% in 1941 to 24,313,000 bbl., due to a lack of tankers and failure to develop new fields. Argentina produced 21,639,000 bbl. of oil in 1941, 70% of the output being from Comodoro Rivadavia. The Iranian production may have declined slightly in 1941, and that of Iraq has fallen seriously, due to loss of markets. The production of the Netherlands East Indies was probably unchanged at about 62,000,000 bbl. It appears likely that Roumania's production fell to 36,000,000 bbl. in 1941, as compared with 43,000,000 bbl. in 1940. G. D. H.

319.* U.S. Production Up. Anon. *Oil Wkly*, 26.1.42, 104 (8), 61.—In 1941 U.S.A. produced 1,403,784,000 bbl. of oil, 30,000,000 bbl. more than in 1940. Kansas had the largest increase, with 17,000,000 bbl. and a total of 83,045,000 bbl., and Texas (total 507,391,000 bbl.), Louisiana, Mississippi, and California had increases of fourteen million, thirteen million, eleven million, and seven million barrels respectively.

A table shows the production by states and years from 1859 to 1941. G. D. H.

320.* Drilling Cost Reductions Permit Deeper Flooding. F. B. Taylor. *Oil Wkly*, 2.2.42, 104 (9), 13-14.—From a strictly engineering viewpoint there appears little question but that deeper horizons can be flooded successfully. The fundamental question is not so much one of engineering as of economics. Floods at depths exceeding 2000 ft. have at times been condemned, on the basis that costs would be prohibitive under nearly any probable economic condition. This is not necessarily true. There are many variables in development costs, some of which allow reduction with depth, and others do not increase in proportion to footage below the surface if more economic practices are adopted.

Drilling expense, the most important budget item, would naturally increase with depth, but could be reduced through adoption of wider well spacing and certain practices that would curtail expenses. The complete water system, second major budget expense is relatively constant regardless of depth. The third function of importance is producing equipment, which cannot be varied too extensively on deeper projects, although some possibilities exist.

Consequently, in attempting to reduce operating costs on deep water-floods, expenditure reductions must be made all along the line, but primarily in connection with drilling expense.

Analysis is made of the effect of drilling and lifting expense on flooding operations. The results are presented in a concise tabular form. A. H. N.

321.* Reducing the Quantity of Salt Water Produced with Oil. F. J. Mikeska. *Petrol. Engr.*, January 1942, 13 (4), 23-26.—Of the various methods employed in an effort to reduce the volume of salt water lifted with the oil production, that which has proved effective in many respects has been the use of a subsurface choke in the tubing string below the pump or gas-lift equipment. This method is discussed.

As implied, the use of a subsurface choke has usually been restricted to pumping or gas-lift wells, the number of which is increasing in the field, as more wells cease flowing from year to year. The generally accepted conception of water encroachment by coning pictures a more or less well-defined plane or surface of contact existing initially between the oil-body and the underlying water. When a well is drilled and completed

in the oil-saturated section, presumably a reasonable distance above the water-bearing stratum, and the well begins producing, the reservoir system changes immediately from a condition of static equilibrium. As flow is established and fluid enters the well-bore, lines of flow are established throughout that portion of the reservoir "controlled" by the well. When only one well serves as an outlet for the reservoir fluid, all lines of flow are directed to this one means of outlet. When two wells are producing from the reservoir, the division of flow-control between the wells is determined basically by the relative volumes produced from the two wells. As the number of wells producing from a common reservoir increases, the number of flow patterns likewise increases. If the rate of withdrawal is restricted, there is less pressure drop and the oil moves laterally along horizontal flow lines to a greater extent than water moving vertically upward.

The function of subsurface chokes is controlling the flow of salt water. Performance data are presented. Based on the results obtained thus far by employing subsurface chokes to control water production, the method appears to have considerable merit. Although there may be conditions in individual wells that might preclude the successful use of a choke, it is believed that application of the method at least should be given consideration by every operator confronted with the problem of producing wells in East Texas by artificial lifting methods. A. H. N.

322.* Petroleum Engineering. Part 1. L. C. Uren. *Petrol. Engr*, January 1942, 13 (4), 27-30.—In this, an informal paper, Professor Uren describes the requirements in training petroleum engineers. Problems encountered in this work are presented. Common problems include those incidental to oil-field development, such as construction of roads, power, water supply and communication facilities and construction of camp buildings; planning and analyzing development programmes, including decisions relative to spacing, arrangement and time and order of drilling wells; the operations incidental to drilling, including transportation and erection of drilling rigs and closely related operations of installing casing and excluding water from wells; methods of well completion, installation of production equipment, and estimating productive capacity.

The production phase of the industry includes studies of subsurface reservoir conditions that govern the production of oil and gas; the installation, testing, and operation of well-pumping equipment, operation and control of flowing and gas-lift wells, well maintenance and repair work, and conditioning of wells to obtain maximum production efficiency. Related to the production phase is the care and handling of oil and gas after they are brought to the surface; gas-trapping, dehydration of oil, pipeline gathering, and transmission of gas and oil; gauging, sampling, and testing of oil and gas. Special so-called "secondary" methods of oil recovery designed to improve production efficiency and obtain an additional "crop" of oil after ordinary methods based on utilization of natural expulsive forces have failed, require close engineering supervision.

A special province of the petroleum engineer is that of maintaining well and property records, such as well logs and other subsurface data obtained during the drilling process. Property and well surveys and maps, records of production, cost data, materials and equipment records and tests are commonly entrusted to engineering personnel. Special phases of this work involve the making of well surveys, electrical logs, depth-pressure surveys, depth-sampling of fluids, inspection and testing of formation samples and oil, gas, and water obtained from different strata. Still more advanced aspects of the work of the petroleum engineer include property management, appraisal of producing properties, and work involved in proration and other methods of production control.

A. H. N.

323.* Subsurface Flow in Condensate Sands. J. Breaker. *Petrol. Engr*, January 1942, 13 (4), 80. *Paper Presented before Petroleum Industries Association, Texas.*—Condensate field principles are summarized. The events following upon a drop of pressure in condensate fields are discussed. The only efficient means of operating a condensate recovery system is to maintain the reservoir at as near the original pressure as possible by the injection of the dry residue gas into the same formation from which it was taken. This cycling process, as it is accurately termed, serves four important purposes: (1) it prevents the formation and subsequent loss of condensate in the reservoir; (2) it

drives nearly all the wet gas to the producing wells; (3) it enables greater production rates from the wells, by keeping an almost constant high pressure on the sand, and (4) it conserves the dry residue gas to be later sold as fuel.

Diffusion effects are reviewed. It seems certain that there will be dilution when there is a permeable streak in the sand, particularly when it is between the input and the production well. The velocity of the gas will be greater through the more permeable area, and will cause a fingering of the dry gas into the wet gas area. This will take place to a greater extent when the wells are handling more gas.

Well pattern and spacing for injection and output wells are discussed, together with completion methods used. Well-control is studied at the end. In one instance, where an area of high permeability was known to be present between an injection and a supply well, the problem was solved by injecting a quantity of clear water into the injection well. The water will seek the area of greatest permeability and stay there, preventing the gas from by-passing through it.

An important phase of well control is testing. Tests should be made regularly and frequently. In this way reservoir conditions can often be determined and serious trouble sometimes prevented. It is helpful to plot results of tests in order to observe the trend of the well. All these tests need not be complicated. Before a well begins drying up, some idea as to its comparative content can be had by merely finding the end-point of the condensate. This will not necessarily be true after dry gas reaches the well, the encroachment of which may increase the bottom-hole pressure and vaporize around the well-bore.

A. H. N.

324. Patents on Production. A. Arutunoff. U.S.P. 2,270,666, 20.1.42. Appl. 4.11.37. Deep well pump of the centrifugal type.

E. L. Barker. U.S.P. 2,271,535, 3.2.42. Appl. 3.8.40. Well flowing device with an automatic cut-off valve responsive to fluid velocity in a pipe in the well-head.

K. H. Kanalz. U.S.P. 2,271,594, 3.2.42. Appl. 9.10.39. Pumping mechanism comprising a pair of walking beams projecting in opposite directions from each other and worked simultaneously by one motor.

F. R. Shultz.—U.S.P. 2,271,832, 3.2.42. Appl. 13.5.40. Gas and water separator for wells and the like.

H. U. Garrett. U.S.P. 2,271,859, 3.2.42. Appl. 5.12.38. Two stage intermitter mechanism for use in wells working on gas-lift.

H. Y. Carson. U.S.P. 2,271,936, 3.2.42. Appl. 9.12.40. Pipe joint for bell and sprigot pipe.

F. E. Roberts. U.S.P. 2,272,022, 3.2.42. Appl. 17.11.39. Tubing head with a combination guide and seal for pump rods wherein the rod is subjected to flexing action.

A. H. N.

Transport and Storage.

325.* Vapour-Saving Roofs for Gasoline Tanks Found Profitable at Bettendorf. Anon. *Nat. Petrol. News*, 15.11.41, 33 (45), 19-20.—The different types of roofs are described. *Breather-Roof*.—A flexible steel diaphragm, attached at periphery to tank and supported but not fixed to a framework when in "down" position. Recommended for tanks more than 60 ft. in diameter, and with a small throughput. Prevents breathing losses when tank three-quarters to full and reduces loss when contents are lower. *Balloon-Roof*.—An extension of the breather-roof idea providing larger capacity for vapour accommodation. Roof usually 12 ft. larger in diameter than tank. Said to be more efficient than breather-roof for smaller tanks and to prevent breathing loss from nearly empty tanks. May affect partial reduction in filling losses. *Floating Roof*.—A pontoon deck rests directly on liquid surface and prevents all vapour loss by preventing vapour formation. *Spheroid Tanks*.—Designed to withstand maximum vapour space

pressures resulting from normal temperature changes and vents set to operate only under extreme conditions. Breathing losses in storage exceed losses during filling which are harder to reduce. The annual breathing loss from 2,000,000-gallon tank with ordinary roof may amount to 2.6% and filling losses to 0.2% per fill, a total of 80,000 gallons for 6 fills per annum. Vapour saving roofs may reduce the loss to 20,000 gallons. It is suggested that the installation cost may be recovered in gasoline saved in 2 years.

H. G.

326.* Southern Pipe-Line Undertakes Cathodic Protection in Saxet. N. Williams. *Oil Gas J.*, 4.12.41, 40 (30), 38.—In Saxetfield, Lower Texas Gulf Coast, a heavy black clay, highly alkaline, soggy, poorly drained soil has been unusually conducive to electrolytic corrosion. Coating of lines has not afforded sufficient protection and cathodic protection is being undertaken. Lines involved form a complicated network and are of great variety, representing both high and low pressure gathering and transmission systems, and range in size from 20 in. to 2 in. In addition, protection is being provided for the bottoms of 10 new 93,000-brl. storage tanks.

So many lines within a small area necessitated extra large units, and installations consist of 3 copper-oxide rectifiers and 12 gas-engine-driven generators. Two additional rectifier units protect the 10 tanks. The available current is supplemented by a generator at the Southern Minerals Corp.'s gasoline plant. Units are all of the same size, which helps to obtain satisfactory spacing. Ground beds are set back 350–400 feet from the protected lines and are designed with sufficient metal for a minimum life of 2½ years. In an attempt to prolong life the ground-bed pipes have been filled with a carbon residue obtained from a near-by carbon-black plant. Of interest in connection with the gas-engine-generator-unit installation is the use of the fuel-gas line, suitably insulated, as the negative connection from the pipe-line to the generator. The current requirements for the protection of the 10 tanks have been minimized by precautions taken to protect the tank bottoms from the soil of the original foundation. J. C.

327. Crude Oil and Gasoline Pipe-Lines in the United States, May 1, 1941. G. R. Hopkins and F. S. Lott. *U.S. Bur. Mines. Information Circular*, No. 7196, December, 1941.—It is estimated that on May 1st, 1941, the crude oil pipe-line system in the United States involved a total length of 118,350 miles, an increase of 7770 miles since June 30th, 1936, when the previous survey was made. The total length of gasoline pipe-lines at the same date was 9001 miles, nearly double the figure estimated for 1936. Average diameter of trunk pipe-lines for crude oil is 8.4 in., the tendency being to lay far less small diameter pipe; actually 74 per cent. of the total trunk-line mileage in 1941 consisted of pipe of 8-in. and over in diameter. Diameter of gasoline lines ranges from 2 to 12 in., 6- and 8-in. sizes predominating. The technique of pipe-line construction, operation and maintenance has materially improved and has resulted in increased efficiency of transport with corresponding reduction in costs. In the construction field, aerial survey has become standard practice on long lines and has eliminated much of the slower pioneer survey work of earlier years. Another factor of importance is elimination of couplings for joining lengths of pipe in favour of electric welded seamless pipe. Operating pressures as high as 2000 lb./sq. in. are safely achieved by use of forged steel fittings, cast alloy-steel valves, stronger materials in compressor cylinders and in all other parts under stress. All these improvements have permitted an increase in distance between pump stations to 100 to 200 miles compared with the former practice of boosting at 40- to 60-mile intervals.

H. B. M.

Crude Petroleum.

328.* World Crude Oil Production by Countries by Years. Anon. *Oil Wkly*, 26.1.42. 104 (8), 42.—Crude oil output is tabulated yearly by countries from 1857 to 1941, the figures for the latter year being preliminary estimates.

G. D. H.

329.* Salt Removal from Refinery Charging Stock. J. C. Albright. *Petrol. Engr.*, Nov. 1941, 13 (2), 94.—The Michigan crude processed at the Alma plant of Leonard Refineries, Inc., averages about 125 lb. salt (NaCl) per 1000 brl. Only part of this can

be washed out by the usual method of heating with added water and settling. Consequent difficulties were short-time runs, all too frequent cleaning of equipment, with expensive replacements due to corrosion, and the degradation of the liquid products, especially the kerosine cut.

A Petreco unit was installed in the crude charge line operating as follows. Water is pumped, at a rate of 150 brl. per 1000 brl. of crude, into the line carrying crude, heated to 190° F. An intimate mixture is produced by means of a back pressure valve which causes high turbulence and high velocity. The crude-water emulsion enters the desalting vessel where the electrified zone causes rapid separation of the water, the oil flowing from the top of the unit. The results are that salt is reduced to 6 lb. per 1000 brl., leading to increased running time, lower maintenance costs, and improved products.

J. C.

330.* Characteristics of California Crude Oils. R. C. Mithoff, G. R. McPherson, and F. Sipos. *Refiner*, November, 1941 **20** (11). 462-470. *Paper Presented before American Petroleum Institute.*—California crude oils differ markedly from most other crude oils produced in the rest of the United States in gravity, paraffinicity, sulphur content, and asphalt content. They also differ markedly among themselves in these factors. These wide variations in crude-oil quality lead to the necessity that companies processing California stocks should place considerable emphasis on crude-oil analysis. They also lead to wide variation in the refining methods required. In this paper, crude-oil-analysis methods used by Standard Oil Company of California are described briefly, the different qualities of the California crude oils are compared with those of oils produced elsewhere in the United States, and a brief description is given of the differences in the required refining processes.

After defining certain terms used in the classification and pointing out the difficulties in finding a truly satisfactory method of classifying California crude oils the following general remarks are made: Crude oils from the San Joaquin Valley fall into two main groups, produced in about equal volume. The first group includes the heavier and more naphthenic oils, most of them ranging in A.P.I. gravity between approximately 14 and 25°, and in characterization gravity from 19 to 23°. Up to about 1930, most of the valley production was of this type. Midway-Maricopa district produces oil representative of this type.

The second group includes lighter and more paraffinic crude oils, most of them lighter than about 30° A.P.I. gravity and with a characterization gravity between 26 and 30°. Kettleman, Coalinga Eocene, and Coles Levee are representative. Most of the production in this group is from fields opened in recent years—especially from deeper, older geologic zones. The relationship to geologic age appears to be general throughout California. Deep wells producing from geologically older strata usually yield lighter, more paraffinic oil of lower sulphur content than do shallower wells in the same field producing from geologically younger rock.

Typical crude oil from the Southern California fields is intermediate in gravity and paraffinicity between the two main San Joaquin Valley types, but is of appreciably higher sulphur content than is either of the two. However, stocks from the different Southern California fields differ widely among themselves in gravity, gasoline content, paraffinicity and sulphur content.

Most of the crude oil produced in the California coastal area resembles the lighter group of oils produces in the San Joaquin Valley. However, the coastal area also produces considerable oil of markedly different types, such as the high-sulphur low-gravity Santa Maria Valley crude oil.

The paper gives results on the gravity, viscosity, sulphur content, paraffinicity, and cracking of these crudes.

A. H. N.

Gas.

331.* Alternative and Auxiliary Fuels from Liquefied Petroleum Gases. G. Segeler. *Oil Gas J.*, 23.10.41, **40** (24), 41.—There are now 173 communities in the U.S. which are provided exclusively with some form of liquefied petroleum gas (l.p.g.) service. In addition, about 25 gas utility companies are using l.p.g. for alternative, emergency, or supplementary supplies.

The successful interchange of l.p.g. with manufactured gas, so that either gives satisfactory results in existing burner equipment, demands that l.p.g. shall be suitably adjusted as regards (a) air requirements for combustion, (b) calorific value, (c) density (which affects the rate of flow through jets, etc.), and (d) ignition and burning characteristics.

The methods which may be used to ensure that these requirements are fulfilled are discussed, and it is shown that in the case of propane, a fair compromise may be obtained by mixing with a "carrier gas."

The carrier gases which have been suggested and investigated include air, blast-furnace gas, blue gas, coke-oven gas, hydrogen, reformed, cracked, or partially burned natural gas, etc. In general, whilst such mixtures may be compounded to give good burning properties, their calorific values are higher than that of manufactured gas. For this reason, the primary use of l.p.g. by gas utility companies up to now has been enrichment of their product to attain a specified thermal value. C. G. G.

332.* Treating Makes Arkansas Sour Gas Usable by Industry. R. M. Sanford. *Oil Gas J.*, 13.11.41, 40 (27), 32.—During the past two years a number of fields producing large quantities of sour gas have been opened up in South Arkansas. Until recently the McKamie field was considered to produce a gas containing the greatest quantity of H_2S —4250 grains per 100 cub. ft., but the newly opened Patton field yields a gas with more than 9000 grains of H_2S per 100 cub. ft.

Formerly there was little industrial demand for gas in S. Arkansas and most of the production was piped off and flared. However, a number of large plants to be erected under the Government defence project are now prospective consumers of large quantities of sweetened gas in the district and desulphurization has had to be considered.

A 60-day experiment has been carried out with the McKamie gas using the Girbotol process. This is the sourest gas which has yet been considered for commercial use. The results of this test have not yet been fully released, but it has been found that the sulphide content of the gas can be reduced to a point which makes it suitable for commercial and domestic use at a cost estimated to be between $1\frac{1}{2}$ to 2 cents per 1000 cub. ft. processed.

Plans are in hand for the erection of Government plants which would require about 75,000,000 cub. ft. sweet gas/day and it is considered that the State will in due course be able to assure industries a daily supply near 100,000,000 cub. ft. at a price of 4 cents/1000 cub. ft.

Only the McKamie field has reached a definite stage at the moment, but desulphurization plants will be made available for other fields as the demand for sweet gas increases. D. L. S.

Cracking.

333.* New Method for the Determination of Equivalent Cracking Conditions for Commercial Cracking Reactions. S. L. Neppe, *J. Inst. Petrol.*, February 1942, 28 (218), 27–35.—Empirical studies of cracking rates under different temperatures and times are concluded with the following points:

(1) A chart is given showing that a straight-line relationship exists between the factor F , for which velocity of cracking is doubled and the cracking temperature t . The relation can be expressed algebraically as $Ft = 0.04t - 10$.

(2) An equation—

$$\frac{\theta_1}{\theta_2} = \left\{ \frac{0.04t_2 - 10}{0.04t_1 - 10} \right\}^{17.32857}$$

(where θ_1 and θ_2 are the periods of cracking at temperatures t_1 and t_2 , respectively), has been derived from theoretical considerations. This very closely defined the relation between time of cracking and temperature for ordinary commercial cracking under constant pressure for a definite yield of product.

(3) Another chart has been constructed which can be utilized in a most simple manner for converting cracking conditions at any one temperature or period into equivalent cracking conditions at any other specified temperature or period.

A. H. N.

334.* Carburization of Cracking-Still Tubes During Service. C. L. Clark. *Oil Gas J.*, 27.11.41, 40 (29), 69.—Carburization on the inner wall of cracking-still tubes was investigated by a variety of laboratory mechanical tests on tubes made of the following steels: (a) 5 Cr Mo, (b) 7 Cr Mo, (c) an austenitic 18 — 12 + Cb. When carburization was relatively slight it was revealed by the flattening test, since slight deformation caused cracking in a ring section, whilst an adjacent section from which the carburized layer had been removed by machining could be completely flattened without the appearance of defects. A more pronounced degree of carburization may considerably decrease the room-temperature impact resistance and the ductility, but the Charpy impact resistance at 1200° F., a representative metal-operating temperature, does not appear to be influenced detrimentally. It is suggested that carburization occurs on the inner wall, especially at the fire side, much more often than is commonly supposed and that carburized tubes should not be subjected to shock at room temperature, as by a knocking type mechanism for removing coke. J. C.

335.* Reaction Chambers of Thermal Cracking Units. R. C. Mithoff and L. F. Schimansky. *Refiner*, November 1941, 20 (11), 427–431. *Paper Presented before American Petroleum Institute.*—Eight cracking units having a total raw-feed capacity of approximately 90,000 bbl./day have been installed by one company in recent years. The results have been highly satisfactory.

In this paper correlations are presented relating reaction-chamber size with results obtained by the use of these chambers. It is shown that their use increases the severity of cracking of the gas-oil component of the raw-feed, and decreases the severity of cracking of the asphaltic component. This results in production of cracked residuum of lower sediment content and increased viscosity, and of cracked gasoline with increased volatility and higher octane number. Use of chambers also results in increased plant capacity, due to decrease in the heat requirement for cracking, to reduction in tube coking, and to improved furnace conditions.

These advantages result in appreciable decrease in the manufacturing cost of cracked gasoline. It is believed that installation of additional reaction chambers on many of the cracking units in use in the U.S.A. would be advantageous.

The paper gives details regarding the theory of reaction chambers and thus the expected advantages of cracking chambers over the two-coil operation. The method of correlating the results obtained is described and a correlation factor is used which, although not so rigorously accurate from theoretical view-points as other more complicated methods, is believed to be satisfactory from practical considerations.

Plant capacity and economics are briefly outlined, together with the advantages accrued. A. H. N.

336. Patent on Cracking. R. M. Melaven. U.S.P. 2,270,812, 20.1.42. Appl. 31.12.38.—Conversion of heavy hydrocarbon oils into gasoline by vaporising and subjecting the vapours at a temperature between 700 and 1050° F. to the action of a solid, porous contact catalyst consisting essentially of silica gel, the surface of which is coated with a layer of thorium. Afterwards the vapours are cooled and the gasoline recovered from the products. H. B. M.

Hydrogenation.

337. Patents on Hydrogenation. Anglo-Iranian Oil Co. E.P. 542,500, 13.1.42. Appl. 2.4.40. A two-stage continuous process for the conversion of paraffin hydrocarbons into naphthenic or non-aromatic cyclic hydrocarbons. First the hydrocarbons are contacted with chromic oxide or molybdenic oxide at a temperature between 400 and 700° C. to produce a reaction product comprising aromatic hydrocarbons and hydrogen. Then this reaction product is contacted with a hydrogenating catalyst under conditions of temperature and pressure favourable to conversion of the reaction product into naphthenic hydrocarbons.

C. M. Thacker. U.S.P. 2,266,520, 16.12.41. Appl. 27.6.38. Dehydrogenation of paraffinic hydrocarbon gases by contacting at reacting temperatures with a catalyst

consisting of activated alumina, prepared by precipitating the trihydrate of alumina from an aluminate solution and calcining the precipitate at a temperature between 300 and 800° C., and a vanadium-oxygen compound.

V. N. Ipatieff. U.S.P. 2,270,303, 20.1.42. Appl. 25.2.38. Continuous process for the hydrogenation of octenes which comprises subjecting the vapours in admixture with a molal excess of free hydrogen to contact with catalytic material consisting of approximately 62% nickel, 4% oxygen combined in nickel oxide, 6% graphite, and 28% kieselguhr.

H. B. M.

Polymerization and Alkylation.

338.* **Lion Revamps Recovery System . . . to Better Supply Polymerization Unit.** W. T. Ziegenhain. *Oil Gas J.*, 4.12.41, 40 (30), 37.—A vapour-recovery unit and a catalytic-polymerization unit have been placed in operation so that they can work independently or in conjunction. The vapour-recovery plant processes refinery gases, the daily charge averaging 2,000,000 cubic feet, of which 85% is cracking-still gas. The cooled charge, compressed to 105 lb. per sq. in., is scrubbed with oil in the absorbers. The resultant rich oil passes through lean-to-rich oil exchangers and enters a flash drum, where a portion of the light fractions flashes overhead to the stripping still. The flashed rich oil is then further heated before flashing into the still, which is equipped with a reboiler. The lean oil passes through lean-to-rich oil exchangers to an oil cooler, whilst unstabilized light gasoline, the overhead product, is condensed and collected in the stabilizer feed accumulator.

To recover the maximum quantity of C₃ and C₄ unsaturated hydrocarbons for poly-feed stock, some stabilized gasoline is recirculated into the condensed stripping still overhead. Uncondensed gases from the stabilizer-feed accumulator enter a re-absorber to recover propane and butanes not reclaimed in the main absorber. The unstabilized gasoline goes to a conventional stabilizing unit, which yields a light blending material as bottoms, whilst the overhead passes to a Girdler desulphurization unit, where it is mixed with cracked gasoline stabilizer overhead. The combined gases are caustic and water washed, compressed, condensed, and collected as liquid in the poly-feed accumulator. The liquid feed is pumped through a heater into two catalyst chambers in series. The effluent is cooled and flashed into the depropanizer whilst the bottoms product, consisting of poly-gasoline, butane, and some propane is passed to the debutanizer, where commercial butane is produced as overhead. The bottoms product is 12 lb. vapour pressure poly-gasoline with a motor-fuel blending value of 115.

J. C.

339. **Patents on Polymerization and Alkylation.** G. B. Hatch, E. F. Pevere, L. A. Clarke, and F. H. Bruner. U.S.P. 2,267,097, 23.12.41. Appl. 30.8.39. Continuous alkylation of *isoparaffin* hydrocarbons by reaction with olefin hydrocarbons in the presence of a liquid alkylation catalyst of greater density than the hydrocarbons undergoing treatment.

A. R. Goldsby. U.S.P. 2,267,457, 23.12.41. Appl. 4.8.38. Production of alkylated hydrocarbons by the interaction of *isoparaffins* and olefins. The hydrocarbons are reacted with the olefins in contact with strong sulphuric acid at optimum pressure and temperature. As the strength of the sulphuric acid decreases the reaction temperature is increased.

A. V. Grosse and C. B. Linn. U.S.P. 2,267,730, 30.12.41. Appl. 31.12.38. Method of synthesizing hydrocarbons which comprises reacting an *isoparaffin* with an olefin under alkylating conditions and in the presence of an alkylating catalyst consisting essentially of hydrogen fluoride.

F. H. Bruner. U.S.P. 2,269,250, 6.1.42. Appl. 11.5.39. Alkylation of *isoparaffin* hydrocarbons with olefin hydrocarbons including C₄ and C₃ olefins. A hydrocarbon fraction comprising olefins and paraffins having 4 or more carbon atoms per molecule

is subjected to contact with a liquid alkylation catalyst in the presence of an *iso*-paraffin hydrocarbon in a reaction stage maintained under sufficient pressure to keep C_4 hydrocarbons in the liquid phase. A stream of used catalyst is continuously withdrawn and a C_3 and lighter hydrocarbon fraction injected into the stream. In this way olefins are absorbed and non-olefins rejected. Rejected hydrocarbons are removed and the stream containing olefins is returned to the reaction process.

H. B. M.

Synthetic Products.

340.* Synthesis and Properties of Hydrocarbons of High Molecular Weight. J. N. Cosby and L. H. Sutherland. *Refiner*, November 1941, **20** (11), 471-480. *Paper Presented before American Petroleum Institute.*—This paper is a summary of the first 16 months' work on American Petroleum Institute Research Project 42, on the synthesis and properties of hydrocarbons of high molecular weight, at the Pennsylvania State College. The synthesis of these hydrocarbons had as objectives the obtaining of data: (1) To permit conclusions on the effect of chemical structure on physical properties in the higher-molecular-weight ranges. (2) To furnish data on hydrocarbons of high molecular weight of value in identification of hydrocarbons or hydrocarbon mixtures isolated from petroleum. (3) To afford data useful in chemical-engineering calculations on petroleum fractions above gasoline. (4) To provide the industry with reliable methods of preparation and purification of hydrocarbons of high molecular weight which will be useful guides when the need arises for preparing larger quantities of such hydrocarbons.

Twenty-two hydrocarbons ranging in molecular weight from 344 to 450 have been prepared, with a purity of 95% or better. The following physical properties have been determined on each of these hydrocarbons: (1) Kinematic viscosity at 68, 100, 140, and 210° F. (2) Kinematic viscosity index by the Dean and Davis method. (3) Density at 68, 100, 140, and 210° F.; gravity, in °A.P.I., calculated. (4) Melting point taken from melting curve. (5) Boiling points from vapour-pressure curve over the range 0.5 mm. to 5.0 mm. (6) Heat of vaporization, calculated for the range 0.5-5.0-mm. pressure. (7) Refractive index at 20, 30, and 40° C. (8) Specific refraction, calculated at 20° C. (9) Mean and specific dispersion at 20° C. Measurements of other physical properties are in progress.

Several generalizations have been pointed out in the relation of physical properties to structure. Application of the data presented in this paper has been made in checking the work of Kurtz on molecular volume.

A. H. N.

Refining and Refinery Plant.

341.* Evaluation of Granular Adsorbents for Petroleum Refining. O. FitzSimons, R. C. Amero and R. G. Capell. *Nat. Petrol. News*, 29.10.41, **33** (44), R. 339.—The test procedure consists of screening the adsorbent to a standard size, heat-activating it under standardized conditions, and packing it into a column which provides for temperature and oil-throughput rate control. Efficiency is adjudged by a colour measurement of the contacted oil, a criterion being supplied by a standard reference clay. In the article, tabulated results are discussed in terms of particle size, activation, and filter-bed depth of the clay and rate of percolation of the oil.

H. G.

342.* Greater Use of Coal in Refineries. Anon. *Nat. Petrol. News*, 29.10.41, **33** (44), R. 346.—A questionnaire has been circulated to a sample of refineries and seeks pertinent information concerning the extent to which coal or coke is used as under-boiler fuel and with a view to indicating the future tendency as between these fuels and oil or gas. There are no indications that the demands of the petroleum industry will cause a coal shortage. The use of coal appears to be an expedient, the desiderata being mainly economic. Coal has replaced gas largely because of those demands for gas which show a greater financial gain.

H. G.

343.* New Lubricating Oil-Decolorizing and Clay-Reactivating Process. W. B. Chenault and A. E. Miller. *Nat. Petrol. News*, 26.11.41, **33** (48), R. 374.—The process consists of continuously decolorising lubricating oil with clay and the continuous recovery of the clay by extraction with suitable solvents. "Magnesol" is the clay used and the colour solvent is a mixture of 45% acetone and 55% naphtha. Contacting is carried out at a temperature of 400–415° F. (furnace outlet temperature). The charging stock has been Pennsylvanian neutrals and raffinate on which an average clay life of 1030 brl. per ton has resulted. H. G.

344.* Increasing Capacity from Old Oil Heaters in Refineries. R. Reed. *Oil Gas J.*, 23.10.41, **40** (24), 34.—The rate of heat transfer in old tubular type heaters may be increased either by increasing the tube surface or by modifying the combustion conditions in the heater. Generally, the former operation is both difficult and expensive, but many of the older heaters leave room for considerable improvement in combustion conditions.

In recent years, the average heat release in such heaters has risen from about 10,000 B.Th.U. per cu. ft. of combustion space to about 18,000 B.Th.U. per cu. ft., partly as a result of more efficient burner design. By replacing older burners with modern units giving efficient flaring and low discharge velocity, more efficient circulation is obtained over the tube bank in the radiant portion of the furnace.

The amount of excess air supplied to the burner plays an important part in the performance of the heater. Reducing this excess to the lowest possible amount results in higher combustion temperature and in lower heat loss up the stack.

Cases are cited where improvements of up to 100% in operating rates have been obtained by applying these principles to old heaters. C. G. G.

345.* Hot Clay Treatment for Removal of Sulphur from Gasoline. H. Bottomley. *Nat. Pet. News*, 15.10.41, **33** (42), R. 330.—A method for the desulphurization of gasoline is described and compared in results with other refinery methods. As a preliminary to this study the author tabulates the sulphur content of various crude oils and gasolines from U.S.A. fields. A list is given of the various possible methods: (1) multi-stage caustic wash, (2) solutizer treatment, (3) caustic-methanol extraction, (4) hot clay treatment and its variations, and (5) sulphuric acid treatment. The five methods are compared and results are tabulated. A. H. N.

346.* Designing Insulation for Hot Refinery Lines. R. G. Lovell. *Petrol. Eng.*, October 1941, **13** (1), 23.—Efficient heat insulation of steam lines and hot oil lines is considered from the commercial point of view. A comprehensive chart is presented to enable refiners to deduce the economical thickness of insulation in relation to various factors, such as the value of the heat in dollars, the hours of operation per year, the temperature difference, the cost and conductivity of the insulation, the shape of the surface, and the per cent. annual fixed charges.

Whilst heating liquids by direct steam injection is impracticable for most refinery purposes the method of calculating the quantity of steam required is shown by a worked example.

Heating liquids by steam coils is, however, a method of great importance in refineries and, since the maintenance of a high temperature differential is necessary for rapid heat transfer, it follows that the heated stock adjacent to the transfer system must be instantly replaced with cooler stock. Therefore, to increase efficiency of heat transfer it is necessary to circulate the liquid and it is shown that, because of its lower specific heat, oil must be circulated more rapidly than water. Charts giving B.Th.U. loss per sq. ft. of pipe surface from copper, brass and iron pipe and quantity of steam condensed per sq. ft. of pipe surface per hour enable various problems to be solved and examples are provided.

The article concludes with a brief discussion of the relative merits of saturated *vs.* superheated steam for heat transfer. J. C.

347.* Gas Purification Plant in Magnolia Field, Arkansas. F. H. Love. *Petrol. Engr.*, November 1941, **13** (2), 31.—A description, with a flow diagram, of the Lion Oil Co.'s

plant for the removal of hydrogen sulphide and carbon dioxide from natural gas by the Girbotol process. The gas stream, at 150 lb. pressure and 100° F., enters the bottom of the absorber tower, passes upwards through Raschig rings, and is contacted by a solution of diethanolamine flowing counter-currently. The desulphurized gas is used for fuel, whilst the used diethanolamine flows from the base of the absorber to the bubble-tray reactivator tower, from which the stripped reagent returns to the absorber, the cycle being continuous. The installation, patented by the Girdler Corporation, provides for the treatment of 15 million cu. ft. of natural gas daily.

J. C.

348.* Details of New Refinery Installation on Louisiana's Gulf Coast. H. L. Flood. *Petrol. Engr.*, November 1941, 13 (2), 34.—The new Lake Charles Refinery of the Continental Oil Co., described as a "combination topping, cracking, gas reversion, thermal polymerization, and alkylation unit" is one of the most important single additions to Gulf Coast refining capacity and is said to be one of the most efficient plants ever constructed. It is claimed that practically every hydrocarbon is utilized in the integrated processing of the combination charge of 10,000 bbl. of crude oil and 6000 bbl. of 70 lb. P.B.C. (propane-butane-casing-head) daily. The plant is complicated, including much recycling, and the description is amplified with a flow diagram, photographs and tables.

Crude Oil Processing.—The crude is pumped through a series of heat exchangers, passes to the 3-coil furnace and thence to the crude tower. The products from the crude tower, after suitable treatment and stripping, etc., are gasoline, naphtha, kerosine, and diesel fuel, whilst the topped crude from the base of the tower goes to the viscosity-breaker accumulator in the evaporator tower. There it is joined by heavy recycle and is transferred to the viscosity-breaker coil in the 3-coil furnace. The resulting cracked oils join the output of the gas-oil coil, the mixed stream passing to the soaking drum, where additional time is provided for the cracking reaction. The cracked stock goes to the evaporator, which may be regarded as the utility vessel of the plant, dealing with a variety of stocks, including (1) the mixture of gas-oils from the viscosity-breaker coil and from the gas-oil coil, (2) the output of the reversion equipment, (3) polymer gasoline from the partial stabilizer, (4) polymers removed from cracked gasoline. The evaporator separates a marketable fuel oil and cleans the stock used to charge the gas-oil coil in the 3-coil furnace. The latter stock goes to the bubble-tower, the overhead from which is cracked gasoline, which is clay-treated and then goes to the after-fractionator tower, where polymers and heavy ends are removed. The polymer-free cracked gasoline passes through the high-pressure gas separator and the cracked-gasoline debutanizer tower and is then blended with *n*-butane by means of a ratio-controller. It is washed with caustic, copper-treated and is then ready for blending to produce motor-grade gasoline.

The gas from the high-pressure separator, etc., goes to the absorber tower where it is treated with gas-oil taken from the stripping tower.

The bottoms from the bubble-tower constitutes clean stock for the gas-oil coil in the 3-coil furnace, after passing through which it joins the output of the viscosity-breaker coil and goes to the soaker drum.

From a "boot" on the side of the bubble-tower gas-oil is taken for a variety of uses including reboiling, refluxing, and absorption.

Casinghead Stabilization.—The P.B.C. enters the casing-head stabilizer tower to be stabilized to a natural gasoline, the properties of which are varied according to market requirements and which is pumped to storage without sweetening. The overhead, consisting mainly of propane, butane, and isobutane, goes to the depropanizer feed-drum, which also receives hydrocarbons resulting from cracking operations.

Polymerization Plant.—The mixed charge from the depropanizer feed-drum goes to the depropanizer tower and the overhead, propane, joins butane from the alkylate debutanizer as charging stock for the thermal polymerization furnace. From the furnace the stock goes via exchangers and reboilers to the partial stabilizer, the overhead from which consists of non-polymerized propane and butane which is recycled. Polymer distillate from the base of the partial stabilizer goes to the evaporator for cleaning.

Alkylation Plant.—The bottoms from the depropanizer tower are pumped to the combination alkylate reactor and acid settler, where the material is intimately mixed

with 98% sulphuric acid. The reactor effluent is neutralized with caustic, water washed, and then goes to the isobutane tower, which removes isobutane to be returned as recycle to the system. The bottoms go to the alkylate debutanizer, where butane is removed to be utilized as fuel, as charging stock for the poly furnace and for blending with cracked gasoline. The debutanizer bottoms are fractionated into light and heavy alkylates, the latter being further fractionated in the after-fractionator tower, the heaviest fraction becoming cracking stock.

General.—The article includes a short description of the methods adopted for water, steam, power production, and water disposal, and also a discussion of yields.

An interesting feature of boiler operation is the installation of automatic equipment controlling the speed of the motors driving the stack draught fans. Change in volume of fuel is reflected in the draught, which gives uniformly high combustion efficiency automatically. J. C.

349.* Combating Organic Fouling of Cooling Water Circuits. F. J. Matthew. *Petrol. Times*, 27.12.41, 45 (1159), 752.—Cooling water systems offer practically an ideal medium for the development of algæ, protozoa, and other micro-organisms. These form slimes and accumulations in the system necessitating periodic shut-downs for cleaning.

It has been found that this trouble can be prevented by dosing the water with small amounts of chlorine gas.

A new method of treatment has now been developed whereby a reagent—sodium pentachlorophenate—is added to the water in the form of briquettes which slowly dissolve. This reagent is highly toxic to these organisms, the amount necessary to kill varying from 5 to 30 p.p.m. It is stable, non-volatile, freely soluble in water, and non-corrosive to the usual industrial metals in the concentrations used. Systems already fouled can be cleansed by maintaining a concentration of about 30 p.p.m. for 10 to 15 days and can then be maintained in a clean condition by a lower concentration.

The application of sodium pentachlorophenate requires no complicated equipment, the briquette being placed in wire baskets hung in the circulating water stream or alternatively bags of the material may be immersed in the water. The operating cost is low, amounting in several large industrial systems to 3s. 4d. per week per million gallons water.

The compound is not highly toxic to man in the concentrations used, but it is recommended that water so treated should not be used for drinking or bathing purposes.

D. L. S.

350.* Naphtha Treating. C. F. Mason, R. D. Bent, and J. H. McCullough. *Refiner*, November 1941, 20 (11), 432–435. *Paper Presented before American Petroleum Institute.*—The method of caustic-methanol treatment of naphtha is discussed. This process removes essentially all mercaptans from sour gasolines by extracting them with only 2% of strong caustic and a suitable quantity of methanol. The spent reagent is regenerated by steam-stripping and fractionation, and can be used indefinitely for mercaptan extraction.

The paper presents pilot-plant studies of the extraction and regeneration steps. Data are given on reagent losses, utility consumption, control of the stability characteristics of the finished gasoline, and improvement in octane number and lead susceptibility over the untreated gasoline. The increase in leaded octane numbers of the treated products usually will offer an attractive saving in lead additions. The process is ready for full-scale application. Several large plants are under way.

The economics of the process are discussed and it is stated, on the basis of certain data, that manufacturing cost of approximately 1.0 cent./bbl. of naphtha, including reagent loss, is reached. From the standpoint of lead susceptibility and octane number, the previously mentioned data show that, in the average application, at least 0.25 ml. of tetraethyl lead/gall. of gasoline can be taken as a credit and, in many cases, a considerably higher figure will be obtained.

From the plant-investment cost angle, precise figures are difficult to give, due to variations arising as a result of differences in capacities and local conditions. It is believed that, for a plant of reasonable size—say 5000 bbl./day—the investment will range from \$8 to \$2/bbl./day.

A strong plea is made to discard the doctor test on the basis that at various times

during the experimental programme the product from the caustic-methanol plant has run slightly "off doctor" for long periods of time, and yet the actual mercaptan content of the gasoline was lower than the "OK doctor" product from the doctor-treating plant running on the same stock and alongside it. A. H. N.

351.* Precise Commercial Fractionation in 1000-Barrel Stedman Unit. L. B. Bragg and F. Morton. *Refiner*, November 1941, **20** (11), 457-461. *Paper Presented before American Petroleum Institute.*—The paper describes the design and operation of a commercial fractionation unit (1000 bbl./day) utilizing Stedman packing. The tower is packed with Stedman packing having a cross-sectional area of 78.5 sq. ft. and a packed height of 7 ft. Full details of the design are given, with flow sheet and photographs. Three different types of operation are described.

(A) Fractionation of a straight-run gasoline into seven narrow-boiling fractions, a composite slop fraction, and a still residue. Two of these fractions which contain, respectively, substantially pure *n*-hexane and *n*-heptane and the residue may be isomerized, cyclized or reformed. The other fractions, containing substantially all the isoparaffins, naphthenes, and aromatics, and the *n*-pentane may be variously rebleded to give high-octane-rating complementary spirits suitable for blending with *iso*-octane or alkylates to give 100 + aviation fuels.

(B) Fractionation of special fractions—the example given being the production of a concentrate of isomeric hexanes from a low-octane-rating gasoline, the fraction so obtained having a leaded octane rating of greater than 100.

(C) Fractionation of a narrow-boiling sidestream from conventional topping unit (boiling range 210° to 250° F.) to give substantially pure toluene.

The operations described indicate the commercial feasibility of large-diameter columns packed with Stedman packing, and show that narrow-boiling fractions can be obtained with a high degree of separation. For specific fractions, such as the production of substantially pure hydrocarbons, it will be necessary to use a greater packed height than has been used in the operations under discussion.

As has been indicated the batch Stedman unit offers the possibility of making a large number of cuts from a single charging stock, with good control and exact fractionation, even with varying feed composition. The present state of the art of controlling continuous bubble-tray batteries does not permit satisfactory operation to meet such requirements. In addition, batch operation permits one to take advantage of the possibility of using reduced reflux ratios in the early stages of the run, thereby reducing utility consumption and the size of the tower, condenser, and heating coils. Batch operation permits wide flexibility in the operation of the unit such as may be required to meet changing market demands.

Stedman packing is also particularly suitable for use: (a) in continuous-distillation units, with charging stock of substantially constant composition; (b) when a large number of theoretical plates is required; (c) when a low friction loss per theoretical plate is necessary; and (d) when moderate to high efficiency columns of small diameter are desired. A. H. N.

352.* Turbines for Power Generation From Industrial Process Gases. J. Goldsbury and J. R. Henderson. *Refiner*, December 1941, **20** (12), 505-514. *Paper presented before American Society of Mechanical Engineers.*—The use of turbines driven by process gases in order to conserve power and to cool gases economically is advocated. The most important development so far in the use of turbines driven by industrial process gases other than steam is found in connection with certain catalytic petroleum refining processes. In these processes carbon is deposited on the catalyst. The carbon must be burned off and the catalyst regenerated at frequent intervals. In several of these processes it is apparently most effective and economical to burn off the carbon under pressure. In some cases the pressure is as high as 300 lb. and much higher pressures have been proposed. Several catalyst retorts are frequently used so that one or more can be undergoing the regeneration processes continuously. The maximum regeneration temperature is controlled either by tubes through which a coolant is passed or by recirculation of some of the products of combustion which have passed through a waste-heat boiler or by other suitable means. There is, then, a steady flow of these products of combustion or flue gas which is of no further use to the process. The heat

could, of course, be partially recovered in a waste-heat boiler or other type of heat exchanger, but the pressure potential would be largely wasted. The pressure potential can be utilized and a large portion of the heat removed by passing the gas through a turbine.

A 3500 h.p. flue-gas turbine is studied briefly and the method of governing its speed is explained. Similarly, a flue-gas turbine working in conjunction with a steam turbine, both being controlled by one governor, is discussed. A special detailed study is made of natural gas as elastic fluid for turbine purposes. Methods for calculating available energy for different pressure drops in complex mixture of gases are explained in full details. P - V - T and k data are collected from the literature and reproduced here.

It is pointed out that certain processes may be improved or operated more economically by the installation of turbines to derive power from the expansion of gases the energy of which might otherwise be wasted or inefficiently used. In some cases the reduction in temperature resulting from expansion through a turbine may be more important than the power obtained. By expanding gases through turbines rather than wastefully through valves and small pipe-lines, power can often be derived which will replace power derived from the burning of fuel and thus help to conserve fuel. A. H. N.

353.* Straight-Line Fractionation. Anon. *Refiner*, December 1941, **20** (12), 530-531.—Fractionation and treating are combined in one series of operations in the plant described. Five columns following the steam distillation equipment are operated to de-ethanize and remove hydrogen sulphide, manufacture and dry propane, separate isobutane from normal butane and produce natural gasoline to specifications. Immediately following the column employed for removing ethane and reducing hydrogen sulphide content is a caustic contactor to complete the removal of H_2S . A horizontal caustic settler is next in line followed by a vertical vessel filled with standard grades of sand to dry the gasoline and prevent passage of entrained treating solution to the sweetener. The sweetener is the type which makes use of cupric chloride carried in a bed of fuller's earth to convert the mercaptans to disulphides. The gasoline-treating system is stepped into the straight-line process following the de-ethanizing column, so that the gross product is sweetened in a single operation instead of treating each product separately.

Certain details of the plant and products are given.

A. H. N.

354.* Water and Chemicals Accomplish Salt Removal. Anon. *Refiner*, December 1941, **20** (12), 535-536.—The major portion of salt content, 70 lb./1000 brl., are removed by this system. The first step is the introduction of 6% by volume of fresh cold water through a mixing nozzle so as to form an emulsion. Then a treating chemical is introduced after the charge takes its first preheat by exchange. After a second preheat by exchange the raw charge passes to a desalting drum. The combination reduces salt content to around 7 lb./1000 brl.

Fresh water is introduced at the suction of the reciprocating charge pump and is metered for accuracy. After gaining the contact provided by a special mixing nozzle, the charge goes to the first of three heat-exchanger units, where sufficient heat is provided to permit chemical action and the emulsion-breaking agent is introduced at this point.

In the second topped-crude-to-charge-stock heat exchanger, temperature is raised to around 300°, after which the oil, water, and chemical enter the horizontal desalting drum, 6 ft. in diameter and 43 ft. long, where the water is drawn off and the oil continues through the topping plant.

This vessel is mounted on concrete piers with one end 30 in. higher than the other. The charge enters the drum at the top of the shell at the low end, passing to the interior through a perforated line extended along the bottom for 16 ft. Baffles are used inside the drum to bring about complete separation of the aqueous solution from the oil. Tell-tale cocks at the lower end of the drum are used to determine the water level, which is controlled by bleeding to disposal lines continuously.

Other details are given.

A. H. N.

355.* Continental Plant Designed for Flexible Operation. Anon. *Refiner*, January 1942, **21** (1), 1-8.—Outstanding features of this unit are: a close integration of crude

distillation, visbreaking, gas-oil cracking, naphtha reversion, clay treating, debutanization, thermal polymerization, catalytic alkylation, ability of portions of the unit to function when other parts are not operating, centralized control of entire unit, manufacture of high-octane gasoline, including aviation alkylate, from field gases, and ability to produce a wide variety of products by change of operating conditions.

The Lake Charles plant was designed to charge Ville Platte crude, a low-sulphur oil containing 35 to 40% of 400 end-point gasoline, although Tepehate crude is also being processed. Alternate design conditions called for (1) charging 7000 bbl./day of crude and about 6100 bbl. of 70-lb. R.V.P. field casing-head, or (2) 10,000 bbl. of crude and 6100 bbl. of raw casing-head. Specified yields were set for either condition. In general, operation has coincided closely with design conditions both as to yields and quality of products. In addition the unit has been producing alkylate.

Both the Ville Platte and Tepehate crudes are stabilized in the fields by removal of propane and some of the butanes. Gases lighter than these also are removed and used for pressure maintenance of the oil sands. Propane and butanes are blended with natural gasoline and the blend is carried by pipe-line to the refinery. The crudes are also piped in. A desirable characteristic of these feed stocks is that they are relatively free of sulphur. This made practicable limited use of alloy steels.

Operation of the unit consists of four fundamental steps: crude distillation, cracking (including reversion), thermal polymerization, and sulphuric-acid alkylation. The entire unit need not be operating at any given time, a fact of importance when some portion needs to be shut down for cleaning or repairs. The cracking system, of course, can run alone as long as the crude system is functioning. The casing-head stabilizer can run alone. The alkylation system can operate if the cracking system is on stream. The polymerization system can run if aided only by the casing-head stabilizer. The four steps are described in some detail. The design and construction of the plant is also discussed.

A feature of the unit is the economical manner in which steam is used. The refinery steam is generated in two 1100-h.p. boilers producing 350-lb. steam and provided with stack draft blowers automatically regulated to vary in speed according to the boiler load. Three turbines, one driving the 4-stage centrifugal charging the visbreaker coil, another driving the 6-stage centrifugal charging the gas oil cracking coil, and the third driving a horizontal triplex power pump charging the polymerization furnace, take 350 lb. steam and exhaust to 150 lb. A portion of this exhaust is used in the crude system, evaporator, and bubble-tower as stripping steam. The remainder enters a superheater and emerges still at 150 lb. Part of this superheated steam is used in six reboilers. The rest drives the circulating pumps, with the exception of those with motor drives. These circulating pumps exhaust 15 lb. steam. Some of this steam is used in the refinery feed-water heater and the remainder goes to two reboilers. Part of the condensate from the 8 above-mentioned reboilers is used in the steam superheater and the rest returns to the boilers.

A. H. N.

356.* Role of Blending in the Production of Aviation Motor Fuel. E. S. Bissell. *Refiner*, January 1942, **21** (1), 9-15.—Blending by means of pump recirculation utilizing swing lines, pipe spiders, venturies, or a combination of these is discussed and illustrated. It has been found that the average overall efficiency ratio between an in-tank propeller-type mixer and the method of pump recirculation, is approximately 10 to 1. In other words, an efficient pump recirculation system will require 10-h.p. hours to 1-h.p. hour of the propeller-type mixer. The method of comparison is detailed.

In general, a propeller-type in-tank mixer when compared with a pump, is not called upon to overcome head losses, pipe friction, and casing friction. There is no violent change in direction in the propeller-type mixer, as the feeding is done from a large area back of the propeller and in all directions radiating from the axis. The entire energy at the propeller is imparted directly to the liquid, and since there is no pipe friction or casing losses, all of this energy is turned into mixing effort. The stream leaving the propeller is not a uniform stream flow such as leaving a nozzle or pipe, with all components moving in a forward direction, at the same velocity. A three-bladed propeller creates three helical paths for the liquid which moves forward at an average forward stream velocity, which can be approximated by multiplying the pitch of the propeller

times its r.p.m. times 70%. Particles in this stream, however, are also revolving in a spiral or helical path at a speed derived from the point on the blade from which discharge at the tip of the blades; the velocity of these components approaches the peripheral speed of the propeller, which is simply the circumference of the propeller times the r.p.m.

The following factors of the propeller-type in-tank mixer account for its high overall efficiency. First, the displaced stream is of large volume, insuring that the entire contents of the tank will be displaced or moved through the zone of high local turbulence at the propeller within a short time. Low per cent. components are rapidly dispersed when introduced into the tank near the propeller. Second, the stream velocity is sufficient to insure displacing additional volumes of liquid by its momentum in all parts of the tank. Third, the helical or spiral path induced at the propeller maintains itself throughout the tank (velocity decreases as distance from propeller increases), once the contents have been set in motion and initial inertia has been overcome. The existence of these local swirls in different parts of the tank is exhibited through the study of the phenomenon by high-speed photography and through the use of the stroboscope, as well as visual observation in the suspension of light solids. These swirls are not to be confused with a general around-and-around motion of the entire contents, but are of short duration and local existence, their size being directly proportional to the size of the propeller.

The position of the propeller and methods of installation as well as costs and losses are detailed.

A. H. N.

357.* Tube Corrosion Held to a Minimum by Continuous Check on Dehydrator Water pH. J. S. Pfarr and H. A. Blackstone. *Refiner*, January 1942, **21** (1), 16-18.—At the plant in question corrosion arose mainly from the release of hydrochloric acid which, unless neutralized, attacked tubes and linings. By incorporating a pH measuring and recording system a check was maintained on corrosion with the result that a 10,000 brl./day combination skimming and cracking unit could be run for 218 days without corrosion of tubes. The principles involved as well as the installation of the system are discussed.

A. H. N.

358.* Fundamentals of Refinery Piping Design. Part 1. A Cibulka. *Refiner*, January 1942, **21** (1), 19-27.—The stresses involved on heating pipes which are not allowed to expand are studied. These stresses are found to be high. Standard 12-in. pipe with a metal area of 15.71 sq. in. when heated only 100° F. produces a force of 150 tons. This force is the same, whether the pipe is 1 in. or 1 mile long. The elongation only varies directly with the length, but the force does not.

The coefficient of expansion is not a constant; with most materials it increases with temperature, while the modulus of elasticity usually decreases with the temperature. These facts must not be overlooked when calculating the total expansion and the forces produced.

The temperature change t produces in every square inch of cross-sectional area (if restricted) a force P given by the formula $P = \epsilon t E$. Where E = modulus of elasticity of material (in lb./sq. in.). E for steel 29 to 30,000,000 (steels for cables vary between 20 to 32). Monel metal 25,000,000; copper rolled 17,000,000; copper case-hard 12,000,000; brass 10 to 13,000,000; aluminium 10,000,000; lead 1,000,000; glass 10 to 11,000,000.

ϵ = coefficient of linear expansion: steel at atmospheric temperature 0.0000065; copper at atmospheric temperature 0.0000177; bronze at atmospheric temperature 0.0000181; brass at atmospheric temperature 0.0000187 to 205; Admiralty at atmospheric temperature 0.0000202; Muntz at atmospheric temperature 0.0000208; aluminium at atmospheric temperature 0.0000122; lead at atmospheric temperature 0.0000163; glass at atmospheric temperature 0.000004 to 0.000006; KA2 at atmospheric temperature 0.0000089.

A complete solution of a typical problem is given where a statically indeterminate structure was involved.

A. H. N.

359.* Increase in Refinery Power Requirements. R. Haldane. *Refiner*, January 1942, **21** (1), 28-30. *Paper Presented before Petroleum Electric Power Association.*—The paper discusses the effect of the increase in defence products on the power requirements of refineries in the U.S.A.

A. H. N.

360. Patents on Refining and Refinery Plant. Refiners Ltd. E.P. 542,134, 29.12.41. Appl., 18.6.40. Refining of oils and spirits such as petrols, cracked spirits, naphthas, kerosenes, benzoles, and low temperature distillation spirits. The oils are treated with a catalyst obtained by the reaction of trihalogeno derivatives of elements of Group 111b of the Periodic Table with phenols. In this way the olefinic constituents of the oil or spirit are polymerized.

C. L. Walsh. E.P. 542,605, 19.1.42. Appl. 18.6.40. Treatment of viscous liquids such as dirty mineral or vegetable oils which, owing to their viscosity, are difficult to filter rapidly by ordinary methods. A colloidal gelatinous precipitate is formed in the liquid in the presence of finely divided magnetic material, so that suspended matter and the magnetic material are both entrained in and deposited with the colloidal substance. Afterwards the whole of the deposited material owing to the presence within it of the magnetic material is completely or substantially separated from the liquid by means of a magnetic separator.

T. O. Edwards and O. Larsen. U.S.P. 2,266,359, 16.12.41. Appl. 9.5.38. Method of treating petroleum oils which comprises contacting hydrocarbon oil containing acidic compounds with an alkali in the presence of water at a temperature between 200 and 500° F. Afterwards the contacted oil is fractionally distilled to remove not less than 97% as distillates, and a relatively low boiling fraction substantially free from acidic bodies is recovered from the distillation, together with an intermediate fraction containing acidic bodies and a bottoms fraction comprising 0.2-3.0% of the original charge.

L. D. Jones. U.S.P. 2,266,553, 16.12.41. Appl. 2.12.38. Method of dewaxing a mixture which consists of precipitated wax in an oil solution consisting of oil and a solvent of such character, and present in such amount, as to make said oil solution of lower specific gravity than the wax.

L. D. Jones. U.S.P. 2,266,554, 16.12.41. Appl. 11.7.39. Method of dewaxing a mixture consisting of an oil solution containing precipitated wax of higher specific gravity than the oil solution. The solution is passed to a centrifugal rotor and the wax stratified from the solution in a zone of the rotor free of stratifying discs to form a plastic wax stratum lying entirely within the unobstructed zone. A stratum of spacing liquid is maintained between the wax and the inner circumferential wall of the rotor. The oil solution from which the wax has been removed is then passed inwardly to a disc-bloc zone of the rotor and subjected to further centrifuging to remove residual wax. The oil solution is continuously discharged from the rotor; also the wax continuously and separately discharged from the wax stratum.

A. R. Goldsby. U.S.P. 2,267,458, 23.12.41. Appl. 18.8.38. Method of refining hydrocarbon oils containing objectionable sulphur, colour, and gum-forming compounds by subjecting them to treatment with used sulphuric acid which has been obtained from the alkylation of isoparaffins with olefins in the presence of strong sulphuric acid. In this way objectionable compounds are substantially removed.

A. E. Catanach and E. Kolthoff. U.S.P. 2,269,647, 13.1.42. Appl. 15.1.40. Process for neutralising an acid-treated oil of the lubricating type, derived from a petroleum distillate of high neutralization number. A caustic soda solution is used substantially to neutralize the mineral acidity of the oil without neutralizing the organic acidity. Thereafter the partially neutralized oil is treated with a rosin soap solution to settle out mineral salts and soaps. Finally the organic acidity of the oil is neutralized with caustic soda solution.

M. C. K. Jones. U.S.P. 2,270,058, 13.1.42. Appl. 15.5.40. Treatment of mineral oils containing objectionable sulphur compounds with an alkali metal aluminium silicate of the zeolite type at a pressure above 75 lb. per sq. in. and a temperature above 600° F.

W. L. Benedict and C. G. Dryer. U.S.P. 2,270,248, 20.1.42. Appl. 28.7.39. Method of sweetening sour hydrocarbon distillates by treating with an aqueous hydrogen halide solution and afterwards separating the distillate from the solution and treating the former with a sweetening agent containing combined copper and a combined halogen.

C. D. Lowry. U.S.P. 2,270,322, 20.1.42. Appl. 31.5.39. Treatment of sour hydrocarbon distillate with plumbite solution to convert mercaptans to lead mercaptides. Thereafter unconsumed plumbite solution is separated from the distillate and additional sour distillate combined with the latter. Sulphur is then added to the mixture to convert the lead mercaptides to lead sulphide. Finally the mixed distillates are washed with water to separate the lead sulphide.

S. E. Campbell. U.S.P. 2,270,411, 20.1.42. Appl. 26.1.39. Process for desalting oil which comprises agitating a petroleum oil containing particles of salt with a saline solution partly to dissolve the salt, and passing the mixture through a body of contact material substantially to dissolve the solid salt in the saline solution. The solution and the oil are separated immediately afterwards. H. B. M.

Analysis and Testing.

361.* Spectrophotometric Characterization of Lubricating Oils. C. R. Johnson and E. A. Garcia. *Refiner*, December 1941, **20** (12), 520-521.—A report is given in which the apparatus and procedure proposed for spectrophotometric characterization of lubricating oils are described in some detail, together with results already obtained. It is concluded that the colour of an oil may thus be specified by its percentage transmittance T of 30 millimicron bands of light of average wave-lengths, relative to Squibb's clear heavy Californian mineral oil as a reference liquid, in square cuvettes 1.303 cm. in depth, at a temperature of about 25° C. The transmittances may be measured rapidly with the same sample of oil and reference liquid used in determining the spectral number, by the usual direct procedure. Transmittances measured with cuvettes of any depth l cm. reasonably close to 1.303 cm. may be calculated to the standard transmittances defined above, by use of the Lambert law relation: T

standard = $100 \left(\frac{T_l}{100} \right)^{\frac{1.303}{l}}$. A special slide-rule is available for this calculation.

The method has been related to other methods of colour description through the A.S.T.M. colour numbers of two sets of oils. A. H. N.

Motor Fuels.

362.* Sulphur Compounds in Petroleum and its Distillates. H. Bottomley. *Oil Gas J.*, 23.10.41, **40** (24), 37.—In order to study the effect of sulphur compounds on the T.E.L. response of gasolines, various blends of a sulphur-free gasoline with pure organic sulphides, disulphides, and mercaptans were prepared and examined, with special reference to octane number and T.E.L. response.

It is shown that the first small increment of added sulphur (0.01% wt.) affects the octane number to the greatest degree, and that five times this amount causes little further reduction in the octane number. The depressing action on the T.E.L. response, however, continues up to 0.05% sulphur, beyond which the investigation did not go.

Five methods used for desulphurizing gasoline are discussed, and the results of an experimental investigation of four of these methods are tabulated, showing the physical and chemical properties, with T.E.L. responses, of a West Texas straight-run gasoline before and after the various treatments. C. G. G.

363.* Refiners Fear Post-War Effects of 100 Octane Expansion. J. P. O'Donnell. *Oil Gas J.*, 13.11.41, **40** (27), 15.—Plans are in hand for the production of 120,000 bbl. of 100 octane motor fuel daily in 1943-44. Conclusion of the war will be accompanied by an immediate decline in the demand for aviation spirit and the effect of the release of a great quantity of high grade motor fuel is causing some concern to certain refiners.

This concern is based on the belief that car manufacturers may produce automobiles that will be able to take advantage of the better fuels which may then be available and

that this may place a great burden on the producers of such fuel. The author believes that compression ratios will in fact continue to increase, but judging from the rate of increase over the past 14 years he believes that this will continue to be gradual and will not leap from the present 6.66 to the figure of 8—a satisfactory figure for 95 O.N. fuel.

It is pointed out that commercial aviation will probably demand much of the available 100 O.N. fuel after the war. In any case, a large increase in the production of this grade of gasoline would create a great demand for butane which could not be produced without lowering the O.N. of the gasoline supplied to the public. Again a shortage of anti-knock blending agents is a possibility.

All these facts indicate that little if any 100 octane fuel is likely to be available for the motoring public for some time after the end of the war.

D. L. S.

364.* Improved Motor Fuels through Selective Blending. C. R. Wagner, W. B. Ross, L. M. Henderson, and T. H. Risk. *Refiner*, November 1941, 20 (11), 436-448. *Paper Presented before American Petroleum Institute.*—This long paper, which is given in 4 parts, is a report of the progress that has been made in a programme begun in 1938 to investigate the effect of the chemical composition of fuels on the road anti-knock performance and road lead susceptibility of these fuels. The data presented are based on the results of road tests of some 284 special fuel blends and approximately 200 commercial gasolines in 25 different cars. The border-line road-knock testing method was used throughout these tests, as it seemed best adapted to a study of fuels in accordance with the arbitrary definition of the "ideal" fuel set up at the start of the investigation. As defined for the purpose of these tests, an "ideal" fuel is one which will satisfy the anti-knock requirements of any engine in which it is used throughout the engine-speed range, but which will not possess any "wasted" or excessive anti-knock quality at any car speed. The results obtained to date indicate that the fuel which most nearly will satisfy this definition of the "ideal" fuel is one in which the light fractions are composed primarily of olefinic material and the heavy fractions are composed primarily of paraffinic material. Several ways of utilizing this information in the commercial production of motor fuels are suggested. There is, of course, the possibility that some of the newer existing processes, such as catalytic cracking and catalytic reforming, alone or in proper combination, may produce fuels which will meet these requirements with little or no alteration. Changes in refining equipment might entail the addition of a few specialized units to supplement present equipment or the construction of an entirely new plant. Before extensive equipment changes can be justified, the refiner should be sure that the new fuel will be relatively satisfactory for a number of years.

Throughout the work, the consideration of hydrocarbon analysis of a fuel in conjunction with its "motor" and "research" octane values has seemed to offer the best means of correlating road performance with laboratory data. It is shown that all fuels of two series of experiments were cut into either two or three fractions with respect to boiling range, and each fraction analyzed, separately for its content of aromatics, naphthenes, paraffins, and olefins. These tests have shown that any fuel containing large portions of olefinic material throughout the boiling range will tend to knock at high engine speeds, and will have relatively poor lead susceptibility not only in the laboratory, but on the road. A highly sensitive fuel, however, in which the high-boiling olefins have been replaced with heavy paraffins, aromatic, or naphthenic material will show considerably better road-lead susceptibility and considerably better high-speed performance. Fuels containing large amounts of paraffinic material in the light-boiling range, in general, will have poor low-speed anti-knock performance and poor lead susceptibility at low speeds; but if the low-boiling paraffins are replaced with light olefinic and/or aromatic material, low-speed anti-knock performance and low-speed road lead susceptibility usually will be improved. Although sufficient data are not available to permit the formulation of any quantitative procedure for predicting fuel road performance, the method outlined above does give reasonably accurate qualitative indications. Perhaps better correlation could be obtained if consideration were given to the "motor" and "research" octane values of the various fractions of a fuel obtained by simple distillation.

An appendix gives the method used in determining the composition of the gasolines tested.

A. H. N.

365. Patents on Motor Fuels. F. E. Frey. U.S.P. 2,266,019, 16.12.41. Appl. 27.1.37. Continuous process for the production of normally liquid motor fuel hydrocarbons from a normally gaseous hydrocarbon mixture containing not less than 10% by volume of olefinic hydrocarbons predominantly ethylene and 50% by volume or more of paraffinic hydrocarbons of 3 or more carbon atoms per molecule.

M. L. Chappell. U.S.P. 2,266,848, 23.12.41. Appl. 4.3.38. Production of *iso*-paraffinic hydrocarbons boiling in the motor fuel range by reacting a paraffinic hydrocarbon containing at least three carbon atoms per molecule with acetylene in the presence of a metal oxide catalyst at a temperature between 350 and 400° F. and hydrogenating the resultant product.

C. L. Thomas and H. S. Block. U.S.P. 2,267,766, 30.12.41. Appl. 21.8.39. Production of substantially saturated gasoline of high anti-knock value by combining olefinic gasoline with hydrocarbon oil heavier than gasoline and subjecting the resultant mixture to the action of a cracking catalyst at a temperature between 600 and 900° F. In this way gasoline of low olefin content is produced and is separated from conversion products heavier than gasoline. At least a portion of the heavier products are cracked at a higher temperature than previously and olefinic gasoline and gas thus formed. Gaseous olefins are separated out and subjected to polymerization. The resultant polymers and olefinic gasoline formed during cracking are supplied to the first conversion process.

E. H. McGrew. U.S.P. 2,270,071, 13.1.42. Appl. 31.8.39. Conversion of hydrocarbon oils to produce gasoline containing a relatively small amount of olefinic hydrocarbons. A relatively high boiling hydrocarbon oil is subjected to thermal cracking treatment and concurrently a relatively low boiling hydrocarbon oil is subjected to thermal reforming. The products of the two processes are mixed together and fractionated to form light and heavy reflux condensate and to separate vapours boiling in the gasoline range. Simultaneously an oil boiling intermediate between the high and low oils is subjected to a high temperature catalytic cracking process and the resultant product mixed with the light reflux condensate. The mixture is then cracked for a sufficient length of time to effect substantial saturation of the olefin content of the gasoline.

C. L. Thomas and H. S. Block. U.S.P. 2,270,091, 13.1.42. Appl. 21.8.39. Production of substantially saturated gasoline of high anti-knock value by combining olefinic gasoline with hydrocarbon oil heavier than gasoline and subjecting the resultant mixture to the action of a cracking catalyst at a temperature between 600 and 900° F. In this way gasoline of low olefin content is produced and can be separated from conversion products heavier than gasoline. At least a portion of the heavier products are cracked at a higher temperature than in the first process, thereby forming olefinic gas and gasoline. The gases are subjected to polymerization and the resultant olefin polymers supplied to the first conversion process.

J. A. Wyler. U.S.P. 2,270,400, 20.1.42. Appl. 30.11.39. Method of accelerating the ignition of liquid fuels in an internal combustion engine by admixing to the fuel prior to ignition a minor proportion of tetranitromethane.

H. B. M.

Chemistry and Physics.

366.* Chemical Composition is the Guide to the Perfect Anti-Knock Fuel. Anon. *Nat. Petrol. News*, 26.11.41, 33 (48), R. 370.—An abstract from "Improved Motor Fuels through Selective Blending." C. R. Wagner, W. B. Ross, L. M. Henderson, T. H. Risk, presented at A.P.I. refining session 7.11.41.

The article comprises preliminary results in an investigation of the development of the chemically ideal motor fuel with maximum anti-knock properties throughout the entire speed range. The present indications are that this fuel should contain low-boiling olefins, high-boiling paraffins, and aromatics or naphthenes.

H. G.

367.* Progress Report on the Hydrocarbons in the Kerosine Fraction of Petroleum A.P.I. Research Project 6. F. D. Rossini and B. J. Mair. *Refiner*, November 1941, 20 (11), 494-498. *Paper Presented before American Petroleum Institute.*—In this progress report from A.P.I. Research Project 6, on that part of its work dealing with the isolation and identification of hydrocarbons in the kerosine fraction of petroleum, the following topics are discussed: present status of the work on the gasoline and kerosine fractions; outline of the separation of the kerosine fraction; properties of the hydrocarbons isolated; other hydrocarbons likely to be separated; amounts of the hydrocarbons in the kerosine fraction and in the original crude petroleum; significance of the work to the petroleum industry.

From data presented the following points are noted with regard to the distillate 200–230° C: (a) All the normal paraffin and 30% of the aromatic portion have been resolved with respect to pure compounds. The total resolved material represents about 20% of the distillate 200–230° C. (b) There remains to be resolved 70% of the aromatic portion and all the portion containing the *isoparaffins* and *naphthenes*. The total unresolved material represents about 80% of the distillate of the range 200–230° C. (c) There is a more or less regular relation in the relative abundance of naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene, and of their partly hydrogenated derivatives, 5:6:7:8-tetrahydronaphthalene, 1-methyl-5:6:7:8-tetrahydronaphthalene, and 2-methyl-5:6:7:8-tetrahydronaphthalene.

It may well be that the analysis of the kerosine and other fractions below the lubricant fraction, because they are less complex, will yield more information, with less effort, about the composition of the lubricant fraction than a direct attack on the lubricant fraction itself. Already valuable information along these lines has been obtained. Thus the presence in the kerosine fraction of tetrahydronaphthalene and its homologues is consistent with the previous finding that the lubricant fraction contains compounds in which both aromatic and naphthene rings occur in the same molecule. Similarly, it has been shown previously that in the lubricant fraction those molecules containing two aromatic rings were in large part ones in which these aromatic rings were linked together through two carbon atoms, as in naphthalene and its homologues. As previously reported, these latter compounds have already been isolated from the kerosine fraction. A. H. N.

368.* Radial Temperature Gradients in Gas-Heated Tubes. L. E. Stewart, J. B. Green, and R. L. Huntington. *Refiner*, December 1941, 20 (12), 522-525.—Experimental results on radial temperature gradients, both in packed and gravel-free tubes, of various sizes were studied by means of radially placed thermocouples. The gas, which consisted of 95% methane, 3% ethane, and 2% nitrogen, was preheated in a copper coil before being passed into the bottom of the experimental tube. In some cases, with low rates of heat input, it requires as much as 4 or 5 hrs. to bring the tube to a steady operating state. This was particularly true for the 8-in. tube when it was packed with flint-rock gravel.

A gas meter (accurate within $\pm 1\%$) measured the natural gas before it was heated. Temperatures were held within a 5° F. range at the inlet of the tube during each steady state run. The temperatures were obtained from thermocouple readings on a potentiometer.

Radial and longitudinal variations of considerable values are reported. The gradients were as steep for insulated as for uninsulated tubes. A. H. N.

369.* Catalytic Hydrogen Peroxide Oxidation of Straight Chain Olefines. W. Treib. *Refiner*, December 1941, 20 (12), 532-534. *Paper translated from Brennstoff Chemie*, 20 (19), 358.—Researches on cyclic compounds have shown that hydrogen peroxide in the presence of suitable catalysts gives the same end products as does auto-oxidation and that, in contradistinction to the latter, labile intermediates do not suffer spontaneous polymerization (resinification), in fact, they are completely hindered by a special reaction technique. Employing either alkaline or acidic oxidation-reagents, the reaction proceeds without rearrangements, for instance, due to enolization or ketonizing of the molecule—which ordinarily might influence energy partitioning and the direction of the resulting equilibrium. It is for this reason important to determine the reactive positions in the molecule during the H_2O_2 oxidation in neutral solutions. On these

bases the work is extended to fields of the highly reactive olefines. As a catalyst pervanadic acid was found useful. Besides controlling the oxidation it acts as indicator during the reaction.

Results of several tests are presented briefly with explanations of the mechanisms of the oxidation reactions. A. H. N.

370. Determination of Types of Sulphur Compounds in Petroleum Distillates. J. S. Ball. *U.S. Bur. Mines, Report of Investigations*, N. 3591, December 1941.—A technique of analysis for sulphur groups in petroleum distillates has been developed by the U.S. Bureau of Mines, in co-operation with the University of Wyoming, which is specially applicable to the high sulphur-bearing "black oils" of Wyoming, incidentally to similar crudes yielding only small percentages of straight-run light distillate and characterized not only by sulphur but also by a high asphalt content. The scheme of analysis makes provision for determination of sulphuretted hydrogen, free sulphur, mercaptans, disulphides, aliphatic sulphides, aromatic sulphides, and thiophenes. Positive methods of determination are used instead of methods involving determination by difference at a point when the sulphur content of the distillate is high and determination of total sulphur correspondingly less accurate. By this scheme more groups of sulphur compounds are directly determined and residual sulphur, *i.e.*, difference between total sulphur and summation of the groups of sulphur independently determined, is reduced to a minimum. A distinction in properties exists between aliphatic and aromatic sulphides and the latter are accordingly placed in the thiophene group. It is pointed out that this scheme of analysis is strictly only applicable to straight-run distillates of the gasoline range. But useful results may be obtained on cracked distillates in this boiling range, equally on kerosines, if the limitations of the system be borne in mind. Certain difficulties arise due to presence of aromatic sulphur compounds in which the reactivity of the sulphur atom is changed by long carbon chains or heavy radicals. For instance, aromatic mercaptans readily oxidize to disulphides and these tend to polymerize. With increase of carbon-sulphur ratio, the sulphur compounds behave less like the types involved and resemble more closely the hydrocarbons from which they are derived. This report stresses need for further research in this particular field. H. B. M.

371. Patent on Chemistry and Physics. P. T. Tarnoski. U.S.P. 2,269,134, 6.1.42. Appl. 2.6.39. Preparation of a de-salting and demulsifying compound for treating crude petroleum consisting of a ketone body and a sulphonated body, both mutually soluble in water and petroleum. H. B. M.

Gas, Diesel, and Fuel Oils.

372.* Effect of Type of Fuel on Engine Output. Anon. *Gas Oil Power*, November 1941, 36 (434), 245.—Tests have been carried out with various fuels in a 6-cylinder commercial vehicle diesel engine of the pre-combustion chamber type developing 90 B.H.P. at a normal speed of 2400 r.p.m. The fuels used were (a) Kogasin from Fischer-Tropsch process, cetane number 86.5, (b) cracked gas-oil, cetane number 35, (c) 17.5% "a" + 82.5% "b," cetane number 43, (d) synthetic fuel oil, cetane number 46.5, (e) medium oil from lignite, cetane number 32, (f) gas-oil from lignite, cetane number 48.5, (g) 5% lubricating oil, 95% petrol, cetane number 29.5.

A curve gives power output based on engine speed and type of fuel used. Results indicated that fuel "c" gave a better output than fuel "a." This is explained by the fact that too short an ignition delay hinders the maximum possible mixing of air and fuel and the satisfactory progress of combustion. The tests show that for each fuel the most favourable conditions during the early part of the injection period have to be sought.

The author concludes that it is not economic to use fuel of very high cetane number, nor is the use of such fuels accompanied by better engine performance. D. L. S.

373.* Army Specifications Call for Three Basic Diesel Fuels. Anon. *Oil Gas J.*, 13.11.41, 40 (27), 27.—Army specifications for fuel for high-speed diesel engines have been revised, providing for three basic types of product.

These products must have minimum cetane numbers ranging from 45 to 50.

D. L. S.

374. Patents on Gas, Diesel, and Fuel Oils. R. S. George, G. S. Crandall, E. M. Nygaard, and D. E. Badertscher. U.S.P. 2,266,021, 16.12.41. -Appl. 4.6.40. Addition to diesel fuel of a compound having the general formula $R\cdot CX\cdot SNO$ in which R represents a radical selected from the group consisting of alkyl, alkaryl, aryl, and aralkyl radicals, and X is selected from the group consisting of oxygen and sulphur. The compound is added in sufficient quantity to decrease the ignition-delay period.

L. N. Leum. U.S.P. 2,266,776, 23.12.41. Appl. 24.9.38. Preparation of a compression ignition fuel consisting of a fuel oil having an initial boiling point of at least 300° F. and an organic borine-amine addition compound in sufficient quantity substantially to increase the cetane number of the fuel. The structure of the borine compound is such that the boron atom is directly attached to a carbon atom only singly bonded to other atoms.

M. T. Kendall. U.S.P. 2,267,109, 23.12.41. Appl. 3.6.39. Method of treating a petroleum distillate fraction boiling approximately within the range 400–750° F. in order to stabilize it and inhibit increase in residual carbon content. The distillate is subjected not more than 72 hrs. after it has been distilled from the crude petroleum to contact with fresh unused aqueous caustic soda solution. In this way a stable diesel fuel is produced.

L. N. Leum. U.S.P. 2,267,701, 23.12.41. Appl. 5.4.41. Preparation of a compression ignition fuel consisting of fuel oil having an initial boiling point of at least 300° F. and an organic borine, the latter in sufficient quantity substantially to increase the cetane number of the fuel.

G. H. Cloud. U.S.P. 2,268,382, 30.12.41. Appl. 21.7.38. Manufacture of a fuel for compression-ignition engines of the diesel type consisting essentially of a hydrocarbon fuel and about 1–5% of an organic compound containing a thiocarboxylic acid radical. The addition compound imparts better ignition qualities to the fuel.

G. H. Cloud and L. A. Mikeska. U.S.P. 2,268,384, 30.12.41. Appl. 29.1.41. Preparation of a fuel for compression-ignition engines of the diesel type consisting essentially of a hydrocarbon fuel and a small amount of an organic compound containing an active thiocarboxylic radical and nitrogen.

H. B. M.

Lubricants and Lubrication.

375.* Testing of Heavy-Duty Motor Oils. H. C. Mougey and J. A. Moller. *Nat. Petrol. News*, 10.12.41, 33 (50), R. 387.—Data from a series of tests carried out by a modification of the 67-hour Chevrolet Varnish Test are presented. It is concluded that the test gives a reproducible behaviour pattern for a series of standard oils which may be correlated with service behaviour. A standard is thus obtained for the examination of unknown oils and as a basis for specification. Other tests are required to assess resistance to ring and valve sticking and carbon formation. The effects of inhibiting agents added to the oil or derived from the fuels and the air/fuel ratio are discussed.

H. G.

376. Patents on Lubricants and Lubrication. Standard Oil Development Co. E.P. 542,834, 29.1.42. Appl. 30.8.39. Method of decreasing corrosion of a metal in contact with a hydrocarbon lubricant by adding to the lubricant a small amount of an organic peroxide having a ring structure and which is of sufficient stability to remain substantially unchanged in a lubricant at temperatures up to 212° F.

A. Lazar and P. M. Ruedrich. U.S.P. 2,266,325, 16.12.41. Appl. 21.2.38. Preparation of a lubricant for internal combustion engines which includes a body of mineral oil containing an active oxidation and corrosion inhibitor. The main constituent of the inhibitor is taken from the group consisting of calcium sulphonate, barium sulphonate, and strontium sulphonate. The lubricant is substantially free from metal salts.

W. A. Smith. U.S.P. 2,267,142, 23.12.41. Appl. 10.3.38. Preparation of a lubricant consisting of a petroleum lubricating oil and a relatively small amount of quinhydrone. The resulting composition is suitable for use in internal combustion engines and has increased resistance to sludging in the crankcase, greater colour stability, and greater resistance to decomposition.

F. R. Moser and D. R. Nijk. U.S.P. 2,267,337, 23.12.41. Appl. 29.8.36. Preparation of an extreme pressure lubricant consisting of a mineral lubricating oil and from 1 to 10% of a polyphenyl substituted methane having at least one hydroxyl-containing radical with not more than one carbon atom between the hydroxyl group and the ring.

W. A. Whittier. U.S.P. 2,268,232, 30.12.41. Appl. 23.12.39. Preparation of a lubricant by reacting phosphorus containing material selected from the group consisting of phosphorus tri-halide, phosphorus sesqui-sulphide, phosphorus tri-oxide, phosphine, and elemental phosphorus with sulphur halide, and reacting the product with fatty body.

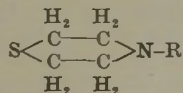
E. W. Adams and L. C. Brunstrum. U.S.P. 2,268,234, 30.12.41. Appl. 5.10.40. Preparation of a lubricant capable of forming an invert emulsion with water and consisting of 0.25-5% of an ester of a high molecular weight fatty acid having at least one hydroxyl group, 5-45% of an inert substantially non-abrasive finely divided solid material, and 50-94.75% of a lubricating oil.

E. Lieber. U.S.P. 2,268,409, 30.12.41. Appl. 20.9.38. Preparation of a lubricant consisting of a mineral oil and a small amount of a condensation product of a polycarboxylic acid halide and a petroleum oil fraction.

G. M. McNulty and J. C. Zimmer. U.S.P. 2,268,608, 6.1.42. Appl. 5.12.39. Preparation of a lubricant which includes an active halogen in a form normally corrosive to metals but capable of greatly increasing the load-carrying capacity of the lubricant, together with a small amount of an oil-soluble cyclo-aliphatic amine having a p_{KH} value greater than 7.0.

L. A. Hamilton, E. W. Fuller, and H. G. Berger. U.S.P. 2,269,265, 6.1.42. Appl. 14.12.39. Preparation of a petroleum product consisting of a refined viscous petroleum fraction, normally subject to deterioration under conditions of oxidation, and a minor proportion of the reaction product obtained by reacting an *N*-substituted dialkyl aromatic amine with a halide of sulphur. Deterioration of the petroleum fractions is thus retarded.

R. C. Moran, D. E. Badertscher, and H. G. Berger. U.S.P. 2,269,282, 6.1.42. Appl. 31.5.39. Preparation of an improved mineral oil composition consisting of a viscous mineral oil fraction and a minor proportion of a compound of the general formula



in which R represents a radical selected from the group consisting of alkyl, aryl and alkaryl hydrocarbons. The addition agent is incorporated to inhibit the deleterious effects of oxidation on the oil.

V. A. Salim. U.S.P. 2,269,485, 13.1.42 Appl. 9.1.40. Conversion of asphaltic hydrocarbons to lubricating oil by bringing them into momentary contact with a body of molten metal maintained at a temperature between 450 and 550° C. The asphaltic hydrocarbon will thus be brought to a temperature between 275 and 375° C. The

resulting converted products are brought to this temperature by further contact with the molten metal by volatilization and atomization in a concurrent flow of both volatilized and non-volatilized portions. Steam is so adjusted that substantially no converted or unconverted asphaltic hydrocarbon is left in contact with the molten metal for longer than the desired momentary contact.

H. E. Johnson. U.S.P. 2,269,720, 13.1.42. Appl. 3.3.39. Preparation of a lubricant comprising in combination petroleum jelly and candelilla wax as the major constituent.

E. Lieber. U.S.P. 2,270,062, 13.1.42. Appl. 14.12.38. Preparation of a composition consisting of a hydrocarbon oil normally having a high pour-point and a small amount of an oil-soluble pour-depressing condensation product of one mol. of a condensable cyclic compound.

J. O. Clayton and B. B. Farrington. U.S.P. 2,270,113, 13.1.42. Appl. 10.6.40. Preparation of a liquid compounded hydrocarbon oil containing a metal salt of an organic acid in sufficient amount substantially to increase the corrosivity of the oil, and a corrosion inhibitor comprising an ester containing an amine substituent.

E. W. Adams, L. C. Brunstrum, and A. W. Weitkamp. U.S.P. 2,270,241, 20.1.42. Appl. 30.10.40. Preparation of a lubricant consisting of a lubricating oil, a metal salt of a carboxylic acid in an amount in excess of that which would be soluble in the oil, and a phosphatidic material in an amount sufficient to render the salt soluble in the oil.

E. Lieber, U.S.P. 2,270,319, 20.1.42. Appl. 16.7.40. Preparation of a lubricant consisting essentially of a waxy lubricating oil and not more than 5% of tall oil.

R. F. Bergstrom and E. E. Phillips. U.S.P. 2,270,577, 20.1.42. Appl. 31.5.40. Preparation of lubricating oil suitable for use in internal combustion engines and containing 0.25% to 5.0% of a sulphonate salt and an arylamine having anti-oxidant properties in an amount not less than one-sixth of the salt content. The sulphonate is oil soluble, free of free-acid, and combines a petroleum sulphonic acid with a polyvalent metal, which forms an oxide which is not readily converted to other oxides under conditions of crankcase lubrication.

U. B. Bray. U.S.P. 2,270,620, 20.1.42. Appl. 2.8.37. Production of lubricants by oxidizing a highly refined paraffinic type lubricating oil to produce in the oil reaction products including petroleum acids. A calcium compound is added to the resultant mixture to react with the saponifiable materials and the whole filtered. The resultant soap-oil solution is added to a naphthenic type lubricating oil to yield about 0.8-3.0% of total soap in the final lubricating oil composition. H. B. M.

Asphalt and Bitumen.

377. **Patents on Asphalt and Bitumen.** F. Dijkstra. U.S.P. 2,268,810, 6.1.42. Appl. 2.3.40. Addition to an asphalt of a sufficient amount of solid paraffin wax materially to increase its water repellancy and to give it a wax content of 2-10%. The resultant product is combined with water and an aggregate containing clay and used for soil stabilization purposes.

H. S. Goodwin and H. D. Winters. U.S.P. 2,270,047, 13.1.42. Appl. 30.12.39. Impregnation of asbestos cement board with a liquid saturant consisting of an asphalt having a melting point of 140-185° F., and 60-65% of a solvent naphtha having an A.P.I. gravity of 28-48° and a kauri butanol solvent power of at least 53. H. B. M.

Special Products.

378.* **War Use of Gaseous Products from Cracked Oil.** A. G. Arend. *Petrol. Times*, 13.12.41, 45 (1158), 720.—This article discusses the use of gaseous products obtained by cracking mineral seal or solar oil as a fuel for airships.

In the Graf Zeppelin, instead of only one gas being used provision was made for the introduction of a second gas to afford a certain measure of flexibility after the first gas had been exhausted.

Normal runs were made with Blau gas which was followed by Pyrofax gas, whilst at certain stages of the flight a mixture of methane and ethane was utilized.

In preparing Blau gas the oil is cracked at 600° to 700° C., and the butane, *isobutane*, and ethane are liquefied. Some of the methane and practically all the ethylene are dissolved in the liquefied gas, which is stored in steel cylinders at 100 atmos. pressure.

When released from the cylinders, the liquid evaporates to a gaseous product of about the same density as air.

Pyrofax, which was substituted after supplies of Blau gas had been exhausted, consisted of propane containing 2% butane, which was mixed with some 36.8% hydrogen to give a gas of the requisite specific gravity. The third mixture—methane and ethane—also had a density similar to that of air.

Since these gaseous fuels had densities comparable with that of air, their consumption did not alter the total weight of the airship, since they were replaced with air without making any appreciable difference to the buoyancy.

D. L. S.

379. Patent on Special Products. E. M. Hattox. U.S.P. 2,270,052, 13.1.42. Appl. 29.12.38. Production of polymers of *isobutylene* not higher in molecular weight than *tetra*isobutylene by contacting di-*isobutylene* with anhydrous ferric chloride at a temperature between 150 and 300° F.

H. B. M.

Detonation and Engines.

380.* New C.F.R. Road Test Technique Proves its Value in 1941 Programme. Anon. *Nat. Petrol. News*, 26.11.41, 33 (48), R. 381.—An abstract of a report by D. P. Barnard to A.P.I. refining session 7.11.41.

The new "border-line" technique for the determination of road octane values in terms of engine speed has been further developed during the 1941 tests and has confirmed earlier indications of its value. The latest results emphasize that single octane ratings cannot accurately evaluate the ignition quality of a fuel.

H. G.

381.* 1941 C.F.R. Road Detonation Tests. J. M. Campbell, R. J. Greenshields, W. M. Holaday, and C. B. Veal. *Refiner*, November 1941, 20 (11), 499–504. *Paper Presented before American Petroleum Institute.*—During the past year the Co-operative Fuel Research Committee has continued its investigation of the knocking characteristics of fuels and engines in actual service. The centralized road knock tests made at San Bernardino more than a year ago resulted in the development of various road-test procedures. At the same time the tests supplied data illustrative of certain new principles, which appeared to have useful application as a means of expressing some of the engineering relationships between fuels and engines. The data obtained at that time, however, although valuable and suggestive, were not considered sufficiently extensive to warrant unqualified recommendation of these procedures and methods of analysis without further experience by individual laboratories. Accordingly, the programme carried out during the past year has been designed to test these procedures and methods of analysis, and to obtain more definite information with regard to their limitations as indicated by more extensive data.

The 1941 road detonation programme was divided into sections, as follows: (1) Ignition-timing relationships. (2) Control fuel tests. (3) Procedure evaluation. (4) Survey of characteristics of commercial gasoline. (5) Survey of octane number requirements of 1940 and 1941 cars, with particular attention to Chevrolet, Ford, and Plymouth models.

All items except the last one are discussed in detail, item 5 being briefly discussed.

On account of large variations in octane-number requirements among different cars of the same make—due to differences in ignition-timing, combustion-chamber deposit, and other causes—and on account of variations in commercial gasolines, it has been necessary to use statistical methods of analysis in the appraisal of fuel and engine

relationships. These methods of analysis have been applied in a number of ways, and have proved very useful. For this reason, the continuance of co-operative activity in compiling current statistical information annually on fuels and car requirements is recommended.

A. H. N.

Coal and Shale.

382. Creosote in Diesel Fuels. Anon. *Chem. Tr. J.*, 19.12.41, 109 (2848), 307.—This is a short summary of a paper read at a meeting of the Manchester and District Junior Gas Association. At the outbreak of war the Halifax Transport Dept. decided to put their whole fleet of buses on a creosote-fuel oil mixture.

In making the blend the petroleum fuel is run into a tank, followed by the correct quantity of creosote: The mixture is allowed to stand for 24 hrs., and then put through a centrifuge running at 7000 r.p.m. and passing 350 g.p.h. It was found necessary to use a washed creosote to reduce deposition of sludge on blending.

Bench tests gave fairly uniform figures and confirmed the results obtained on the road.

The creosote used in these tests showed sp. gr. at 60° F. 0.943, open flash 170° F., closed flash 150° F., distillation I.B.P. 180° C., 50% to 230° C., 90% to 336° C., phenols not over 4% vol.

Some individual buses are claimed to have completed 60,000 miles without trouble.

D. L. S.

Economics and Statistics.

383. Coal, Petroleum, Natural Gas, and Electricity in the United States, 1929-40. J. R. Bradley. *U.S. Bur. Mines. Information Circular*, No. 7189, December 1941.—

There are four primary sources of fuel and power: coal, petroleum, natural gas, and water power. This report is a survey of the extent of these sources of energy in the United States and covers the period 1929 to 1941. It is to be noted that the United States is responsible for one-third of the world's coal output, practically two-thirds of the petroleum produced, 89% of natural gas marketed, and 23% of developed water power. The annual U.S. production of all forms of energy in terms of coal is about 1000 millions tons, and it is stated that even without opening new mines, drilling new oil wells, or harnessing additional water resources, the annual output of fuel and power could be substantially increased. Productive capacity during the period under review was estimated at about one-half the total world output of fuel and power. It is natural that the primary sources of fuel and power should be closely connected with major industrial developments; in this way coal (as coke) is essential to the metallurgical industries; hydroelectricity is similarly linked with electro-chemical and electro-metallurgical industries; petroleum has its obvious place in power and transport services and has been responsible for evolution of the internal combustion engine and all it has meant in the last few decades. It is conceded that coal still remains the dominant source of power, but is in point of fact losing ground to competitive fuels and water power. This is emphasized by production figures of bituminous coal (including lignite) which declined from 535 million tons in 1929 to 393 million tons in 1939. By contrast crude oil production increased from around 1000 million bbl. in 1929 to about 1265 million bbl. in 1939, an increase of over 25%. Similarly, natural gas production showed an increase of 29% over the same period and capacity of electrical generating plants increased 27%. The report includes full statistical data and graphs in support of these conclusions.

H. B. M.

BOOK REVIEW.

Printing Inks, their Chemistry and Technology. By Carleton Ellis. Reinhold Publishing Corporation, New York. 1940. Pp. 560. Price 42s.

The subject of printing inks is one of considerable importance in everyday life and in these days ink may justly be considered a munition of war. Printing inks have a special interest for the petroleum technologist because so many petroleum products are used in their manufacture and application. Thus, oils of the lubricating and cylinder oil ranges, bitumens and residuals, petrolatum and waxes enter into their composition, especially in the case of the news inks. Kerosine and lighter petroleum products are extensively used as solvents and reducers and for cleaning printing machinery. Probably about two-thirds of the materials used in ink-manufacture in this country are of petroleum origin.

The volume on printing inks here reviewed is a very welcome contribution to the literature of the subject, particularly since, as the author remarks in his preface, there are so few books available and these are generally not of recent date. The literature on printing inks (apart from books), is, however, quite extensive and, as would be expected in a work by Carleton Ellis, the references are very numerous, more than two thousand being quoted.

The early chapters are introductory. In the first an excellent description of printing methods and processes is given, and this is followed by a discussion of inks divided according to their uses in typographic, intaglio, and planographic printing. A short chapter follows on the history of printing inks. Vehicles, driers, modifiers, and pigments (including carbon-black, the most important of all) are discussed in turn and then the three main classes of ink are treated in more detail.

Chapter 8, which deals with mineral-oil and quick-drying typographic inks describes the uses of asphalts and petroleum oils in inks intended to dry by absorption. It would, however, be difficult to get much practical guidance in the selection of a petroleum oil for use in, say, news-inks, from the information in this chapter.

Several chapters deal with inks of special types and for particular purposes and give a very interesting resumé of the materials used for printing on a variety of surfaces as diverse as fruit and meat, glass and metal.

"Printing ink problems" is the title of a chapter which includes discussion of a number of interesting subjects, such as storage, offset, and odour. A section on press-room problems includes some formulæ for roller and general cleaner fluids—for example "petroleum naphtha with 10% petroleum" and "80% petroleum naphtha, 15% xylene, and 5% petroleum." The use of the word "petroleum" in this way by such a well-known writer on petroleum chemistry is a little surprising; it is probably due to translation.

Various methods of testing inks are described in Chapter 17, and the final chapter discusses paper for printing purposes. The book is concluded by an excellent glossary and a very complete index.

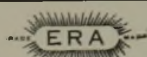
This work is as comprehensive and detailed as are previous books by this author, and, while it is not a "practical guide to ink-making," it will be found a very valuable source of information and of ideas to all who are concerned in any way with the ink industry.

E. B. EVANS.



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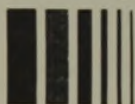
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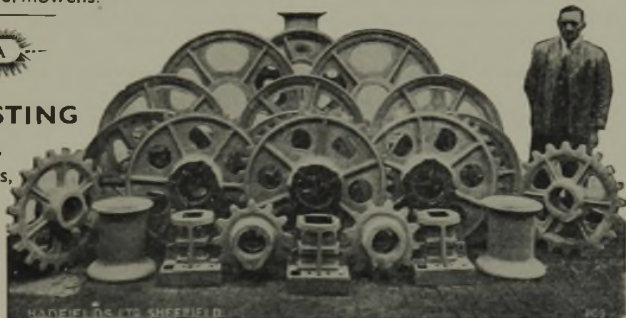
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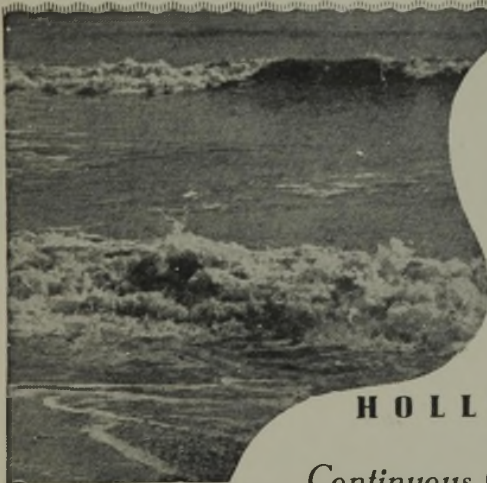
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
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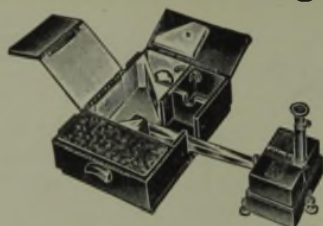
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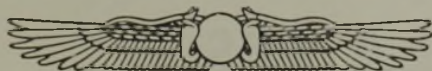
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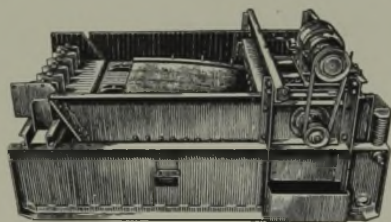
Rotary Gear Pumps with Double Helical Rotors.

Steam Jet Air Ejectors.

De-Waxing and Heat Exchange Auxiliaries.

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SYMONS "JW" TYPE SCREEN



This Screen has been specially designed for the handling of rotary mud; particular attention has been given to the vibration mechanism so that large capacities and accurate separation can be obtained with the minimum screening area. Its rugged construction make it easily transportable.

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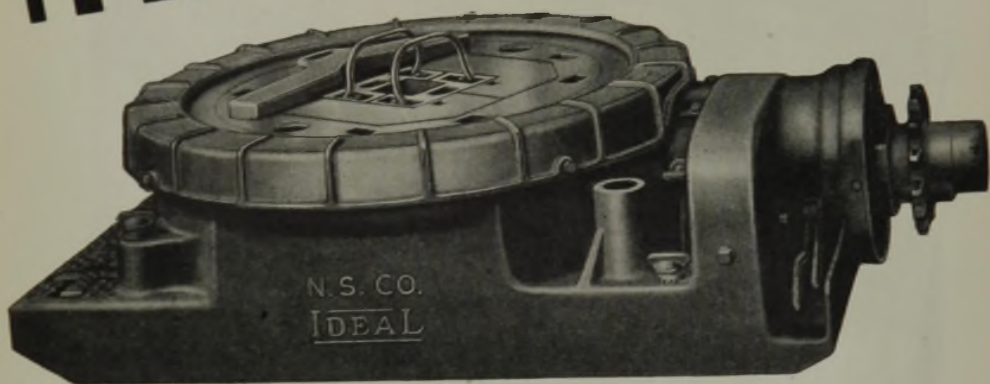
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*The most popular rotary table for all purpose
deep drilling for depths of 10,000 ft or more*

SPECIFICATION INCLUDES :

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Mailings Address: P. O. Box 52 Oakhurst, Calif.
February 14, 1941

Cardwell Manufacturing Company, Inc.
P. O. Drawer 1001
Wichita, Kansas

Gentlemen:

We are glad to send this report on our "Cardwell" Model S twin-engine draw works.

First, let me say we are very pleased with the entire set-up, especially as the rig drilled this well to 7,006 feet. This is 2,000 feet beyond your recommended depth with Waukesha GAE engines.

The drillers liked the draw works from the start. It is light and compact, even with both engines assembled, making rigging up much easier. The air controls, even-stop transmission and Hi-Speed drive saved them much time and effort.

In checking the round trip time, the following results were obtained: at 7,006 feet, we had 45 stands of 4-1/2" and 35 stands of 8-1/2" drill pipe in the hole. We pulled a stand every 2 minutes and 20 seconds in low gear; 2 minutes and 15 seconds in fourth gear; 1 minute and 30 seconds in third gear; 1 minute and 20 seconds in second gear; 22 in fourth and 22 in fifth. We cannot give you the exact time as we had to stop at intervals to change tools, etc., but as near as we could figure, it took 2 hours and 20 minutes to pull out from bottom, 7,006 feet.

Going in, we ran at the rate of one stand per minute average all the way, or 78 stands in 78 minutes. The drillers all agreed that the brakes are the best they have ever used, as they held the load nicely even at 7,006 feet.

We hope this report will be of value to you, and remain,
Yours very truly,
E. Bender

EAB:BN

1215 19th Street
Bakersfield, Calif.
Business Phone 971

288 Dawson Ave
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Telephone 424-82



TWIN-ENGINE MODEL S FEATURES

"Cardwell" five-speed, even-ratio transmission drives to the drum and rotary table through friction clutches.

Friction clutches are air-controlled.

Air-controlled Hi-Speed drive operates outside of transmission for quick "kick-up" of block.

Power take-off friction clutches are air-controlled.

Draw works can be moved complete without removing engines.

When rotating, the drum may be engaged and the drill pipe lifted without stopping the rotary table.

Dual safety, self-energizing brakes.

Heat-treated brake flanges have water-tough for quick cooling.

Sand line drum is available with rig or for field installation at later date.

*Twin engine Model S is available with two Waukesha GAE, Waukesha WAE, Cummins HP-600, Cummins HPS-600 (Supercharged) or Caterpillar D-15000 engines.



EXPORT OFFICE

570 Lexington Avenue

Phone Plaza 5-9385

*Cable Address "Cardwell"

New York City, N. Y.

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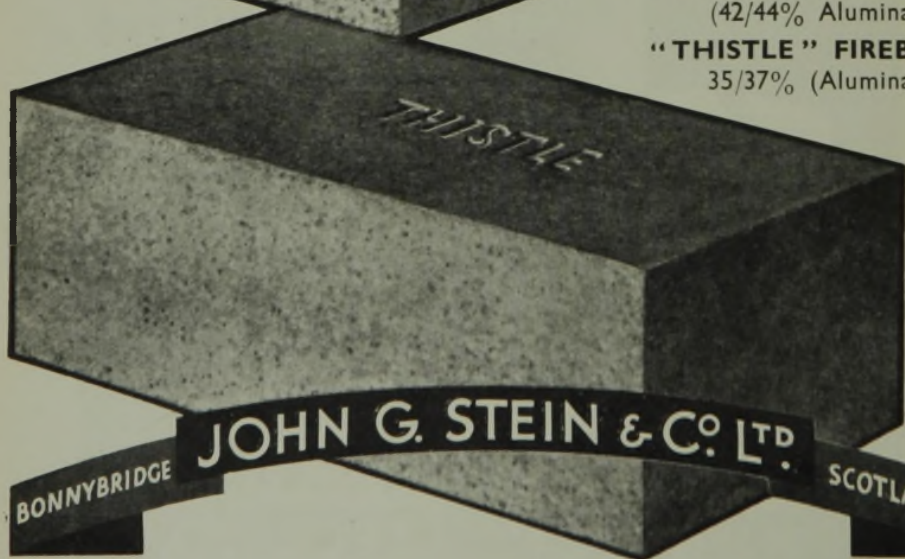
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CRACKING UNIT

Accepted

*This one
after 18
days of
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For a major oil company Lummus recently completed a Lummus Combination Three-Coil Cracking Unit . . . viscosity-breaking, gas oil and heavy naphtha reforming. » » » Eighteen days after the unit was put on stream it was completely accepted, having met all guarantees. The initial run was continued to 25 days, when the unit was shut down for inspection purposes. » » » This recently completed unit — the ninth consecutive Lummus Cracking Unit to be accepted during initial firing runs of 25 days or more — is equipped with Lummus Floor-Fired, Raised Hearth Heaters, with improved steam generation feature in the convection section. Provision is also made for steam generation from waste heat.

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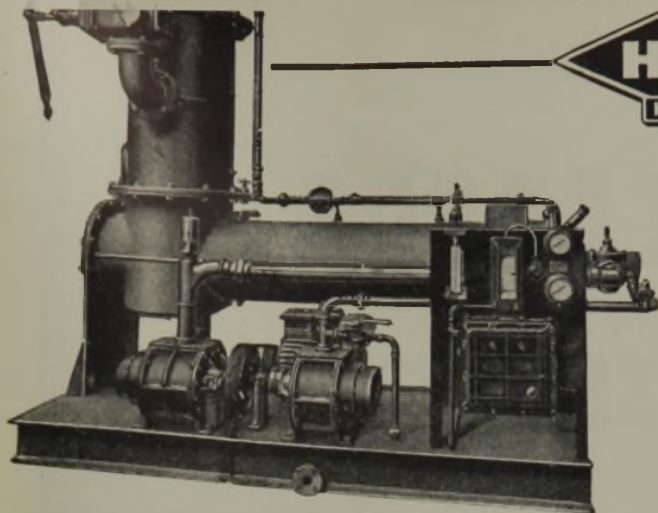


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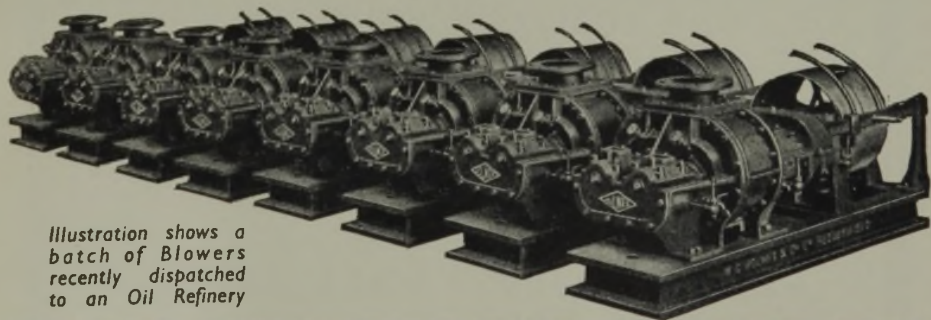


Illustration shows a batch of Blowers recently dispatched to an Oil Refinery

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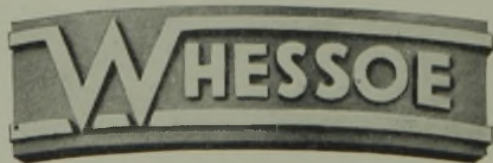
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